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University Statistics and Tendencies.

SINCE the comparative tables of statistics before us[1] have been compiled by the University Grants Committee, it is but natural that we should turn first to those which shed light upon the financial position. Nor need we make any apology; for unless that position be sound there can be little expectation that the function of the universities can satisfactorily be discharged. Happily the accounts show a decided and general improvement, particularly when it is noted that only in the case of thirteen institutions has expenditure exceeded income; and even in these cases the deficits were small and were due to the fact that the institutions concerned met out of income an unusual amount of capital or other non-recurrent expenditure.

The improved position is due largely to increased Treasury grants made upon the recommendation of the Grants Committee, and indicates very clearly that that recommendation has been justified. At first glance the increase in "Government Grant," 35·9 to 39·5 per cent., does not appear to be great, but it has nevertheless been an excellent incentive. Not only have the institutions suffering from a deficit been reduced from twenty-four to thirteen, but also, as the Committee points out, there is another gratifying fact which does not appear in the tables: during 1925–26 reductions of debt to the amount of more than £50,000 were effected. This possesses a special significance when it is observed that increases of salaries of teaching staff cost more than £88,000; increases in departmental and laboratory maintenance more than £23,000; in general libraries and museums, £24,000; in repairs and maintenance of buildings, £38,000; in capital expenditure met from income, £57,000; and in grants to students' societies, £10,000. The increase of government grants was not, of course, wholly responsible. Income from local education authorities, from endowments, donations, subscriptions, and students' fees, was, in each case, greater than in the preceding year.

With regard to the number of full-time students it may be said that the year has shown a return to what may be normally expected. Actually there is a slight decrease from 41,794 in 1924–25 to 41,443 in 1925–26, but this is largely accounted for by the fall in the number of ex-service students from 263 to 17. Any small aggregate decrease in the number of full-time students is not, as the

[1] University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, 1925–1926. Pp. 24. (London: H.M. Stationery Office, 1927.) 3*s*. net.

Committee points out, very surprising in view of the prolonged industrial depression; and against that small decrease must be set an encouraging increase in the number entering for the first time upon degree or diploma courses.

Whatever may be the numbers of students, the main interest must be concentrated upon what they are doing; and here there emerge facts which at present we shall not attempt to explain, since they depend upon conditions which are more or less familiar to us all. In the medical, technological, and agricultural groups there is a fall, the decreases being 1000, 152, and 70 respectively. In the pure science group there is a slight increase, while in the arts group there is the substantial increase of 869. As to what specific subjects are proving more or less popular, however, the Committee finds it difficult, for obvious reasons, to carry its analysis far enough. It realises, nevertheless, that it is possible for certain subjects to become rather more popular than is desirable in the national interest. Is philosophy, for example, "not tending to be unduly neglected by our arts students"? Or is chemistry "not tending to attract an unduly large proportion of our science students"?

For our part we do not lack evidence to show that chemistry is, at present, attracting a number of students which may be unduly large. But on the question as to whether this is a matter for alarm or congratulation we do not propose to speak at the moment. We do, however, regret the tendency—and we cannot fail to note that in this age of specialisation it must inevitably increase—for students to neglect philosophy. Nor would we confine that regret solely to the fact that it is neglected by arts students. Philosophy is not the monopoly of any particular group: it is an essential to every student. Let there be no mistake. We are not thinking of it as a form of metaphysics down the tangled by-paths of which we would have science students lose themselves. But if science means, ultimately, an enlargement of experience, we regard philosophy as a critique of that experience.

If we appear to over-emphasise this point in connexion with the courses—in arts or science—of university students, let our excuse be that we claim a lofty view of the function of a university—a view which made us sympathetic, some three or four years ago, with the writer of an article in a prominent university magazine. "Let us learn from others and make our own peculiar gift to the common stock of undergraduate life. If, however, we are not prepared to do this, then let us at least be honest and call ourselves first-rate teeth-extractors, assiduous engine-wipers, and the like, but not 'varsity men."

This matter of the actual subjects followed by university students leads us directly to another important aspect which the present Committee's returns place before us. The whole document seems to us to fall into three main parts: that dealing with accounts, the congratulatory nature of which we have already indicated; that dealing with the subjects and groups of subjects which are being followed in the universities; and that dealing with a matter upon which there is, as yet, little reason to regard as satisfactory. We refer to university libraries. In this connexion a new table of figures has been introduced into the Returns before us. In its general reports in 1921 and 1925, the Committee reminds us, not only was great stress laid upon the importance of well-equipped libraries, but their maintenance and development was insisted upon as one of a university's primary duties, "since defects in this central organ must inevitably have a harmful effect upon the work both of teachers and of students in all departments alike." But the state of affairs revealed by the Library Table, in spite of the fact that a larger sum was spent in 1925–26 than in the preceding year, still presents "an essentially gloomy picture."

In the universities of Great Britain (excluding Oxford and Cambridge) the total expenditure on libraries was £120,616. This sum was made up of £46,280 (salaries), £58,237 (books), £8946 (binding), £7153 (ordinary upkeep). The amount spent upon books by more than fifty institutions of university rank is astonishingly small, and while the Committee is not unaware of the difficulties which beset comparisons between our university conditions and those of other countries, it does not hesitate to justify its phrase "an essentially gloomy picture" by comparison with the United States. We cannot improve the wording of the Committee: ". . . we could not escape some rather melancholy reflections at finding that for the item of expenditure on books during the academic year 1925–26 the total figure for all our grant-aided universities and colleges put together appeared to be little larger than the combined figure for the universities of Harvard and Yale. . . ."

We said above that our reflections concerning the neglect of philosophy led us directly to the important aspect which the returns show us of university library conditions. We do not imagine that, for those who share our views as to the function of a university, any further explanation is needed.

Physical and Chemical Tables.

International Critical Tables of Numerical Data, Physics, Chemistry and Technology. Prepared under the Auspices of the International Research Council and the National Academy of Sciences by the National Research Council of the United States of America. Editor-in-Chief: Dr. Edward W. Washburn. (Published for the National Research Council.) In 5 vols. Vol. 1. Pp. xx+415. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) Sold in sets only, 12 dollars per vol.

THE volume under review constitutes the first of a series of five volumes of critical tables of numerical data relating to physics, chemistry, and technology. They have been prepared under the auspices of the International Research Council and the U.S. National Academy of Sciences by the National Research Council of the U.S.A., with Dr. Washburn as editor-in-chief. Dr. Washburn has worked through the agency of ten corresponding editors and advisory committees in the leading countries of the world, except Germany.

The bulk of the contributors to the first volume are American; of the fifty names mentioned, thirty-four are American, seven British, three French, two Austrian, two Danish, one Dutch, and one Japanese. The nomination of contributors from Britain was left in the hands of a committee composed of Dr. Kaye (editor), Sir Robert Robertson, Dr. Rosenhain, Prof. Porter, Dr. Stanton, Mr. Sears, Mr. Egerton, with Mr. Higgins as secretary.

Some idea of the magnitude of the venture may be gained from the fact that the editorial, contribution, and manufacturing costs have been appraised at 570,000 dollars. The price per set is 60 dollars, but a special pre-publication offer at 35 dollars per set was made, which brought in orders for nearly 6500 sets. It is interesting to note that only twenty per cent. of these orders came from countries outside the United States, although 150,000 announcements of the offer were mailed to all parts of the world. If any conclusion can be drawn from this return, it is that in the United States there is a large public which can appreciate the value of such an undertaking and has also the purchasing power to acquire copies. The publication of these Tables at a price that would make possible a world-wide distribution, required that the project should be financed by those realising its importance and in a position to make the necessary investment. Some 244 American firms and individuals, and two of the larger foundations, have provided the sum of 170,000 dollars required for the compilation.

If we may judge the entire work by the standard of the volume under review, then we may say that this work is likely to be of incalculable value to scientific and technical workers, and the organisers and 300 experts have rendered a signal service to mankind by their co-operative effort to render readily accessible the enormous accumulation of data.

It is only when one reflects that until the middle of the last century no attention had been given to the accurate determination of physical and chemical data that one appreciates the tremendous advance that has taken place. In science the accumulated facts make for progress, but the rate at which data are piling up at the present time is such that, unless a systematic effort is made to cope with it, there is a likelihood of a vast amount of human labour being frittered away in unnecessary duplication.

Scanning over the four hundred or so pages of this volume, packed with carefully analysed data, one cannot but marvel at the immense industry of the scientific workers both past and present who have toiled with but one goal in view—the measurement with the highest precision of a physical or a chemical constant.

The dawn of this era of exact measurement was heralded in by a galaxy of mighty experimentalists, amongst whom Stas, Dumas, and Regnault stand out pre-eminently. One recalls the resourcefulness of Stas, who, in order to prepare silver of the highest purity, boldly undertook the task of distilling this metal; the painstaking care of Dumas, who, when making his experiments on the gravimetric composition of water, frequently started an experiment at daybreak and did not see its completion until the dawn of the following day; the meticulous accuracy of Regnault, who, in order to preserve his data, engraved directly on a sheet of polished copper his experimental points and the mean curve through them.

These old pioneers have had worthy successors endowed with added knowledge and the development of fresh instruments. The primary object of these critical tables is to harvest fruit of their toil, sorting the wheat from the chaff, for the benefit of civilisation.

It would be presumptuous to criticise a work such as the volume under review. All one can attempt to do is to offer a few friendly suggestions that might help to make the volume of still greater utility when a further edition is called for.

One feature of the book which immediately impresses the reader is the mechanical perfection of the 'set up.' The arrangement of the tables and the selection of the various sized type leave nothing to be desired. One must, however, point out that the only full-page graph in the volume (page 33) is one which it is impossible to use with comfort. It would have been advantageous to have the data in the form of a nomogram.

The volume opens with a section on national and local systems of weights and measures. The reader can derive much amusement from a study of these; for example, on page 10 the Persian unit of 1 guerze is given as 0·63 m. to 0·97 m.; such elasticity in a unit probably fits in with Eastern notions of buying and selling! It is also of interest to learn that the sacred cubit differs quite considerably from the common cubit. The compilation of this table, occupying fifteen pages, must have involved an immense amount of searching on the part of the compilators.

This is followed by a section on conversion factors and dimensional formulæ. These factors are well arranged and complete, but one does not find a conversion factor familiar to all concerned with thermal conductivity work, namely, for converting thermal conductivities expressed in gram calories per sq. cm. per sec. for 1° C. difference into B.Th.U.'s per sq. ft. per hour for 1 inch thickness and 1° F. difference in temperature. One would like to see B.Th.U. used for British Thermal Unit instead of B.T.U., which is apt to lead to confusion with the Board of Trade electrical unit. Many people prefer to make conversions with the aid of diagrams, so it would have been helpful if reference were made in connexion with this table of conversion factors to the existence of a collection of forty-three graphic tables for the conversion of measurements in different units compiled by R. H. Smith and published in 1895.

We feel that the utility of these volumes could be increased if especial attention had been given to indicate the location of special tables the importance of which is not such as to justify their inclusion in these volumes. For example, it may not be generally known that the annual reports of the British Association contain tables of Bessel functions, sines and cosines of angles in radians, logarithmic Gamma functions, etc., and that the Physical Society has published a table of hyperbolic sines and cosines. Then, again, there is the useful collection of physical and chemical data of nitrogen compounds prepared by the Munitions Inventions Department during the War.

The definition of selected terms occupies nine pages.

We are rather astonished to learn that the Hefner unit is obsolete. Probably the wish is father to the thought! The Hefner is the only official standard for the whole of Germany and has more statutory significance than the standards of Great Britain. As regards the definition of the candle, the author might possibly have expressed himself a little more clearly. It is a unit that is maintained at certain national laboratories in terms of electrical incandescent lamps.

The section on "The Structure of the Isolated Atom" partakes more of the appearance of a scientific paper than the pages of a highly condensed book of reference. Many will question the advisability of quoting Table 2, page 49, from Bohr's book, especially when the subject is in such an unsettled state. It might be noted that Stoner has calculated a table which differs from that given in Table 2. Incidentally, there is a misprint in the middle of this table, 8 being printed instead of 2. The full-page diagram of the normal orbit of the outer electron on page 51 is of more academic interest than practical utility. But the diagram on the preceding page of maximum elongations of electrons of several groups may prove useful in working out optical properties.

The section on resistance thermometers under the main heading "Thermometry" is all too brief. One would like to have found there a table of t and χt to facilitate calculations in the same way as one finds under "Thermocouples" standard tables of temperature and thermo-electric force.

To British ears the statement that "The Callendar equations were devised to facilitate computations by the method of successive approximations" will sound a little strange, even if it is strictly true. It would have been helpful if the writer of the article had indicated the sources where platinum of the requisite degree of purity was obtainable, as it is rather difficult to secure material which complies with the specification he quotes.

In connexion with the article on temperature measurement, it might have been appropriate to point out that certain laboratories supply materials of certified melting points or boiling points which can be used for calibration purposes. A range of pure metals is available for high temperatures and organic compounds for low temperatures.

To the section on optical pyrometry the addition of a table of the emissivities of various substances and a reference to the very detailed charts based on computations from Wien's Law issued by the

Bureau would have been useful. Total radiation pyrometry is not dealt with.

The section on laboratory methods for producing and maintaining constant temperatures should prove of considerable service. The addition of one mixture may be suggested, namely, crushed ice and fuming nitric acid, by means of which $-30°$ can be obtained almost instantly. A reference to the article on the production of cold in the *Journal of the Optical Society of America and Review of Scientific Instruments* would be helpful to the reader.

It is difficult to understand the editor's motives for placing the section "Standard Buffer Solutions and Acid-Base Indicators" in Vol. 1, for they could most appropriately accompany other electrochemical data on ionisation, etc. Wedged at present between a section on "Volume of a Mass of Liquid of known Weight in Air" on one side and "High Vacuum Technique" on the other, it seems out of place.

In the section on "High Vacuum Technique," one might suggest that a note be made to the effect that the expression for the rate of flow of gas through a tube is applicable to within five per cent. only up to a pressure when the free path of the gas molecule is 0·4 times the bore of the tube. No mention is made of Knudsen or of his general equation connecting the rate of flow with the dimensions of the tube. The formula for the molecular flow through a circular opening is not quite correct; it should be $W=\frac{3\cdot192}{d^2}$; the arithmetical slip occurs in Dushman's original paper.

In the table giving data on various types of pumps, it might be noted that the Gaede molecular pump referred to is now obsolete; no mention is made of the Holweck pump. It is probable that a slip has crept into the table giving pumping speeds of various types of pumps and that the figures in the last line refer to the three-stage Gaede steel pump, for the recently introduced two-stage steel pump will not function against a back pressure of 20 mm. The value 60,000 quoted for the performance of this pump is not one which can be obtained under the usual conditions of operation. It is also rather surprising that no information is given concerning the gauges employed for measuring the pressures. Experience has shown that the normal upper limit of the ionisation gauge is 1/1000 mm., while the Pirani cannot well be employed for pressures below this.

We suggest the addition of a table giving the nature and amounts of various gases to be expected from various typical glasses, metals, and silica when heated *in vacuo*. The reader would also have been glad to know that, in addition to the substances mentioned, red phosphorus can be used with glass apparatus for removing the residual gas. Other additions which may be suggested are (*a*) a table of the vapour pressure of the oils used in pumps; (*b*) a table of the expansion coefficients of glasses and metals suitable for sealing in to glass with tolerance limits.

On page 102, in the table entitled "Elementary Substances and Atmospheric Air," there is a misprint in the value quoted for the viscosity of air. It should be 180·8, not 284·2.

The most important table in the volume is labelled B Table, extending over 55 pages, and gives the important constants of chemical compounds. A point of criticism in regard to this is the order of accuracy to which the molecular weights are given; for example, TiO_2 79·9000, MnF_2 92·9300, $Al(OH)_3$ 77·9831, LiH 7·94670. One wonders what justification there is for the number of significant figures quoted. Yet it is stated on page 98 that the values given are approximate, and it is proposed to give more accurate values in subsequent sections. A second point is whether some of the substances to which formulæ are ascribed are true compounds; for example, $66PbO,21As_2O_5,12H_2O$, 19552·5. Possibly this and countless others are merely 'solid solutions.' No literature references are given in this table.

On page 165 there is a table of refractive indices of numerous compounds, but not of the fundamental elements. It would have been advisable to include the table published in Finnish by J. A. Wasastzerna on ionic refractivities.

On page 357 one finds a section on "Sweeting Agents and Odoriferous Materials" sandwiched between "Dispersoidology" and "Radioactivity"!

Many will feel disposed to question whether the tables on the properties of stars—their distribution and their motion—are physico-chemical data. If astronomical data are to be included, a reference might be given to Brown's tables of the moon, which embodies the results of thirty years of mathematical investigations of a high order. Possibly some day similar tables will become available for the minor planets or asteroids, of which about a thousand are known. Encouragement might thus be given to such monumental pieces of calculation by a reference in a standard book.

The table on X-ray diffraction data from crystals and liquids, page 338, is remarkably complete, but some indication of the accuracy of the data in the

unit cell column is desirable. This subject is advancing at such a prodigious rate that, even in the short time which has elapsed since its publication, quite a formidable array of substances has received investigation in the intervening period. We may mention the following: TiO_2 (anatase), $ZrSiO_4$, SnO_2, MnO_2, MnF, $CaSO_4$, $CaWO_4$, $CaMoO_4$, $BeAl_2O_4$, $Be_3Al_2Si_6O_{18}$.

The compilation of the section on aerodynamics, page 404, must have presented unusual difficulties on account of the wealth of material available. It would be advisable in Table 2 on page 404 to indicate that V_i means either feet per second or metres per second, according to whether one is reading to the right or the left. Fig. 9 has a misprint in the letterpress; the word Riabouchinski is incomplete. On page 410 (foot of second column) the statement concerning the effect of adding fins might be a little more explicit. It states that adding fins greatly increases the drag of streamline solids; the effect of the fins on the airship R33, for example, put up the drag by eight per cent. The percentage effect would of course be greater if the hull alone was considered.

The reviewer must stress the fact that the various points raised in his review detract little, if anything, from the value of this splendid piece of work. All busy workers are under a profound debt of gratitude to the various experts who have collaborated to produce this unique collection of tables. The best way in which the user can show his appreciation is to indicate to the editors where he considers improvement possible, so that we may look forward to later editions which will embody the best that science has achieved.

The task of compiling this monumental work has obviously necessitated much serious study on the part of the corresponding experts, and, by bringing to bear their critical judgment on the literature, they have discovered serious lacunæ and contradictions. An excellent illustration of this will be found in an article by Bichowsky in the *Journal of Industrial and Engineering Chem.* for April 1926, entitled "The Data of Thermochemistry." There he points out discrepancies which appear in tables generally accepted as standard. As examples he cites Al_2S_3, the value for which given in the tables should be multiplied by 2, while in the case of $Fe(NO_3)_3$ the quoted value should be halved, and numerous other inconsistencies. Again, Washburn, in an address delivered before the American Association for the Advancement of Science, December 1924 (published in *Science*, Jan. 16, 1925), points out "Some Effects of the Atmosphere upon Physical Measurements" and cites numerous examples of fallacies.

The same state of affairs probably exists in regard to some others of the constants scrutinised, and it would serve a very useful purpose if the experts would publish their findings independently and in greater detail. EZER GRIFFITHS.

Mechanism and Vitalism.

(1) *Die anorganischen Grenzgebiete der Biologie (insbesondere der Kristallvergleich)*. Von Hans Przibram. (Sammlung Borntraeger, Band 10.) Pp. 240. (Berlin: Gebrüder Borntraeger, 1926.) 7·50 gold marks.

(2) *Man not a Machine: a Study of the Finalistic Aspects of Life*. By Prof. Eugenio Rignano. (Psyche Miniatures: General Series, No. 3.) Pp. 77. (London: Kegan Paul and Co., Ltd., 1926.) 2*s*. 6*d*. net.

THE perennial conflict between the mechanistic and the vitalistic views of life is illustrated by the two books before us. Prof. Przibram endeavours to persuade us that living beings are governed by the same laws as those which regulate the structure and growth of crystals, whilst Prof. Rignano, the distinguished editor of *Scientia*, is equally certain that the phenomena which subjectively we recognise in our conscious life as memory, are characteristic of all life and afford the most fundamental explanation of the living process. It is somewhat surprising that Przibram, who has a European reputation as an experimental biologist, should be the champion of the mechanistic view, and that Rignano, who was trained as a physicist, should espouse the cause of vitalism.

The comparison of living beings to crystals is one that has often occurred to the minds of biologists, because crystals, like organisms, have a specific form which they preserve, with minor modifications, as they grow; but the difficulties of this comparison are obvious, and until now have appeared insuperable. Crystals grow by accretions to their outer surface; organisms by the interposition of new living molecules amongst those already existing. The additions to the body, like those to crystals, come from the surrounding medium, but the molecules added to a crystal exist as such in the mother liquor and are merely precipitated on the crystal's surface, whereas those that build up the organism are elaborated by the organism itself out of simpler ones which it takes in as food. The crystal is a mass of similar molecules, whereas the organism is composed of different chemical substances arranged

in a definite manner so as to build up a structure which will work.

(1) With extraordinary ingenuity and perseverance Przibram sets himself to surmount these difficulties. He begins by pointing out that although living substance always appears in the form of a colloid whereas crystalline substances are solids, yet almost any crystalline salt can be made to appear as a 'colloid' consisting of a number of minute crystalline particles suspended in the mother liquor. The form in which it will appear depends on its concentration in the solution and the rapidity of evaporation. Further, whilst it is true that in the most familiar crystals growth only occurs at the surface, yet there exist 'fluid crystals' and crystals like those of hæmoglobin and similar organic substances which can imbibe water and in which therefore new molecules can be interposed between those already existing; in these cases Przibram holds that "growth by intussusception" may be said to occur.

The objection that a crystal consists of a repetition of similar molecules is met by what we must regard as a quibble on Przibram's part. He says that molecules do not exist as such in crystals, because all are united in a common lattice-work of atoms, and therefore in going from point to point in a crystal we encounter alternations of different kinds of atoms; and this alternation he compares to the mixture of distinct chemical substances found in all living matter.

With regard to the assimilation of food, Przibram makes a brave attempt to find something like it in crystals. He points out that in certain cases where an optically inactive substance is present in a solution, the presence of a crystal of the dextral or sinistral variety will determine the precipitation of this variety of the substance on the surface of the crystal. Further, when two salts crystallising in somewhat similar forms are mixed in a solution, alternate layers of each may be deposited on the crystal.

Postponing for the moment the question whether or not these analogies are sound, let us look at what Przibram considers the gains of his point of view. He points out that a broken crystal 'regenerates' the missing part, just as many (not all) animals can regenerate an amputated limb; that in some substances the molecular lattice-work is capable of building itself up on alternative forms: thus, substances belonging to the first crystalline system can form cubes or octohedra, and these two forms may tend to appear in the same crystal and thus compete with one another, so that cubes with truncated angles are often observed. The form which will ultimately prevail is that which grows most slowly, for this requires less material for its realisation; the quickly developing form appears first, but its growth comes to a stop for scarcity of the necessary 'food.' This Przibram compares to the cases where an antenna of an insect is replaced by a leg, a phenomenon termed by the late Dr. Bateson 'hamœosis.' He maintains that the form of the regenerated part depends on the arrangement of the 'lattice-work' of the surrounding tissue; thus the formation of limbs from transplanted rudiments in Amblystoma, as evidenced by his own repetition of Harrison's experiments, is governed by the structure of the skin surrounding the rudiment and not by the relation of the new organ to the 'whole,' as Driesch has asserted. He shows that two fluid crystals will coalesce into one as do two blastulæ of Echinus, and he says that Driesch's conundrum of the impossibility of conceiving a machine which by division will give rise to two similar machines is answered by the lattice-work of a crystal, for this if broken into two will regenerate two similar crystals.

We recommend this work of Przibram to the careful attention of all our readers; they will find it a mine of information on the physics of crystals, though it is to be regretted that he only mentions Sir William Bragg's name once, and no one would gather from a perusal of the book that we owe nearly all our modern knowledge of crystal structure to Bragg's discoveries.

Przibram has, however, failed to convince us of the validity and worth of the comparison of the structure of living beings with crystals, and if he with all his knowledge of biology has failed, no one else is likely to succeed. To give a detailed destructive criticism of all his arguments would occupy too much space, but some of the principal objections which occur to us may be noted. Thus it is misleading to compare a colloid solution of an inorganic salt such as ferric chloride with the colloids of living bodies. The former is a suspensoid—really a minutely divided precipitate—the latter a diphasic or even triphasic emulsoid of different fluids enclosing one another, and the physics of the two states are, as Hardy has shown, quite different. The citation of fluid crystals is irrelevant. The term 'fluid crystal' is a misleading one to denote an intermediate phase between complete fluidity and definite crystallisation which is exhibited by certain organic substances. In this condition—stable over only a narrow range of temperature—the molecules of the substance roll over one another,

so that it is a fluid, but these molecules are sufficiently close to exert such an influence on one another as to keep their optical axes parallel. It is really a drop of turbid fluid, of which the turbidity is due to crystalline particles. The fundamental objection, however, is that a crystal is a relatively static form of material, whilst every particle of a living being, so long as it is alive, is in a continual state of destruction and reconstitution, and this reconstitution is effected from relatively simple materials. Nothing at all similar to the miracle of assimilation is to be found outside the domain of life.

(2) It is with this miracle that Rignano begins his book "Man not a Machine." The building up of new protoplasm from food he regards as one example of that 'purposeful striving' which is the inner nature not only of man but also of all life. In this case it is a striving to maintain a certain dynamic equilibrium. Prof. Leathes in his address to the Physiological Section of the British Association last summer pointed out that, given the known compounds into which food is broken by digestion, the number of ways in which they could be strung together runs into countless millions of millions, and yet they are put together in one particular way and no other. Rignano goes on to show that ontogeny, or the development of the individual, is likewise a striving to reach a typical end. It was indeed the recognition of this fact, and of the tendency of the egg to reach this end even when mutilated, by the adaptation of parts to purposes to which in normal circumstances they never would be put, which converted Driesch from being an adherent of Weismann to a vitalistic position.

The whole life of an organism and its movements are, as Rignano asserts, one continued striving to maintain around it the accustomed environment. When living matter is exposed to a new environment "it has no rest until it has either re-established the old environment or becomes adapted to the new one," that is, until it succeeds in establishing a new equilibrium. Adaptation to a new environment is attained by a constant series of trials—but when once it is attained the reappearance of the same conditions call forth the successful response with ever-increasing rapidity. It is this peculiarity of living matter which Rignano calls memory and which accounts for the inheritance of acquired characters. It corresponds to what the reviewer has elsewhere called 'habitudinal memory.' Rignano tries to explain it by his theory of 'specific accumulation,' which is at any rate a plausible one. It is to the effect that every reaction leaves behind it in all the nuclei of the reacting animal a deposit or trace, the effect of which is to accelerate the production of the same reaction when the same circumstances recur. The continual reaction to a stereotyped situation becomes a reflex or instinct, and the reflex is thus not the primary building stone out of which the actions of an animal are built up, as many physiologists have supposed, but merely the result of long-continued repetition.

The application of these principles to the life of man occupies the last chapters of the book. For the detailed criticism and analysis of these chapters we have no space, but we can sum up the controversy between vitalism and mechanism somewhat as follows. *All scientific reasoning is comparison*, starting with what is relatively known and familiar, or with what we imagine to be so, and we strive to compare with it the more complicated and unfamiliar. The mechanistic biologist, taking as familiar the chemical reactions which go on in a test-tube, seeks to reduce the life around him (and incidentally his own) to a combination of these, determined by the juxtaposition of unlike substances, that is, by structure. The vitalist is impressed with the most thrilling of all the facts in biology, namely, the fact that he himself is alive. The life of this one being he knows from the inside, and he thinks it logical to compare with this life the life of other beings, so that a certain measure of qualified anthropomorphism seems to him to be the only rational way of dealing with life.

After all, it is doubtful whether in the last resort Przibram seriously regards himself as a magnified crystal, and, as Dr. Broad has recently said, "the man who asserts that his brother—or his cat—is merely a mechanism, is either a fool—or a physiologist." Dr. Bateson once said: "If to be a vitalist is to admit that here and now we cannot explain the actions of living beings by physics and chemistry, who would not be a vitalist?" It may be held that to accept any form of vitalism is to sterilise biology and that only the mechanistic hypothesis leads to results; but in zoology, at any rate, this is not true. In studying the physics and chemistry of the cell we are studying the tools of life, not life itself, and 'mechanistic' theories of heredity have only led to the creation of a welter of incomprehensible 'genes,' the nature and origin of which are mysterious: real light on the inner nature and evolution of animal life has only come from following the lead of the concepts of striving, habit and memory.

E. W. M.

Our Bookshelf.

The Memory Factor in Biology: a Sketch of the Unity of Life. By Prof. C. J. Patten. Pp. xiii + 175. (London: Baillière, Tindall and Cox, Ltd., 1926.) 5*s.* net.

PROF. PATTEN is an enthusiastic supporter of the mnemic theory of life and heredity which is associated with the names of Hering, Samuel Butler, Francis Darwin, and Semon. His little book is very readable and contains much matter within a small compass. The theses put forward are "that Memory is indeed the Mainspring of Organic Evolution, and also that it is the source and potentiality which unifies both consciously and unconsciously the Psychic side of all living organisms; that vital activities, morphological as well as physiological, are in truth Psychic manifestations; that even the simplest vital activities are quite purposive; that Memory is rhythmic in character; that the processes at work in the evolution both of the Individual and of the Race furnish evidence of being an unbroken chain of Memory Processes, and are, in the main, due to Habit Formation; and lastly, that Memory Processes, when analysed mainly in regard to their physical basis, cast a strong beam of light upon the advocacy of Somatic Inheritance" (p. xii).

One might conclude from this citation that Prof. Patten is a psychobiologist, and indeed he comes very near to that position. On one cardinal point he is quite emphatic, "that unless one postulates the presence of a Psychic side in all living things any attempt to explain Memory phenomena on rational lines would signally break down" (p. xi). But the philosophical position he adopts is apparently that of monism, of the rather vague Haeckelian kind, which is by no means free from the dualistic taint that Prof. Patten has in horror. So it comes about that in elaborating the memory theory he falls back upon the "physical trace" or "engramm" conception of Richard Semon: he tries, in other words, to translate what is essentially a psychical activity into its presumed physical correlate.

For our own part we hold with James Ward that a memory theory of heredity will not work unless based frankly upon a psychological theory of life, and freed from the mechanistic preconception of physical traces. But it must be confessed that no one as yet has successfully worked out such a theory. E. S. R.

Industrial Fermentations. By Prof. Paul W. Allen. Pp. 424. (New York: The Chemical Catalog Co., Inc., 1926.) 5 dollars.

PARAPHRASING the author's statement in his preface, this book is not intended for those who require special knowledge on the subjects it deals with, but its intention is "to bring together in a general way some of our present information concerning the application of micro-organisms to industry." Taking this fully into account, after having read the book, we must confess ourselves disappointed. The text is divided into thirty-one chapters, each dealing with some special applications of micro-organisms to industrial processes. To those who are acquainted with only some of these processes, the task of giving even a general account of so wide a field in so small a compass will appear at once Utopian.

The book contains useful information, but a perusal of the text justifies our criticism. Under "Leather and Tanning" the processes preceding the tanning are described briefly but accurately, whilst tanning itself occupies but twelve lines; and here there is no mention of the use of tannin extracts, or of chromium compounds, formaldehyde, etc., treatment of the hide or skin with a mixture of fish and other oils only being referred to. Bread-making occupies forty pages and gives some useful outlines of the processes employed. We are left in doubt, however, as to the meaning of the following sentences (p. 133): "The particular kind of yeast which is of interest to the bread maker is Saccharomyces cerevisiæ. . . . These organisms are divided into three groups: bottom yeasts of German beers, top yeasts used in making English beers, and distillery yeasts. . . . These are the yeasts generally used in the manufacture of bread." If the author refers to all three, his statements are incorrect. Nor do we obtain any further help in this connexion in the chapter on "Bread Yeast Manufacture" (p. 311). The chapter on the manufacture of industrial alcohol introduces much matter of a purely academic character, but the text will be of little assistance to the general reader who wishes to gain an insight into the industrial processes. A useful feature of the book is the appendage to each chapter of references to the literature. A. R. L.

Marine Works: a Practical Treatise for Maritime Engineers, Landowners and Public Authorities. By Ernest Latham. Second edition, considerably enlarged. Pp. xii + 223. (London: Crosby Lockwood and Son, 1926.) 16*s.* net.

THE second edition of this work consists of two parts, the first of which is identical with the earlier edition and the second is made up of three additional chapters. We have not been able to find any alteration in the first part, and it is accordingly open to the same criticisms as were expressed in the review which appeared in NATURE of Mar. 3, 1923 (p. 285).

As regards the additional matter, Chap. x. deals with quays and jetties in tidal waters and is obviously supplementary to Chap. ix. on deep-water quays. It consists of certain somewhat disconnected jottings on costs and valuations and modern practice in design. It contains, however, a timely and salutary admonition on the economical aspect of the selection of a site for the exploitation of a river frontage, and points out the advantages accruing from the use of runways and other modern transportation facilities. There is a note of a method advocated by the author for the determination of the actual volume of dredged material in computing payments to a dredging contractor. This point crops up again in the next chapter but

one, where the same ground is covered, indicating a lack of care in avoiding repetition, which is almost inevitable when articles on the same, or kindred, subjects are reprinted *in toto* from journals.

The weakness of the book as a whole, in fact, is that it consists of a series of such articles, useful and interesting in their way, but discursive, disjointed, and, in some measure, superficial. Chap. xi. deals with coast erosion; here again the information contained would have been more appropriately blended with that in Chap. vi. on coast defence. The concluding chapter (xii.) discusses dredging and land reclamation. There is a useful appendix on "The Land Drainage Acts examined from the engineer's standpoint," reprinted from *Water and Water Engineering*. B. C.

General Botany: with Special Reference to its Economic Aspects. By Dr. C. Stuart Gager. With three Chapters on Heredity and Variation in Plants, by Dr. Orland E. White. Pp. xvi + 1056. (Philadelphia, Pa.: P. Blakiston's Son and Co., 1926.) 4 dollars net.

THIS is a text-book written along very different lines from the majority of books used as introductions to the study of botany. The work gives the impression that its author has not considered college and examination syllabuses, but has attempted to deal with botany as an indispensable subject of general education. It must be acknowledged that he has largely succeeded in showing that plant life has been throughout history, and still is, closely interwoven with human life.

A general introduction is followed by four parts, subdivided into forty-one chapters, dealing respectively with the vegetative functions of plants, reproduction and life-histories, the great groups of seed-bearing plants, and genetics and evolution. Features of special interest are: the excellent photographic reproductions, the insertion of short historical and biographical notes, and the discussion at every opportunity of the relationship of plants to human affairs. A few of the text figures are not quite accurate and several unfortunate slips in terminology have been noted. The majority of the bibliographical references are to American papers and books, and, naturally, most space is devoted to American genera and species. Nevertheless, this text-book is one that should be of great use to teachers and students not only in the United States but also outside.

The New Book of Trees. By Marcus Woodward. Illustrated with Wood Engravings by C. Dillon McGurk. Pp. 310. (London: A. M. Philpot, Ltd., n.d.) 12*s*. 6*d*. net.

THE author of this work does not attempt to give elaborate scientific descriptions of trees, neither does he try to reveal anything that is new; rather, by delving into ancient tomes, he has brought to light much that is old but interesting. His researches are confined to the commoner kinds of trees and shrubs, and more particularly to native species. He has gathered together a good deal of historical information, and the chapter entitled "Remarks on Forest Scenery" is particularly interesting, dealing as it does with English woodlands from the time of the Roman invasion to modern times. In his descriptions of the various species the author makes good use of the many legends and lyrics concerning trees and forests that are to be found in old sylvicultural works.

Whilst the book is not one to recommend to the student of botany or sylviculture, it is well worth a place upon the shelves of other tree-lovers, whilst people who have no special interest in trees will find much interesting reading. There are numerous good engravings by Mr. C. Dillon McGurk, and both printing and paper are good.

Hydrogen Ion Concentration of the Blood in Health and Disease. By Prof. J. Harold Austin and Prof. Glenn E. Cullen. (Medicine Monographs, Vol. 8.) Pp. xi + 75. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 9*s*. net.

IN this monograph the authors have set out to give a brief account of our present knowledge of the hydrogen ion concentration of the blood. In the first chapter there is a short but complete theoretical survey of the subject; whilst in the last, methods of determining *p*H are briefly described. The second chapter gives our knowledge of normal blood *p*H, and the third, which accounts for half the length of the book, describes the variations met with in disease. The authors have confined themselves strictly to the subject in hand, though, even then, more than two hundred references are given in the bibliography. They also assume a fair knowledge of the subject from their readers: the clarity of certain portions of the monograph, especially those dealing with the more theoretical aspects of the subject, would be enhanced by somewhat fuller descriptions. The book should be of use to all those interested in the subject, as a work of reference to the latest researches.

The Chemistry of Dyeing. By Dr. J. K. Wood. (Chemical Monographs, No. 2.) New and revised edition. Pp. vii + 104. (London: Gurney and Jackson, 1926.) 3*s*. 6*d*. net.

THIS monograph, first issued in 1913, was written primarily for advanced students, but is of great interest to all who are engaged in processes involving dyeing. Commencing with a description of the physical and chemical properties of the more important commercial fibres, the book gives a short description of the principal types of dyestuffs and the methods of applying them to the various types of fibres. This is necessary in order to understand the following chapters, which deal with the numerous theories which have been advanced concerning the actual mechanism of the dyeing process. These theories are very lucidly explained with great attention to experimental evidence, starting from the first idea of a purely mechanical process to the modern conception of dyeing as a dual process, involving first the electrical precipitation of the dye on the fibre and then the chemical combination or physical solution in the cell walls. The references to the published literature are unusually copious.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Simultaneous Ionisation and Excitation by Foreign Ions in a Gaseous Mixture.

WE have recently carried out some experiments which indicate that an ion of one kind may, upon collision with a molecule of another gas, ionise that molecule and excite the resulting ion to the degree that the energy required to ionise the one exceeds the energy required to ionise the other. This means that an ion may rob a molecule of an electron, and at the same time give to the resulting ion the excess of energy made available by its recombination with the electron over the amount needed to take that electron out of the molecule. As the energies of excitation are quantised, there is usually still a remnant of the energy of recombination yet to be accounted for, and this probably goes into increased kinetic energy of one or both particles involved in the collision.

The experiments have been limited to mixtures of carbon monoxide and of nitrogen with argon, neon, and helium, but the same process may occur in any mixture of gases and vapours, monatomic or multi-atomic. We used carbon monoxide in particular because the energy levels of the CO molecule and the CO^+ ion have recently been experimentally determined in this laboratory [1] and interpreted on the basis of the quantum theory of band spectra.[2] Spectrograms were taken with a Hilger E2 quartz spectrograph of low voltage arcs of 40 milliamperes at 23 volts in a hot cathode discharge tube through mixtures of argon, neon, and helium in turn, each containing ten per cent. of carbon monoxide. The total pressure of the mixture was 2·4 mm. in each case. An auxiliary filament was mounted near the cathode filament so that electrons could be introduced into the discharge from it when desired. The purpose of the auxiliary filament was to enable us to determine whether the carbon monoxide bands were being excited by the rare gas ions or by the electrons from the cathode, and whether the excitation was accomplished simultaneously with the ionisation or was a subsequent event.

The spectrograms show that, in the argon mixtures, none of the negative bands of carbon monoxide or of nitrogen is excited; in the carbon monoxide - neon mixtures the comet tail bands and the first negative bands of CO^+ appear, the former strongly and the latter weakly, but the Baldet-Johnson bands are absent; in the helium mixture all three negative systems of carbon monoxide are strongly developed. The negative bands of nitrogen appear fairly strong in the nitrogen-neon mixture and very strong in the mixture with helium.

Before it could be concluded that these negative bands were being excited simultaneously with the ionisation of the molecule on collision with an ion of neon or of helium, several alternative possibilities had to be tested:

1. The excitation of the ion might follow as a later event after the molecule had been ionised by the rare gas ion. That this process was not operative was demonstrated by introducing into the discharge, electrons from the auxiliary filament at a voltage sufficiently great to excite the CO^+ ions on collision. Although the electron current from this filament was twice as great as from the cathode, no increase in the intensities of the negative bands was produced. Thus, though the current through the discharge was three times as great as before, the negative bands were no more intense. On the other hand, the positive bands of carbon monoxide, which were not present in the original discharge, appeared with moderate strength in the discharge with the auxiliary filament in operation, when the difference of potential between the auxiliary filament and anode was equal to the excitation potentials of these bands. The second positive bands of nitrogen were present even though the auxiliary filament was not used, but their intensities increased enormously when the voltage of the auxiliary filament reached their excitation potential. This suggests a new method for determining the excitation potentials of positive bands and arc lines.

2. The simultaneous ionisation and excitation of the carbon monoxide molecule might be due to direct electron impacts, as has been demonstrated to be possible.[1] That this was not the case was proved by maintaining the voltage of the auxiliary filament higher than the excitation potentials of these bands but below the ionising potential of neon. In this way the possibility of excitation by electron impacts was increased threefold, while the concentration of neon ions was increased very little. A barely perceptible increase in the intensities of the negative bands was observed when the current from the auxiliary filament was twice as great as from the cathode.

3. The ionisation and excitation might be due to an impact of the second kind with an excited neon or helium atom. It was for the purpose of determining whether the ion or an excited atom of the rare gas was responsible for the observed phenomena that nitrogen was substituted for carbon monoxide in the neon mixture. The excitation potential of the negative band system of nitrogen is greater than either of the strong radiating potentials of neon, but is less than the ionising potential of neon. Therefore, an excited neon atom could not ionise the nitrogen molecule and simultaneously excite its negative bands. Hence we must conclude that it is the rare gas ions that were effective.

The interpretation of the observed results on the basis of simultaneous ionisation and excitation by the ions of the inert gases is fairly obvious upon consideration of the excitation potentials of the bands involved and the ionisation potentials of argon, neon, and helium as given in the following table:

Band System.	Excit. Pct.	Gas.	Ionis. Pot.
Comet Tail . .	16·8	Argon	15·4
First Negative .	20·0	Neon	21·5
Baldet-Johnson .	22·9	Helium	24·5
		Carbon Monoxide	14·3

Thus none of the negative bands of carbon monoxide would be expected to appear in the argon mixture, while the comet tail bands and the first negative bands would be excited by neon ions, and all three systems by helium ions, as was observed.

Apparently the neon ions are more efficient in exciting the comet tail bands than they are in exciting the first negative bands. This greater probability that the former would be excited rather than the latter upon a collision between a neon ion and carbon monoxide molecule would seem to indicate that the efficiency of ions in this type of

[1] Duffendack and Fox, *Science*, **64**, p. 277; 1926; *Astrophys. Jour.*, in press.
[2] Birge, NATURE, **117**, pp. 229, 300; 1926; *Phys. Rev.*, **28**, p. 1157; 1926; Johnson, NATURE, **117**, 376; 1926; Duffendack and Fox, NATURE, **118**, 12; 1926.

excitation increases, at least for a time, as the excess energy available increases. This view is supported by the fact that all three systems are strongly developed in the helium mixture. Several bands belonging to the comet tail and Baldet-Johnson systems not previously reported were observed in our spectrograms of the carbon monoxide-helium mixture.

The failure of the Baldet-Johnson bands to appear in the neon mixture and their strong development in the helium mixture is significant. According to Birge,[3] these bands constitute a combination system between the initial states of the first negative and the comet tail systems. If this were true, they would have the same excitation potential as the first negative bands and should be excited by neon ions. Their experimentally determined excitation potential[1] is in agreement with their behaviour in the neon and helium mixtures. This confirms the assignment of this system to a higher initial state of the CO^+ ion as made by Duffendack and Fox.[2] It might be added that Miss Ann Hepburn, at the Chicago meeting of the American Physical Society, corrected her published abstract[4] and reported the excitation potential of this system to be 23·0 volts, in agreement with the value given above.

The appearance of the negative band systems of carbon monoxide and of nitrogen in our discharges is in harmony with their appearance in geissler tube discharges through similar mixtures as observed by Merton and Johnson[5] and by Cameron.[6] Their presence can be accounted for on the basis outlined above, and slight discrepancies can be explained by the less definite limitation of the maximum speeds of the electrons in geissler discharges. Similar discrepancies can be produced in our discharges by increasing the voltage, or the current density, or the percentage of carbon monoxide, or in any way increasing the probability of excitation of the carbon monoxide molecules by direct electron impacts.

There is no reason to believe that this method of excitation of radiation from an ionised molecule is limited to the ions of the rare gases or to multi-atomic molecules. The same process may be expected to occur in any mixture of gases or vapours, and should find application in the production of the first spark spectra of atomic ions to the exclusion of higher spark spectra, and in the approximate determination of the excitation potentials of the spark lines. This process may also explain the enhancement of certain lines in discharges through mixtures of gases and the origin of certain radiations of astronomical interest.

We wish to express our gratitude to Dr. W. E. Forsythe of the Nela Research Laboratory (where these experiments were begun during the summer of 1926) for the argon, and to the U.S. Bureau of Mines for the helium used in these experiments.

O. S. DUFFENDACK.
H. L. SMITH.

University of Michigan,
Ann Arbor, Mar. 15.

Spinning Electron and Wave Mechanics.

IN order to obtain an interpretation of the anomalous Zeeman effect, the multiplet structure, etc., Uhlenbeck and Goudsmit (*Physika*, 1925; *Naturw.*, 953, 1925; NATURE, 117, 264; cf. Thomas, NATURE, 117, 514; Slater, NATURE, 117, 587; London, *Naturw.*, 15, 15, 1927; Darwin, NATURE, 119, 282) assume that the magnetic moment corresponding to the spinning movement of the electron is just twice as great as that of the revolving electric point-charge with the same mechanical angular momentum. In the following, an attempt is made to derive this assumption from the relativistic Schrödinger wave equation in connexion with the electrodynamic meaning of the wave function ψ.

The relativistic wave equation for forceless movement of the electron is:

$$\Delta\psi - \frac{1}{c^2}\frac{\partial^2\psi}{\partial t^2} - \frac{4\pi^2}{h^2}m_0^2c^2\psi = 0. \quad . \quad . \quad (1)$$

(Schrödinger, *Ann. d. Ph.*, 81, 133, and other authors.) The solution, in the rest-system of the electron, may be reduced to the following form (r, z, ϕ being columnar co-ordinates, which are suitable to the purpose):

$$\left.\begin{aligned}\psi &= f(r,z)\exp.\, is\phi \exp.\frac{2\pi i}{h}m_0c^2t\\ &= F(r,z,\phi)\exp.\frac{2\pi i}{h}m_0c^2t\end{aligned}\right\}. \quad . \quad (2)$$

F satisfies the equation: $\Delta F = 0$, and is therefore harmonic in the rest-system.

The equation of the continuity of electricity is:

$$\operatorname{div}.\left\{\frac{h}{2\pi i}(\psi\ \text{grad.}\ \bar{\psi} - \bar{\psi}\ \text{grad.}\ \psi)\right\} + \frac{\partial}{\partial t}\left\{-\frac{h}{2\pi i}\frac{1}{c^2}\left(\psi\frac{\partial\bar{\psi}}{\partial t} - \bar{\psi}\frac{\partial\psi}{\partial t}\right)\right\} = 0. \quad . \quad (3)$$

(See W. Gordon, *Zs. f. Phys.*, 41, 117, see p. 121, and O. Klein, *ibid.* 41, 407, see p. 414.)

We multiply the expressions in brackets by the specific charge $\frac{e}{m_0}$ of the electron (the introduction of the factor $\frac{1}{2}$—as introduced by Klein—cannot be justified in our case) and get for the electric density:

$$\rho = \frac{e}{m_0}\left\{-\frac{h}{2\pi i}\frac{1}{c^2}\left(\psi\frac{\partial\bar{\psi}}{\partial t} - \bar{\psi}\frac{\partial\psi}{\partial t}\right)\right\}, \quad . \quad . \quad (4a)$$

and for the density of current:

$$j = \frac{eh}{2\pi i m_0}(\psi\ \text{grad.}\ \bar{\psi} - \bar{\psi}\ \text{grad.}\ \psi). \quad . \quad . \quad (4)$$

From the non-relativistic form of the wave equation only half the density of current follows (cf. Schrödinger, *l.c.*). From that Fermi (NATURE, 118, 876) and Klein (*Zs. f. Phys.*, 41, 425) have derived the magnetic moment for the revolving movement of an electric point-charge, namely:

$$\mu' = -\frac{e}{m_0}\frac{h}{4\pi}s', \quad . \quad . \quad . \quad . \quad (5')$$

whilst the magnetic moment corresponding to the density of current (4) is:

$$\mu = -\frac{2e}{m_0}\frac{h}{4\pi}s. \quad . \quad . \quad . \quad . \quad (5)$$

μ may be regarded as the magnetic moment of the spinning movement, being twice as great as μ' in agreement with the assumption mentioned in the beginning. The conjectures of Slater and London that the rest-energy m_0c^2 is of rotatory character and that the 'internal phenomenon' of L. de Broglie of the frequency $\nu_0 = \frac{m_0c^2}{h}$ causes it and therefore the magnetism of the electron itself, are supported by this.

The necessary half quantum-numbers for s follow readily if one adapts the Schrödinger conditions for the wave function ψ to our problem.

Only the doublet $(\frac{1}{2}, -\frac{1}{2})$ and no higher quantum-states of rotation appear.

We hope, in an early communication, to return to the question of fine structure and analogous problems.

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[3] Birge, NATURE, **116**, 207; 1925.
[4] Hepburn, *Phys. Rev.*, **29**, 212; 1926.
[5] Merton and Johnson, *Roy. Soc. Proc.*, A, **103**, 383; 1923; Johnson and Cameron, *ibid.* **106**, 195; 1924; Johnson, *ibid.* **108**, 343; 1925.
[6] Cameron, *Phil. Mag.*, 1, 405; 1926.

Occurrence of Branched Hairs in Cotton and upon *Gossypium Stocksii*.

IN the columns of NATURE of Mar. 12, p. 392, Mr. N. W. Barritt describes branched hairs in a specimen of Egyptian cotton. Such branched hairs of Gossypium have been known to us for some time and have been the subject of an investigation by us which we hope shortly to publish.

We have growing here each year in our experimental area what is probably the most representative

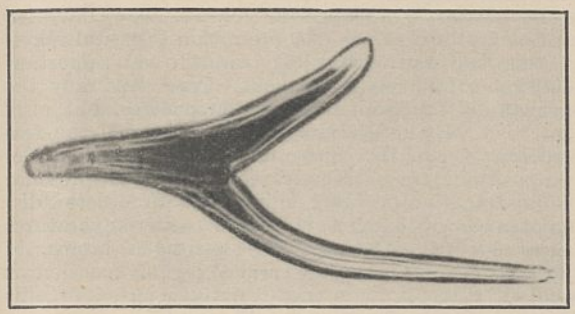

FIG. 1.—Branched hair of *Thespesia populnea*, 0·9 mm. long.

collection of Asiatic types of cotton to be found anywhere in the world. Amongst several of these types, by the exercise of patience, we have found these branched hairs, as also in Upland American and Sea Island types. The branched hair represents a form of hair that occurred in the phylogeny of the Hibisceæ. It is very well seen in *Thespesia populnea*, upon the seed coat of which there are hairs of at least

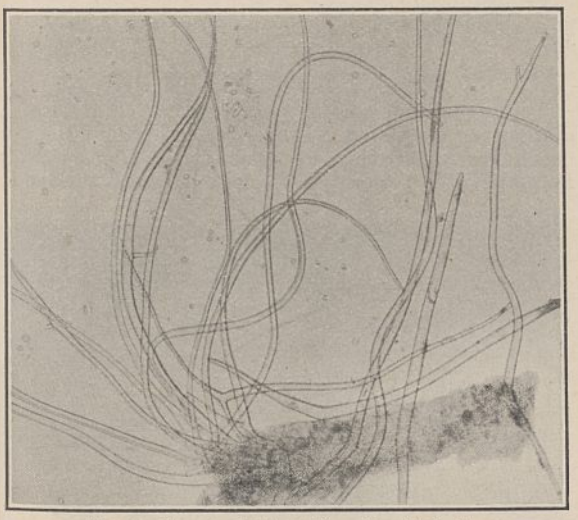

FIG. 2.—Branched hairs of *Gossypium Stocksii*.

two types, one of which is branched and another unbranched. The branched type is shown in the photomicrograph (Fig. 1). The length of this hair is 0·9 mm.

In *Gossypium Stocksii*, a type of cotton in some respects primitive, hairs occur within the capsule not only upon the seed coat but also upon the capsule wall. Many of these hairs, both upon the seed coat and the capsule wall, show branching. These are shown in Fig. 2. Coming off from the mass of capsule wall shown in this photograph is a bifurcate hair with a very short basal part embedded in the wall. To the left of this is another similar one with a longer base than the former. Hairs with shorter side branches can be seen in several places. The hairs on the seed coat of *Gossypium Stocksii* are usually regarded as of the nature of 'fuzz.' In our material they are some 8 mm. to 10 mm. long.

It seems probable that in the modern forms of Gossypium the branched hair has become suppressed, and usually develops only tardily and to a limited extent in the form of 'fuzz.'

We have *Gossypium Stocksii* from the Sind Desert growing and flowering here now. There are several characters in it that have never been correctly described. In our material there are no signs of any stipular glands at the base of the clawed bracteoles as figured in Watt's "Wild and Cultivated Cotton-Plants of the World." The flowers of our material, too, could not be described as 'large'; in comparison with most other Asiatic cottons, they are small. In colour the flowers are pale sulphur yellow and of a totally different shade from that of Asiatic cottons generally. The pollen grains, in the character of their spines, differ from those of any other Asiatic Gossypium seen by us. An investigation has been made into the cytology of *Gossypium Stocksii*, and thirteen chromosome bodies have been found in the developing pollen grain.

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Intensities of Molecular Beams.

KNAUER and Stern (*Zs. f. Phys.*, 39, 775) have recently investigated the relation between the intensity of a beam of mercury molecules and the pressure in the oven or source chamber. They have found that the intensity of the beam increased uniformly with the oven pressure, until the mean free path in the oven was about equal to the width of the oven slit. At this pressure the beam had a maximum intensity, becoming less intense as the oven pressure was increased above this optimum value. As an explanation of this maximum, they have suggested that the molecules emerging from the slit, at pressures greater than the optimum pressure, collide with one another, giving rise to the formation of a cloud in front of the slit. Instead of originating in the slit itself, the beam then has its source in this diffuse surface of low intensity.

This explanation does not seem correct, when a consideration is made of the frequency of the collisions taking place between the molecules which have passed through the oven slit. An indication of the probability of such collisions may be gained from a calculation of the free path in an ideal gas the molecules of which are moving in a single direction with a Maxwellian velocity distribution. The result of such a calculation shows that the mutual collisions between the molecules within the beam are so infrequent as to produce no appreciable effect on the intensity of the beam, except at oven pressures far greater than the optimum pressure observed by Knauer and Stern. The diminishing intensity of their beam, as the pressure was raised above the optimum pressure, was more probably due to scattering by molecules which had been reflected from the uncooled walls of the chamber between the slits. The reason for this statement will appear from the following experiments.

A beam of mercury molecules was formed in a manner similar to that of Knauer and Stern, with the important difference that *the region between the two slits was entirely surrounded by a liquid air cooled surface*. In this way all molecules were removed from this space at their first impact with the walls, with the

exception of a small fraction which were striking an uncooled surface near the image slit. The slits were each 0·1 mm. wide by 1 mm. long and were separated by a distance of 7 cm. The intensity of the beam was measured by means of an ionisation gauge, having as its only opening a slit of the same dimensions as of the two referred to above. The gauge was mounted in the vacuum in such a manner that it could be moved into or out of the beam at a point 8 cm. beyond the image slit. The change of pressure which took place in the ionisation gauge, when it was moved from a position outside of the beam into its centre, was assumed to be proportional to the intensity of the beam.

With this arrangement a beam could be detected when the oven pressure was 0·1 mm., a pressure slightly below that at which a maximum would be expected to occur, if the interpretation which Knauer and Stern have placed upon their results is correct. It was found, however, that with oven pressures ranging from 0·1 mm. up to 30 mm., *the beam intensity increased uniformly with the oven pressure.* Within this pressure range the beam was well defined and had the width calculated from the geometry of the slits. At oven pressures greater than 30 mm., the beam intensity increased more slowly with the pressure, and passed through a maximum at an oven pressure of 100 mm. Within this range the beam gradually became more diffuse, until at the last pressure it was several times its geometric width.

The maximum may be analogous to the maximum observed by Knauer and Stern; it is possibly due to scattering by molecules which have been reflected from the small uncooled area near the image slit. The more complete elimination of such reflected molecules accounts for the fact that the maximum occurred at an oven pressure about one thousand times greater than that predicted by Knauer and Stern.

The mutual collisions referred to above are also an important cause of scattering at these large beam intensities. For this reason the production of a beam of greater intensity will not be materially aided by a further elimination of the reflection of molecules from the walls of the chamber between the two slits.

THOMAS H. JOHNSON.

Sloane Physical Laboratory,
Yale University, April 22.

The Mechanism of 'Knock' Suppression.

THE letter by Messrs. Egerton and Gates in the issue of Mar. 19, p. 427, concerning the mechanism of 'knock' suppressors such as lead tetra-ethyl, prompts me to add certain points of view material to the discussion.

The idea that lead tetra-ethyl acts as an inhibitor of the oxidation of aldehydes was expressed by me in January 1924 at a meeting of the North-Eastern Section of the American Chemical Society in Boston, reported in the News Edition of *Industrial and Engineering Chemistry* for February 1924, and in *Chemical and Metallurgical Engineering*, vol. 30, p. 148 (1924). At that meeting I was able to show an experiment in which the rate of oxidation of 5 c.c. of benzaldehyde was decreased from 1·5 c.c. absorbed oxygen per minute to 0·005 c.c. per minute by the addition of one drop of lead tetra-ethyl to 5 c.c. of benzaldehyde. The report of this work has been delayed, but a forthcoming publication by Mr. H. J. L. Bäckström will record in detail work of which this is one phase.

In the meantime we have obtained other results which demonstrate one other possible mechanism of known suppression by lead tetra-ethyl. Charch, Mack, and Boord have suggested (*Ind. Eng. Chem.*, 18, 336; 1926) that the suppression is to be associated with the liberation of fine particles of the free metal in the gaseous mixture, these atoms functioning as catalysts of oxidation, themselves undergoing rapid oxidation and producing, at a definite stage in the engine cycle, a large number of oxidation centres. A homogeneous combustion throughout the gas mixture ahead of the flame front would thus occur, thereby suppressing the formation of a detonation wave and consequent knock.

Our own experiments on the properties of hydrogen atoms (*Trans. Faraday Soc.*, vol. 21, 1926) have led also to a study of the decomposition of metal alkyls of the lead tetra-ethyl type and to an important addition to the above concept. Not only may the lead atoms function as oxidation centres, but also, and to a very much more marked extent, the free radicals, *e.g.* C_2H_5, liberated by the thermal decomposition, are extremely reactive in the presence of hydrocarbon-oxygen mixtures. Complete disappearance of oxygen is secured at temperatures below 300° C. Indeed, with hydrogen atoms, in the presence of ethylene and oxygen, reaction is secured at room temperatures, oxygenated organic compounds being produced. Free radicals, therefore, may function as oxidation centres producing homogeneous combustion, an effect supplementary to the inhibitory action of the metal alkyl on oxidation of the aldehydes produced by partial oxidation of hydrocarbons. The action of the free radicals may well account for the inhibitory effects produced by non-metallic knock suppressors of the type of aniline. As yet, there does not seem to be any method whereby the relative importance of these several possibilities may be estimated.

HUGH S. TAYLOR.

Princeton University,
New Jersey.

A Mawken Canoe in Algoa Bay.

ACCOMPANYING this is a photograph (Fig. 1) of a dug-out canoe which I found washed up on the sea beach in Algoa Bay at a point known as New Brighton. The canoe is 22 feet long, 16 inches in width, and 14 inches deep. It has been hollowed out from a large tree. Towards the stem there is a cavity in the bottom of the canoe for the reception of a mast. The side pieces, which have the appearance of row-locks, can be clearly seen in the photograph.

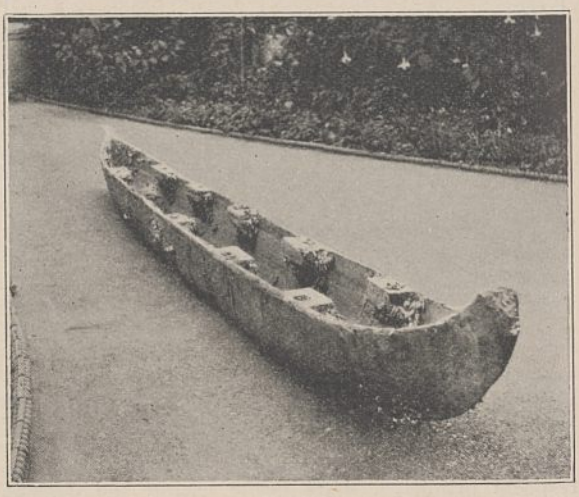

FIG. 1.

Dr. Ernest Schwarz, professor of geology at the

Rhodes University College at Grahamstown, made a careful examination of the canoe, and definitely stated it was not of African origin. He advanced the opinion, confirmed later, that it came from the Mergui Archipelago, which consists of a group of small forest-covered islands in the Bay of Bengal to the north of Sumatra. I have consulted the book entitled "The Sea Gypsies of Malaya," by Mr. Walter Grainge White, which seems to prove that Prof. Schwarz is right. The relic appears to be the hull or base on which a superstructure was built. The so-called row-locks are evidently for the purpose of receiving slats of wood to form ribs. Along these the sliced stems of palms are bound, and the joints caulked with a resinous gum obtained from the forest trees. On cross pieces of bamboo a deck of split bamboos is laid down, and also caulked. At one end (the stern) a small shelter with a mat cover is erected.

These boats are the floating homes of a primitive race of people known as the Mawken.

Presuming our canoe is of Mawken origin, how came it here, a distance of some 5000 miles from its original home? Was it carried by means of the Malabar ocean current which has its origin in the Bay of Bengal? It is, however, the only relic of its kind which has been recorded from South Africa. F. W. FITZSIMONS.
(Director.)

Port Elizabeth Museum,
South Africa.

A Mutant in Cotton.

ON the Government Farm at Dharwar, Bombay Presidency, India, I have for several years had under observation pure lines of cottons of several species and varieties. One of these was *Wagale*, a Burmese variety of *Gossypium neglectum* Tod. From 1919 this variety has been self-fertilised, and only the self-fertilised seed used for sowing in each generation, of which there has been one per annum. Like all the Indian cottons, this variety has normally had simple and stellate hairs on stem, petiole, and leaf. The variety bred true for this character of hairiness until 1925, in which season there appeared one plant which was entirely glabrous.

The normal plant has a ginning percentage of about 30, but the hairless plant had no lint at all although its seeds showed the shorter 'fuzz.' The petal length was also shorter than normal, averaging 17 mm. as against the normal 35 mm. This plant was self-fertilised and seeds were produced. In the season of 1926–27 these seeds were sown, giving 80 plants, all showing absolute hairlessness, lack of lint, and short petals. This new type appears to be a genuine mutant. Its behaviour in further generations and in crosses is being studied. G. L. KOTTUR.
(Cotton Breeder.)

Bombay Agricultural Department,
Dharwar, India, Feb. 19.

The Microscopical Examination of Flint Surfaces.

I AM glad to see my friend Mr. Reid Moir is turning his attention to the surface-structures of fractured and fissured flints (NATURE, April 16, p. 560); and I am sure we shall know something more about them before he has done with them. For more than fifty years I have been pointing out some of these, and the differences in their subsequent disposition to metamorphoses. I used to liken them sometimes to bread cut and broken, both in appearance and in their action when we turn them into the soup. The transitional Fawkhamian implements are splendid examples of these: every man-fractured (or flaked) face is now porcellanised, while the 'natural' facets have been altering ever since.

The question, however, is not quite so simple as it might appear. There are eight factors that enter into the formation of the macro- and micro-surface-structures of free struck (fractured) and thermal fissured flints; these are: (1) the state and its variety to which the particular flint belongs; (2) the exact point the specimen has reached in the collo-crystallar evolution; (3) the degree and kind of metamorphoses the flint has attained; (4) the degree of molecular rearrangement associated with disruption it has reached and which of the various forms of these are present; (5) the support at the moment of fracture (resilient or rigid); (6) the shape of the striking-face; (7) the shape and nature of the striker (hammer); (8) the velocity of the blow.

In addition to these, in the case of thermal fissure, much will, of course, depend upon whether the heat be oxidising or reducing. W. J. LEWIS ABBOTT.

Fluorescence of Sea Anemones.

I NOTICED recently, upon the rocks in Torbay, a number of sea anemones the tentacles of which appeared to fluoresce in sunlight. The effect is limited to the tentacles, for they appear to have a pinkish-brown colour by transmitted light, which changes to vivid green when viewed by light reflected from their surface. The body of the anemone itself is yellowish-brown and does not appear to fluoresce: nor do the pink tips of the tentacles.

Wishing to confirm the effect, I brought two specimens to London, and on placing them in a beam of ultra-violet light from which the visible radiation was filtered, the brilliance of the green fluorescence was very striking. I would suggest, therefore, that a source of ultra-violet light might be a useful adjunct to marine biological laboratories.

CHARLES E. S. PHILLIPS.

Castle House,
Shooter's Hill, S.E.18.

The Modern 'Zoo.'

ON behalf of the Council of the Zoological Society of Scotland I should like to express to you our great appreciation of the excellent notice in NATURE of the Society's appeal for funds for the continued development of the Zoological Park here. The publicity given, through NATURE, to our aspirations and our necessities will aid very greatly the effort we are now making, and I thank you most cordially for it.

Perhaps you will permit me to add that if any of your readers would be interested to receive a copy of the illustrated appeal, which contains a fairly full description of the Park, I should be very pleased to send one to any address given me, and if any one should be generous enough to subscribe towards our development fund, I shall be most happy to receive and acknowledge subscriptions.

T. H. GILLESPIE.
(Director-Secretary.)

The Zoological Society of Scotland,
Murrayfield, Edinburgh, W.

The Law of Flame Speeds.

THE quotation by Mr. A. G. White in NATURE of May 7, p. 674, is misleading from the context, and we would refer readers to the preceding paragraph in the paper from which the quotation is made (*Jour. Chem. Soc.*, 1919, 115, 1455. W. PAYMAN.
R. V. WHEELER.

Safety in Mines Research Board,
Sheffield, May 12.

Logic and Law in Biology.[1]

By Dr. P. CHALMERS MITCHELL, C.B.E., F.R.S.

TEN years after the publication of the "Origin of Species," Kelvin, then Sir William Thomson, threw a bomb into the camp of the apparently victorious evolutionists. "It was quite certain," he said, "that a great mistake had been made—that British popular geology at the present time was in direct opposition to the principles of Natural Philosophy." According to the great physicist, the rate of cooling of the earth and other physical 'principles' showed that our globe could not have been in a position to support life for longer than a period of from 50 to 300 million years. In his opinion, the drafts on the bank of time demanded by those who upheld uniformitarian geology and the evolution of plants and animals could not be honoured.

Science rebuking science! It was meat and drink to the disheartened supernaturalists, the more reviving because in these days physical science was in good odour, and the new doctrine of evolution was the enemy. Huxley dealt with it in his presidential address to the Geological Society in 1869. He had no difficulty in showing that Kelvin's 'principles' were not unbending laws with universal jurisdiction, but merely combinations of observation, inference, and theory in different proportions. He took his final stand on the simple ground that as there was sufficient evidence for the orderly succession of the rocks and the orderly appearance of fossils in them, there must have been sufficient time for these processes. From this logical viewpoint he reached a remarkable result. Assume the correctness of Kelvin's calculation of the earth's rate of cooling and that yet there is sufficient evidence for evolution having taken place; why then there must be some unknown source of heat in the crust of the earth? Such a source of heat has been discovered in the radio-active elements, and from the rate of their disintegration the age of the oldest sedimentary rocks has been calculated at 1200 millions of years—a credit at the bank of time ample to meet all cheques presented by the followers of Lyell and Darwin. Twenty years later, in the course of an amusing controversy with the Duke of Argyll and a brace of bishops who had been talking about the suspension of 'lower laws' by 'higher laws,' as when a man raised a stone in his arm, he discussed the meaning of the term 'law' in science. He insisted that it was no more than the product of a mental operation upon the facts of Nature which had come under observation. It had no external existence and included no conception of causality. He took as examples the Newtonian laws of gravity and of motion and the law of constancy of mass.

At the time, Newton's laws must have seemed as securely established for the whole universe as any principle of science, and the constancy of mass through all chemical changes appeared to be a foundation of chemistry. With regard to both, Huxley insisted that they had no necessary sway. He stated the laws as to gravitation in such terms that they require not a word of alteration now that Einstein's unexpected discoveries have been made and confirmed. With regard to the constancy of mass he went even further, and said that there was no reason in our knowledge of the facts why mass should not be found to alter with the conditions. Recent physics have shown that in the atomic system the mass of the electron is a function of its rate of motion.

If, as Sir Oliver Lodge believes, the disincarnated spirit of Huxley is still in conscious existence, there must be a wry grin on what corresponds with the face of a disincarnated spirit, if Huxley imagines that I am going to claim prophetic powers for him on the grounds that he anticipated the discovery of radio-activity, made allowances for Einstein's amendments of Newton, and foresaw the gyrations of the electron. Huxley laid no claim to any faculties not within the scope and the duty of every man of science. His mental discipline comprised accurate observation, clear statement, the most rigid scrutiny of generalisations, the withholding from these generalisations of any iota of causal principle or any right to application to sets of facts different from those upon which they were based, and, above all, the declaration of ignorance in preference to the invention of imaginary principles. If, as he believed, the writ of science is to run howsoever it may be in opposition to customs, traditions, beliefs, or dogmas, there is the more need for scientific men to distinguish carefully in their pronouncements, especially to the public, between generalisations well founded on observation, probables, possibles, and hopes.

The presidential address to the British Association at Liverpool in 1870 is a conspicuous example of Huxley's methods. He described simple facts of everyday life, such as the appearance of maggots in carcases, of moulds on fruit, of vinegar eels, and so forth, explained by the ancients as due to spontaneous generation of the living companions of corruption from the corrupting but dead matter. In 1568, Redi, the Italian, covered meat with gauze, watched the blowflies, attracted by the smell of putrefaction, settling on the gauze, but noted that as the eggs could not pass through the gauze no maggots appeared in the meat. From similar experiments Redi drew the generalisation that living organisms arose in nutrient media only when the living seeds of these organisms had previously gained access to the media. The gauze of Redi has now been replaced by the far more delicate methods of bacteriologists, and the generalisation has been extended to almost every kind of living thing with which we are acquainted. But the principle remains the same; such 'causa-

[1] From the Huxley Memorial lecture delivered at the Imperial College of Science and Technology, South Kensington, on May 4.

tion' as there may be lies in the meshes of the gauze or their equivalent, not in any absolute distinction between living things and inorganic matter. To this generalisation Huxley gave the name 'biogenesis'; to the opposite conception, that of the direct origin of living from dead or inorganic matter, he gave the name 'abiogenesis.' As if foreseeing how his statement might be abused, consciously or unconsciously, he went on to say in a memorable passage that, so far from seeing in biogenesis a necessary and absolute principle, it was his expectation—belief was too strong a word in the absence of evidence—that a spectator in far-distant geological times might have seen the actual origin of living matter from inorganic matter. His prevision was necessary. In a recent book, addressed to the wide public, Sir Oliver Lodge has said that the "doctrine of biogenesis is that life could alone produce life." In another recent book, addressed to a narrower circle, Prof. Lloyd Morgan, setting out from the article on biology in the 11th edition of the "Encyclopædia Britannica," says that the authors implied that "biological events are not susceptible of interpretation in terms of physics and chemistry." The authors said nothing of the kind. They wrote, "have not been interpreted." Advocacy of the supernatural in natural science seems to confer an obliquity of vision.

My object is now to pass in rapid review some of the history of biology before Huxley and since Huxley, and to show how with a monotonous reiteration the craving for final causes has led many great biologists to extend their generalisations beyond their scope and to impose on them imaginary principles; in short, to invent gods and to place them in the machine to account for the part of the working not yet understood.

What is the order of events in the development of a new individual? Two eggs, similar in size and appearance, placed in an aquarium tank under the same conditions, grow, the one say into a mollusc and the other into a fish. In the words of Bateson, whose premature death removed from us one of the most active and productive workers in the long history of our science, "Shakespeare once existed as a speck of protoplasm not so big as a small pin's head. To this nothing was added that would not equally well have served to build up a baboon or a rat." I do not accept these crude statements without qualifications so great as to reduce them almost to nonsense, but they serve well to pose the main problem of biology, the likeness of offspring to parent. To biologists of the seventeenth and eighteenth centuries the answer was easy. Recall their pictures of the egg with the miniature of a human being coiled up within it. They believed that the process of development was the evolution or unrolling of a preformed minute adult, invisible to us only because of the imperfection of our optical appliances and the opacity of the medium. The English Harvey and some others were uneasy about this interpretation, but it was not displaced until Caspar Wolff in 1759 published the results of his observations on the development of the chick. Wolff was able to show that the germ was unformed material and that it assumed only gradually, stage by stage, the likeness of its parent.

Development is an epigenesis, the putting on of phase after phase. Wolff saw that the preformation theory was miraculous, differing, as he put it, only from ordinary miracles inasmuch as it had been performed once for all by the Creator at the beginning of the world. But having got rid of miracle in one way he introduced it in another. For he endowed his plastic organic material with a *vis essentialis*, an inherent force by which it wrought its own miracle. Wolff thus by actual observation freed biology from the chains of a preconception and set embryology on lines which have led to great advances in knowledge. But the theory he imposed on his observations has been the parent of a great brood, a whole Valhalla of false gods; hear the names of some of them: vital force, *nisus formativus*, bathmism, enteleche, creative evolution, emergent evolution, purposive striving—not one of them more than a beguiling word for ignorance.

After nearly two centuries rich in new knowledge of the observed facts of embryology, but with no important advance in theory, there came August Weismann. A skilled embryologist, he knew the successive phases of development to be a visible epigenesis and to recall at least in a general fashion the ancestral history. The fertilised egg-cell of a human being recalled the morphological grade of the protozoa, next assumed (as Huxley was the first to recognise) the appearance of the cœlenterate or two-layered creatures, then became a simple cœlomate, then a generalised chordate which might be about to become fish, flesh, or fowl, then an anthropoid stage man or ape, and only at a very late prenatal stage assumed definitely its human structure.

But Weismann found an exception to this orderly epigenetic progression. The cells which were going to become the gonad of the future adult did not wait to appear in their turn in their due order and place. They were separated, usually, if not invariably, at an extremely early stage, and preserving their individuality, were passed along through the developing embryo, occupying now one position, now another, until they reached their final place. The likeness between parent and offspring was thus shown to have a material basis and the link between ontogeny was given a local habitation and also a name, the germplasm. The daughter was only a delayed sister of her mother. Neglecting the complications due to parental crossing, the mother and daughter were products of the same germplasm.

With regard to the development of the individual, however, Weismann's endowment of the germplasm with a historic architecture was a return to a more subtle kind of preformation. The bricks of his imagined edifice were 'determinants,' separate particles so arranged as to be given off at precisely the time when they were required to control the

development of the tissues into which they were marshalled. The initial stock of germplasm was thus disintegrated into sets of determinants with limited powers of control until each portion reached its final stage of being able to determine only one kind of cell or tissue. The plasm in these various stages of irreversible disintegration was what he called the somatoplasm. His interpretation brought into clear light the relative if not the absolute stability of the germplasm, found and stressed the material link between ontogeny and phylogeny. But his historic architecture and his determinants were imagined principles to give causal explanations of processes which were not yet understood.

Oscar Hertwig, a very able experimental embryologist, very soon showed that the stresses of the environment acting on adult and embryonic stages could overpower the control assigned to the historic architecture and compel reluctant material into forms which it would not otherwise have assumed. The irreversible disintegration of the germplasm could not account for the facts, and the accessory theories produced by Weismann and his followers were more ingenious than convincing. Hertwig's insistence on the moulding forces of the environment brought the fresh air of observation of facts into the study of embryology and opened up a new and fertile chapter. But he, too, had to invent a causal principle; the name of the god he placed in the machine was the control of the whole organism over its parts in such a fashion that they served the needs of the whole. It is a disconcerting circumstance that his deity is more powerful in the embryo than in the adult, and in the lower than in the higher organisms.

Making the large allowances necessary for the play of the environment in producing the characters of an organism, there remains much which must be assigned to the hereditary material. The Mendelian analysis of heredity and the physiological doctrine of hormones have found a material interpretation for some of the unexplained occurrences for which Weismann invented his historic architecture and Hertwig his 'control of the whole.' The brilliant experimental analysis of the Mendelians has shown that at least with regard to a certain number of characters, heredity is particulate, consisting of unit characters which may be combined in groups in various ways. There is, in short, a mechanism in heredity which is being explored, and converging advances in knowledge of the nuclear changes are finding a material seat for it. On the other hand, the rejection of the influence of the environment is leading Mendelians into fantastic extravagance. The pronouncement by Bateson, in his address as president of the British Association in Melbourne in 1914, was a return to a conception of preformation more miraculous than those of pre-scientific philosophers. Arguing from the success of Mendelian breeders in eliminating factors and their failure in their efforts to add factors, he suggested a similar limitation for Nature, and that the whole course of divergent evolution from the beginning of life to the appearance of Shakespeare had come about by the elimination of factors.

The discovery by Brown-Sequard and D'Arsonval of secretions discharged into the blood stream by glands in addition to the secretions liberated through their ducts, and their extension of this to the supposition that all organs and tissues might produce internal secretions, have been carried much further by more recent work. It has been shown that many of these secretions, called hormones, or chemical messengers, by Bayliss, Starling, and W. B. Hardy, do exist and exercise highly specialised co-ordinating functions. They form a chemical nexus independent of nerve reflexes, and so far definitely reduce the unknown field for which Hertwig invented his mysterious power of control by the whole over the part. Experiments particularly on the development of batrachian larvæ have shown that secretions produced at one stage of the development control the later stages. It may be that in hormones will be found to be the material agents by which the germplasm controls the development of the individual. But those which have been studied so far are extremely precise in their action, and I have been unable to find a trace of direct evidence for the belief so greedily imbibed by those who accept the evidence of the inheritance of acquired characters—the belief, for example, that if the plumage of a bird or the coloration of a moth becomes darker from the effect of some agent in the environment, the melanistic tissues will produce a changed hormone of such a kind that it will influence the germplasm to produce melanistic forms.

To what general issue have I led myself in this rapid review of some biological problems in the light of Huxley's canons? Definitely to the position that if we scrutinise our generalisations and do not extend them to a class of facts from which they were not derived, if we do not endow abstractions with an independent reality, we shall find no logical ground to infer the existence of any but physical events in the world of living things. I agree that the phenomena of living things have not yet been fully interpreted in terms of the inorganic. But I note that every positive addition to biological knowledge in the last century, from the identification of Mendelian factors in heredity, the artificial fertilisation of ova and the other achievements of bio-chemistry, to Sir Charles Sherrington's exploration of mammalian reflexes, has been a diminution of the residuum to which it is possible to apply vitalistic conceptions. On the other hand, Philosophy, since she was judicially separated from science, has made no positive addition to knowledge. How far our progress will go, I do not know. It may only be a phase of anthropomorphism to expect that man can ever comprehend the universe. But science must pursue the quest, and if we adhere to what is called materialism in the simplest sense of the word, we shall at least in the future, as in the past, make positive additions to knowledge.

Some Properties of Coke.[1]

By Prof. J. W. COBB.

COKE is formed when coal, heated out of contact with open air, softens and is blown into a porous mass by its own gaseous products of decomposition. The structure of the coke is determined by a number of circumstances, but the relation between the softening and the evolution of gaseous products of decomposition is all-important.

In the structure of charcoal the original structure of the wood carbonised is, to a considerable extent, retained in the resulting charcoal. The annual rings, marked by a difference in size in the cells, are to be seen quite plainly. In a coke made from a bituminous coal, the original solid structure has disappeared, and has been replaced by a porous honeycombed mass.

It is not every coal which undergoes coking. Anthracite, for example, does not soften or coke. The coking property has been associated chemically with the existence in the coal of substances which can be extracted from it by suitable treatment with solvents, but the interpretation of the results is controversial.

If the various factors are considered, it is not strange to find that the characteristics of a coke made from the same coal under different conditions are themselves very different. This consideration has even greater weight if one visualises the further complication of coke formation as it exists on the large scale, say, in a continuous vertical gas retort. The upper part of such a retort may be quite cool, gases escaping at, say, a temperature of about 100° C. Such an apparatus necessarily acts, to some extent, as a reflux condenser; some of the tarry products of decomposition from the lower and hotter parts of the retort will be recondensed around the cooler particles near the top, so that the descending coal charge is moistened by this film of condensate. If the film evaporates without decomposition a little lower in the retort, it will have produced a caking effect while it was wet and sticky but will have no ultimate coking effect. If it decomposes leaving a cementing residue, the coke will be the stronger for it. At high temperatures such a cementing action can also be exercised by the decomposition of such a gas as methane. Similar considerations apply to the coke oven.

It is for reasons such as these that the type of large scale apparatus used in carbonisation, its method of use, and the preparation of the coal as affecting the penetration of heat to the charge, and the facility of escape of products of carbonisation, become of nearly the same importance as the original character of the coal in determining the character of the coke made from it.

WATER-GAS.

One of the most important properties of coke industrially is its interaction with steam, producing water-gas—a mixture of carbon monoxide, hydrogen, carbon dioxide, with some undecomposed steam. This is made not only in the water-gas process proper, where coke is blown alternately with a current of air and with steam, but also in the gasification of coal in a gas producer which is blown with a mixture of air and steam, and again to some extent in the making of town gas, when some steam is blown into the bottom of the retort—the so-called steaming process.

ASH CONSTITUENTS.

It was suggested by Haber many years ago in his "Technical Gas Reactions" (1903) that a constituent of the ash of the coke used in the water-gas process might stimulate reaction. We have gone further into this matter, being led to do so partly from a desire to obtain specific and quantitative information on that subject, and partly because we were specially interested in the behaviour of the nitrogen and sulphur compounds in coke where the ash constituents were known in some cases to exercise an important influence. For this purpose we prepared special cokes at 500° and 800° C. from coal with which had been incorporated 5 per cent. of such oxides as silica, alumina, lime, and ferric oxide, or equivalent quantities of other compounds, such as sodium carbonate. Since the original coal had been carefully chosen as containing only 1 per cent. ash, it would be reasonably hoped in this way to obtain an idea of the influence of each of the common ash constituents of coal in turn.

That the ash constituents were going to exercise some influence was obvious from the first trials of these mixtures made in an ordinary crucible test. The original coal when so heated gave coke buttons swollen and honeycombed. The iron oxide and sodium carbonate cokes were close-grained and uniformly porous, while the sodium hydrate mixture gave a barely coherent powder. Dr. Lessing, who had worked previously on the influence of catalysts on the carbonisation of coal, had claimed an influence on the character and yield of coke from this cause.

When we came to examine cokes prepared at 500° and 800° C., the results were suggestive. Considering the cokes prepared at 500° C., the presence of iron oxide and sodium carbonate altered the proportion of residual volatile matter. These cokes also differed in structure from the pure coke, being of a much closer and more evenly porous texture. This result would suggest that, whatever the ultimate explanation may be, the action of oxide of iron is to delay or modify the decomposition below 500° C., lessening the evolution of volatile matter from the softened coal and the consequent puffing-up of the mass. At a later stage, below 800° C. apparently, this volatile matter was evolved, but it was presumably then without effect on the structure because solidification had by that time occurred.

[1] Substance of two lectures delivered at the Royal Institution on Mar. 29 and April 5.

Special Cokes in Steam.

We passed on to an examination of the comparative behaviour of these cokes when treated with steam at 1000° C. Marked differences between the cokes now appeared. The lime coke was plainly much more reactive than the pure coke, the iron oxide coke more reactive again, while the rate of steaming with sodium carbonate coke had to be pushed very high before there was any appreciable falling away from complete decomposition. Moreover, the composition of the gas attained was different. At a rate of 10 litres an hour, taking extremes, with the pure coke 61 per cent. of the steam was decomposed, and the water-gas contained 9·2 per cent. carbon dioxide, while the sodium carbonate coke had decomposed 98 per cent. of the steam, giving a water-gas containing only 0·4 per cent. carbon dioxide. It was interesting to speculate whether this difference in behaviour was a specific chemical effect due to the presence of these special constituents in the coke, or whether it was due mainly to the difference in physical structure which we knew had been brought about in the cokes during the preliminary process of carbonisation.

The tendency of opinion for some time has been to attach primary importance to the physical structure of coke as influencing its reactivity, and there seems to be no doubt that it is an important factor. It has, however, been demonstrated by impregnating the 'pure' coke with sodium carbonate (soaking in a solution and drying), that practically the same enhanced reactivity can be brought about in that way as by mixing with sodium carbonate before carbonisation, which eliminates the altered physical structure as playing the principal part in the enhancement of reactivity in this case. The results at lower temperatures were equally striking, a very noticeable feature being the low carbon dioxide content of the gas made by steaming sodium carbonate coke at 800° C.

Reactivity in Carbon Dioxide and Air.

Reactivity to carbon dioxide is probably most important of all and was next examined. The formation of carbon monoxide from carbon dioxide is at the root of the manufacture of producer gas by blowing air through a deep column of coal or coke, is all-important to the working of the blast furnace, and plays its part in every coal or coke fire.

Lower temperatures were used than with steam, because of the higher reactivities. 1 per cent. of oxide of iron was found to give more than half the enhanced effect which came from 5 per cent. An impregnated sodium carbonate coke was proved to be almost as active as one prepared by adding the sodium carbonate before carbonisation. With some of the special cokes, and more particularly the sodium carbonate coke, there was a falling off in reactivity as an experiment proceeded. An interesting observation made on the oxide of iron coke, which is likely to be of theoretical importance, suggests that reduced iron may be present and taking part in the cycle of reactions.

It is difficult to test for differences between cokes as to their reactivity with air at temperatures above the ignition point. This is largely owing to the experiment getting out of hand on account of rise in temperature when air or oxygen is used. We have made some attempts by limiting the heating effect in two ways, by using air diluted with nitrogen until it only contained 2 per cent. to 3 per cent. oxygen, and by leading it over a small flat surface of coke with a limited surface of 1 cm. square. Measurement showed that by this method it was possible to obtain combustion without accumulation of heat or rise in temperature.

In these experiments the behaviour of all the cokes was practically the same above 700° C., but at lower temperatures—400° to 600° C.—wide differences appeared. The opinion previously put forward is thus confirmed that at high temperatures the reactivity of cokes in general is so high in air that differences in behaviour depend upon the rate of supply of air to the coke particles rather than on the reactivity of the cokes. One remarkable feature noticed in these experiments was the apparent slowness with which the highly reactive sodium carbonate coke began to react with oxygen. The same phenomenon had been noticed in experiments on the temperature of ignition of the special cokes.

Heating of Coke in Air.

When air is passed through hot cokes differing in their degree of reactivity, the result obtained appears, at first sight, somewhat anomalous. In each case there is an effect due to the burning of coke to carbon dioxide on first contact, and while the air is in excess. Heat is generated, and if the air supply is the same for each of two cokes, the same heat will be generated by this primary reaction in each case. There follows, however, the further interaction between carbon dioxide and carbon, reducing some of the carbon dioxide to carbon monoxide, and the degree to which this action is carried on is greater the more reactive the coke. It is with respect to this second reaction that cokes differ so much.

Now one characteristic of the conversion of carbon dioxide to carbon monoxide by carbon is that it absorbs heat. The net result is that the difference between the two cokes shows itself in the difference of the cooling effect, and it is with the more reactive coke that the cooling effect is more pronounced. Hence, in blowing air into hot cokes, it is the less reactive coke which generates heat most quickly in the mass.

A comparison of this property has been effected on the laboratory scale. 10 gm. of coke was placed in a vertical, electrically heated furnace. A thermocouple was inserted from the bottom end of the furnace tube in such a way that the junction was 2 cm. distant from the upper surface of the coke. The furnace was then heated up to 700° C. and maintained at that temperature for one hour, after which the heating current passing through

the furnace was left unchanged throughout the remainder of the experiment, and air was passed down the coke column at the rate of 50 litres an hour. The results obtained for three cokes named in the order of their reactivity to carbon dioxide—sodium carbonate coke, 'pure' coke, and beehive oven coke—indicate that the highest temperature effect in the interior of the mass has been attained with the least reactive coke for the reason explained, doubtless an important point in high-temperature melting by coke.

INDUSTRIAL AND DOMESTIC APPLICATIONS.

I should like now to say a few words on the influence of some properties of coke (particularly reactivity) when used for various purposes. The simplest case is perhaps that of the gas producer, in which coal is gasified by blowing with air or a mixture of air and steam. There is a first conversion of carbon to carbon dioxide by air quite near the grate of the producer at the bottom, but after that the gasification of the descending carbon is the result of the conversion of carbon dioxide to carbon monoxide by the reaction $C+CO_2=2CO$. The efficiency and rapid working of the producer depends upon this reaction, so that the coke which is more reactive to carbon dioxide is, other things being equal, the best for the process. This is a reproduction on the large scale of the laboratory experiment last described.

Another interesting example is the domestic fire, where so much depends on the relative ease of ignition and the rapid spreading of heat through the body of the fire. With a hard and unreactive coke it is difficult to carry the heat forward from piece to piece. If there is a little volatile matter left in the coke which comes away in flames, the heat transference is much more rapid. Or, if the coke for any reason is more reactive, the same advantages obtain. There are, however, limitations to the advantages obtainable in either of these ways. If the amount of volatile matter is too great, or if too much carbon monoxide is produced by excessive reactivity of the coke, there may be a twofold loss. In the first place, these gases may screen the solid coke from oxygen and so prevent that rise of temperature on the surface which is all important if a cheerful fire is to be obtained, or if the fire is to have a high radiant efficiency. The other detrimental effect is more important and depends upon the following phenomenon.

A bunsen flame burning in the open radiates only about 10 per cent. to 15 per cent. of its total heat of combustion, or rather more if the flame is luminous. If, however, the flame is used as in a modern gas-fire, to heat a solid radiating surface, the proportion radiated comes up to somewhere about 50 per cent. Consequently, in a coke fire, that portion of the combustion which is raising the temperature of the solid coke surface is being very much more efficiently utilised than in combustion of flames from the top of the fire burning in the open. Thus one may take it that if the amount of gas evolved is relatively small, so that it can burn in the fire, raising the temperature of the radiating surface of coke, it is very effective. But larger quantities of gas burning from the top of the fire are comparatively inefficient.

In experiments made at Leeds on the same fire, burning different solid fuels, this phenomenon was much in evidence on measuring the radiant efficiencies obtained from the fires. The experiments require extension, but I may say that the results were in accordance with the foregoing considerations, and agreed substantially with those of Dr. Margaret Fishenden of the Fuel Research Board, in that coke was found to give a higher radiant efficiency than coal. One striking result obtained, however, pointed to the necessity of not having present in the coal, ash of such a quantity and kind as to form a coherent coating during the burning, which thus formed a screen around the burning material and lowered its radiant efficiency.

Another very interesting point was the behaviour of a coke soaked in sodium carbonate solution, and therefore very reactive. It burned very freely, with visible flames a foot long. In appearance it was attractive. As a matter of fact, its radiant efficiency was not so high as that of the medium temperature coke, and that for the reason that I have explained. It reacted freely, generated carbon monoxide in quantity, the carbon monoxide burned with long flames at the top of the fire, and its radiant efficiency was correspondingly low—a defect due to the high reactivity of the coke.

Obituary.

PROF. A. A. LAWSON.

IT is little more than a month since the formal opening of the new Botanical Department in the University of Sydney was described in NATURE, with an illustration given of the building itself (April 2, p. 509). Before those who read it were able to formulate, much less to convey to Prof. Lawson their congratulations on this tangible mark of his successful tenure of his chair, he was in his grave, in the South Head Cemetery that looks out seawards over the entrance to Sydney Harbour. His death, following closely on a serious operation from the effects of which he never rallied, took place on Mar. 26 at Sydney.

Abercrombie Anstruther Lawson was born in Fife, and entered the University of Glasgow as a medical student. After passing through the course in elementary botany, where his artistic skill had already attracted attention, for reasons of health he went to California, and entered the University of Berkeley, coming under the influence of such teachers as Setchell and Osterhout. Graduating as Master of Science in 1898, he became instructor in botany, having already entered on a career of research. He also studied later in Chicago and at Bonn, with published results which led to his appointment as lecturer in his old University of Glasgow in 1907. Having held this position for

five years, he was appointed to the chair of botany in Sydney, where he not only secured the erection of a new Institute, the opening of which took place on Nov. 6, 1926, but he also built up a school of botany, with a large and growing body of students, and a highly creditable list of published researches.

Lawson's own published work falls into three groups, relating respectively to cytology, to the gametophyte of Gymnosperms, and to that of the Psilotaceæ. The first memoir on the pollen mother-cells of Cobæa formed the thesis for his degree. Already that delicacy of pencil craft was revealed which marks all his later work. Few microscopists have combined more effectively than he did refined cytological method with artistic skill. This was the first of a series of memoirs relating chiefly to meiosis, which were continued until 1912. They are characterised rather by faithful record of detail than by the establishment of new points of view. Armed thus with exact laboratory experience, he carried through a long series of observations of the gametophyte and propagative processes in the gymnosperms. These will stand as a permanent record of patient research, by an observer of high technical skill. They opened while he was still instructor at Berkeley: they were continued during the period of office in Glasgow, and later in Australia, where they related chiefly to local genera, such as Microcachrys and Pherosphæra. The last of this series was a particularly fine memoir on Bowenia, published in 1926, with eight plates (*Trans. Roy. Soc. Edin.*, vol. 54). At the time of his death, a further memoir on Macrozamia was already well advanced. His illustrations from the earlier of his memoirs on the Gymnosperms have been very widely absorbed into Lotsy's "Stammes-Geschichte," vol. 3. No one can in the future treat the Gymnosperms generally without frequent reference to the wide observational work of Lawson.

Lawson left his mark also in a third line of inquiry: in 1917 two memoirs appeared on the gametophytes of Psilotum and Tmesipteris, so long awaiting discovery. It is true that the ground has since been covered in greater detail for the latter by Holloway, and in particular in the embryology: but that need not detract from the exact delineation and description given of their gametophytes. Lawson had also wide interest in the Algæ. He had collected with Setchell on the Aleutian Islands and on the coast of California. He made a special journey to collect them on the Jamaican coast, and he was well posted in the British marine Algæ. But he appears never to have published upon them.

While it must be conceded that Lawson's work has been detailed and analytical rather than constructive, we should bear in mind that he was still a comparatively young man, and that the last twelve years have been devoted to the establishment and consolidation of a school of botany in Sydney. As they stand, his numerous memoirs have added substantially to the sum of positive knowledge. They may not have formed new patterns in the web of the science, but they have filled many of its blanks, not only with artistic effect, but also with honest and trustworthy records. It will be a pleasure to his friends to remember that the Royal Society of Edinburgh recognised the merit of his work, so largely published in its *Transactions*, by the award of the Makdougall-Brisbane Prize. A deeper satisfaction will be felt in the fact that the inclusion of his name in the recent list of selected candidates for fellowship of the Royal Society was published in time for him to have been aware of this high distinction, and to receive the congratulations of his many friends in Australia, though his death has occurred before the date of formal election. F. O. B.

Prof. Adolf Miethe.

Photographic science has suffered a great loss in the death, on May 5, of Regierungsrat Dr. Adolf Miethe, professor at the Technische Hochschule in Berlin-Charlottenburg. Prof. Miethe was born in Potsdam on April 25, 1862, and studied physics, astronomy, and chemistry in Berlin and Göttingen. After working with Prof. Hartnack in Potsdam, and then with Schulze and Bartels in Rathenow, he became director of Voigtländer und Sohn in Braunschweig, leaving this position in 1899 to become professor at Charlottenburg as successor to H. W. Vogel, the discoverer of the sensitising action of dyes on the photographic emulsion. According to the *Photographische Industrie*, Miethe was responsible for the teaching of scientific and practical photography in all its branches, photo-mechanical methods, spectral analysis, optics, and astronomy. He was also well versed in botany, mineralogy, and other subjects.

Miethe was the first to construct anastigmats, the name of which is due to him. He improved opera and field glasses, invented, with Gaedicke, magnesium flashlight photography, and introduced the isocyanine dyes as optical sensitisers for the photographic emulsion. It was due to his efforts that great advances were made in the three-colour collotype process. During the last year or two Miethe's name has been brought more prominently into general notice by his claim to have transformed mercury into gold, a claim which, however, has not been satisfactorily substantiated.

Miethe was prolific as a writer and was very successful in presenting scientific knowledge in such a form that it was readily understood by the general reader. Several books dealing with photographic subjects came from his pen.

We regret to announce the following deaths:

Mr. J. Barnard, formerly senior mathematical master at Christ's Hospital, both in London and after its removal to Horsham, aged seventy-six years.

Sir Sidney Colvin, formerly Slade professor and director of the Fitzwilliam Museum, Cambridge, and keeper of prints and drawings at the British Museum, on May 11, aged eighty-one years.

Dr. Maurice F. FitzGerald, emeritus professor of civil engineering in Queen's College, Belfast, on May 4, aged seventy-six years.

Prof. J. S. Nicholson, until recently professor of political economy in the University of Edinburgh, on May 11, aged seventy-six years.

News and Views.

THE first Conference representative of the Governments of the British Colonial Empire was opened in London by Mr. Amery, Secretary of State for the Colonies, on May 11. The speech in which Mr. Amery welcomed the delegates followed closely the lines of his address to the members of the Imperial Conference held last year. He dealt with the extent, resources, and trade of British undeveloped tropical and subtropical estates, and the diversity of problems, constitutional, economic, and cultural, and of the interest of every part of the Empire—including the self-governing Dominions—in the solution of those problems. There is, however, as he pointed out, very little structural or administrative unity to correspond with the unity of the problems and of the spirit in which they are approached. While the lack of co-ordination between the various parts of the Colonial Empire, their almost complete autonomy and self-sufficiency as regards their essential services is not altogether disadvantageous, yet it militates against the efficiency of those aspects of administration into which scientific method and scientific research enter, problems of agriculture, of veterinary science, of health, and of transport. In all these matters much closer co-operation and more effective interchange of information and ideas is needed, particularly of the trained and skilled personnel, who are the most effective agencies for the distribution and dissemination of such information and ideas. But, except for scientific research, Mr. Amery does not envisage a reconstruction of the services into large, all-embracing federal schemes, as he believes the end in view can be attained by the development of a system of consultation by conference.

WHILE not suggesting any marked departure from existing practice in connexion with the technical services, Mr. Amery advanced the view that the prosecution of scientific research is of such vital importance to the whole Empire that it can no longer be left to local governments to determine. The scientific worker must be given a career, a career in which the field of work is just as important as monetary reward; and it so happens that the Colonies which offer the greatest opportunities for research, the development of which is most dependent on the results of research, are the ones which can least afford to offer the salary or the career which will attract the best men. Moreover, it may be that the problems of research of importance to a particular Colony could be best solved in universities or higher research institutions; or the results obtained in one Colony may have almost universal application. Some of the Crown Colonies are now sufficiently aware of this fact to have made the suggestion that a Colonial Scientific Service should be created, a proposition which it is interesting to note was made twenty-five years ago by the Federated Malay States. If the official representatives of the various colonial governments are prepared to agree with the principle of a unified scientific service, at any rate in the higher research grades of scientific and technical work, they should be able, before they separate, to agree also on the means by which such a service could be made effective. The trouble is, however, that very few of the representatives at the Colonial Conference have much idea of what is meant by scientific research. They either expect far too much in return for expenditure on research or they are contemptuous of the whole subject.

THE new Electricity (Supply) Act has come into operation and the first scheme prepared by the Electricity Commissioners has been published (London: H.M. Stationery Office. 1*s*. net. Supplementary Particulars. 2*s*. 6*d*. net). It has been presented to the Central Board, and those interested will have opportunities of discussing it. The area selected covers most of the Scottish industrial area and includes Glasgow, Edinburgh, Dundee, and Dumbarton. Like most other engineering schemes it was necessary for the Commissioners to make estimates of the probable demand many years ahead, and we think that they have not been unduly sanguine. They have assumed that the output in Britain will double in about every eight years, and that at the end of 1941 about 450 units per head of the population will be consumed. This agrees fairly well with the 500 units given in the Weir report. Nearly 5000 square miles in central Scotland are covered by the scheme. Ten of the present generating stations have been selected as approved stations, but only six are definitely permanent. The ultimate fate of the other four depends on whether their directors are convinced that it is for their own good and the good of the main scheme that they should give up their status as selected stations. A heavy item in the cost is due to standardising the frequency of the alternating current supply. In the case of the Glasgow and Clyde Valley systems the gross cost of standardisation is estimated at about three and a half million pounds. If we are to get the full benefit of a national scheme, however, it is advisable to standardise at the earliest possible moment. The standard voltage for the 'grid' transmission network has been fixed at 132,000 volts, and the secondary transmission lines will operate at 33,000 volts. The power to be transmitted by a main line is not to be less than 50,000 kilowatts. Ring mains will be used, so that in the event of a breakdown at one point of supply the transmission at all the other points of supply is unaffected. The scheme seems to have been well thought out and should prove to be satisfactory.

THE regretted death of Prof. A. A. Lawson, who was recommended for election into the Royal Society this year, left a vacancy in the number of new fellows, and this was filled by the election on May 12 of George Claridge Druce, M.A. (Oxon), D.Sc., Hon. LL.D. (St. Andrews), Fielding Curator in the University of Oxford. Dr. Druce is distinguished for his numerous contributions to systematic botany, and for his series of County floras (Oxfordshire, Berkshire,

Northamptonshire, Zetlandia, West Ross-shire, &c.). He has discovered and described numerous plants, many of which bear his name. The Fielding Herbarium at Oxford owes much of its present importance to his devoted (and all but honorary) curatorship. He has rendered national service in stimulating and practically promoting the study of field botany among all classes of the community.

THE two hundredth and twentieth anniversary of the birth of Carl Linnæus, the naturalist, occurs on May 23. Born in 1707 at Råshult, in Sweden, he died on Jan. 10, 1778. His father, the rector of the parish, sent his son in the first instance to the University of Lund; afterwards he entered the University of Upsala to study medicine. When twenty-five years old, the Royal Academy of Sciences of that city encouraged Linnæus to make a journey to Lapland in the interests of natural science. At an early age he completed many important works. For example, there appeared his "Systema Naturæ" (1735), "Flora Lapponica" (1737), and "Genera Plantarum" (1737). As is well known, Linnæus' extensive collections of plants, insects, shells, and minerals, as well as his library and numerous precious manuscripts, passed into the keeping of the Linnean Society of London. In 1753, Gustavus, King of Sweden, created him a Knight of the Polar Star. By royal command a profile model in wax of Linnæus was made by Inlander in 1773. In this appears a sprig of the flowering plant *Linnæa borealis*. It is interesting in this connexion to mention that in a minute book of the Linnean Society, under date June 2, 1795, this little plant is recorded as discovered for the first time in Britain by Prof. James Beattie, of Marischal College, Aberdeen, in an old fir wood at Mearns, near Aberdeen.

THE Physiological Society celebrated its jubilee by a dinner at the Hotel Metropole on Friday, May 13. The Society was founded in 1876, and its jubilee was in 1926, but owing to the amount of business resulting from the purchase of the *Journal of Physiology* from Mrs. Langley, it was not possible to arrange for the celebration in that year. The four surviving original members of the Society are: Sir David Ferrier, Sir E. Ray Lankester, Sir W. Thiselton-Dyer, and Sir E. Sharpey-Schafer, who presided at the dinner. The toast of the Society was proposed by Major Elliot, Parliamentary Under-Secretary for Health for Scotland, who pointed out the practical benefits that had been obtained as the result of physiological research. The chairman, Sir E. Sharpey-Schafer, in his reply, described how the Society was founded as a dining club to defend the members against the attacks of the anti-vivisection societies, and it thus represented the only good that had resulted from the anti-vivisection agitation. Later in the history of the Society it became customary to visit one laboratory or another before the dinner, to see demonstrations of work in progress. The development of the Society is shown by the present practice, namely, that demonstrations have precedence over other communications, and that all business, except that of a special general meeting summoned for some specific purpose, is transacted after the dinner which is held with most meetings of the Society.

SIR CHARLES SHERRINGTON proposed the toast of the guests, with which was associated the names of Sir Ernest Rutherford, Prof. G. Fano, of Rome, Prof. Gley, of Paris, and Viscount Knutsford. Sir Ernest Rutherford pointed out the relation between physics and physiology, in which a physical instrument was perfected for some special recording device such as the Einthoven string galvanometer, and was afterwards used in physical laboratories because of its delicacy and accuracy. He recommended a training in physics as a preliminary to research in physiology. Prof. Fano made a delightful congratulatory speech in English, and Prof. Gley conveyed the best wishes of his French colleagues in a stirring address in French. Viscount Knutsford referred particularly to the gain to humanity by Schafer's method of artificial respiration, and to the Research Defence Society, which does its best to educate the intelligent public as to the benefits obtained from experiments on animals. He suggested that physiologists ought to do their share by joining that Society, by furnishing accurate information, and by speaking on the subject. Pro. Leonard Hill proposed a vote of thanks to the chairman, who, he pointed out, had sent apostles to Ireland, Canada, Australia, New Zealand, South Africa, United States, China, and many other parts of the world to promulgate the doctrines of physiology. On Saturday, May 14, there was an ordinary meeting of the Society in Cambridge, with the business dinner meeting in Trinity College. On Sunday, Prof. and Mrs. Barcroft gave a garden party in the fellows' garden of King's College, kindly lent by the provost and fellows of the College.

THE Admiralty announces in Fleet Orders that the recommendations of the International Conference held at Washington last year in connexion with oil pollution of navigable waters have been accepted in principle by the Government, and that the main recommendation, that oil should not be discharged within 50 miles of the coast, is being voluntarily adopted by British shipowners. This step will be welcomed by bird lovers and residents on the coast, where oil on the water and clinging to weeds and stones in the intertidal zone does increasing harm to the birds and to the amenities of the seashore. Among other provisions of the Convention—which takes effect as soon as the ratifications of five of the Governments represented at the Washington Conference of June 1926 have been notified to the United States Government—is that no dues based on tonnage are to be charged in respect of any space rendered unavailable for cargo by the installation of apparatus for separating oil from water. Upon the perfection and general adoption of such apparatus, a considerable amelioration of existing conditions may be expected.

THE woods of Glencoin and Stybarrow, which overlook the head of Ullswater, are threatened with the axe. Energetic local action has been able to stay the danger pending the result of an appeal for funds to

purchase the property. The public has responded generously, but approximately £600 is still required to make up the agreed sum, and the option expires on June 30. If the money be not raised by that time all the trees will be felled this autumn, to the grave loss of the amenity of the district, a recognised beauty spot in the Lake Country. If the purchase money be raised, the land and trees, comprising an area of 180 acres, will be presented to the National Trust or some similar body. The Committee makes a final appeal, which we endorse, for immediate contributions to meet the relatively small amount still outstanding; any donation will be gratefully received by the Hon. Treasurer, Mr. H. T. Roberts, Hawkhowe, Ullswater, Penrith.

A NEW annual archæological publication, to be entitled "Vestigia, or The Year's Archæology in Pictures," is announced. It will contain a comprehensive selection of photographic reproductions of discoveries made throughout the world in the course of each year. The first part will cover the year ending June 30, 1927. The contents will be entirely pictorial except for a general introduction by Mr. Stanley Casson. The Trustees of the British Museum have already granted a licence to reproduce illustrations relating to the expeditions under their control for a period of five years, and similar arrangements are being made in respect of the other more important excavations now being carried on elsewhere. The publishers are "European Books, Ltd.," Henrietta Street, London, W.C.2.

THE American Geophysical Union held its eighth annual meeting this year on April 28 and 29 at Washington. The programmes of the six sections were of considerable interest, and the report of the meetings should prove valuable and attractive. The sections of geodesy, and of terrestrial magnetism and electricity, occupied the first morning; the former was concerned with progress reports on geodesy in the United States and Canada, and discussions of world-longitude nets and variations of mean sea-level; the latter section discussed correlations of various radio phenomena with solar and terrestrial magnetic and electric activities. The first afternoon was devoted to the sections of oceanography and volcanology; the problems discussed by the latter range from the United States and Japan to the moon. On the following morning the section of meteorology held a discussion on measurements of the sun's ultra-violet radiation and of the ozone content of the upper atmosphere, while the section of seismology considered progress reports from various institutions, and some theoretical and instrumental problems. On the last afternoon the general assembly held a symposium on some factors of climatic control. The Union also arranged a week's exhibition of apparatus and other material bearing on geophysical research.

SILICA valves are now used by the Admiralty for radio communication. Silica has many properties which render it particularly useful in this connexion. It does not soften until its temperature attains about 1600° C. and it has a low coefficient of thermal expansion. The silica envelope is very diathermanous to the radiation from a red-hot anode, and so cooling by radiation can be adopted. This type of valve was discussed in a paper read on May 4 to the Institution of Electrical Engineers by H. Morris-Airey, G. Shearing, and H. G. Hughes. They pointed out that a most important constituent of the valve is the seal through which electrical contact is made between the electrodes and the external connexions. In the manufacture of the seal, lead is melted *in vacuo* in a thick walled silica tube. When this is done, it is found that the molten metal adheres firmly to the silica, forming a vacuum tight joint. As large currents are used when the tube is working, overheating is prevented by blowers supplying cool air continually to the seals. When valves are supplied with 15 kilowatts or more of electrical power, circulatory methods of cooling are adopted to prevent the radio office getting overheated. The heat energy from the anode is radiated through the silica envelope to a jacket containing a cooling fluid which is kept circulating by a pump. In internal cooling, the anode is made in tubular form and the cooling fluid is forced through the tube. This latter type of valve is still in the experimental stage; it has, however, many advantages. For example, a 4 kw. molybdenum anode has been used experimentally as a 40 kw. tubular spiral anode. Under working conditions, ninety per cent. of the failures of silica valves are due to a burn-out of the filament.

BEFORE broadcasting was introduced in Great Britain, many British radio amateurs used to listen to the Dutch broadcasting station at The Hague. Last March the radio station of the Philips' lamp laboratories at Eindhoven in Holland were in telephonic radio communication with Bandoeng in the Dutch East Indies. This development was made possible by using a short wave-length of 30 metres. In April the radio station at Sydney re-broadcast one of the Philips' programmes. Holland therefore is to be congratulated as the pioneer of long-distance broadcasting on short wave-lengths. The *Wireless World* for April 27 discusses the feasibility of Empire broadcasting. It seems certain that a short-wave British station of sufficient power to be heard for many hours a day throughout the British Empire could be built at no great expense. News could be broadcast and possibly Daventry programmes relayed at fixed times. This would perhaps be outside the scope of the B.B.C. and would have to be under the control of the Foreign Office and the Colonial Office. It would be a boon to many who have to live in lonely parts of the earth.

ON Friday, May 6, Air-Marshal Sir John Salmond unveiled at Cambridge a tablet to the memory of three pioneers in the application of scientific methods to aeronautical problems. Prof. Bertram Hopkinson, Dr. Keith Lucas, and Mr. Edward T. Busk all devoted great natural ability and mechanical inventiveness to the subject before they gave up their lives in their country's service. Bertram Hopkinson, professor of engineering and fellow of King's College, learnt to fly

when more than forty years of age, that he might the better understand the problems connected with the bombs, bomb-gear, and aeroplane guns with which he was confronted in the Technical Department of the Air Ministry. Keith Lucas, fellow of Trinity College, one of the most brilliant young physiologists of his day, had made considerable progress in the development of air compasses when a collision in the air cut short a career of great promise. Edward Busk had already made notable contributions to the solution of the problem of the stability of aeroplanes, when in the very early days of the War he was killed when flying at Farnborough through his machine catching fire. It is well that their devotion and zeal should be commemorated in the headquarters of the Cambridge University Air Squadron, so that future generations may share in some slight way the admiration and high regard which their Cambridge contemporaries feel for them.

SIR HENRY A. MIERS delivered the seventeenth annual May Lecture before the Institute of Metals on Wednesday, May 11, taking as his subject, "Growth of Crystals." Sir Henry recalled experiments made twenty years ago by himself and Miss Isaac which seemed at that time to show that when a solution is cooled below its saturation temperature it passes into a 'metastable' state in which crystals can only be produced by introducing a fragment of the dissolved substance or of one isomorphous with it, and that at a lower temperature it passes into a 'labile' state in which crystals may appear spontaneously. Later investigations have shown that, in the metastable state, crystallisation can also be produced by shock. Sir Henry considers, however, that his experiments record the normal behaviour of crystallising liquids, and that crystallisation only takes place with some degree of supersaturation or undercooling. In his experiments there was always a sudden outburst of crystal growth at a definite temperature. Little importance is ascribed to undercooling by most geologists in their speculations concerning the crystallisation of molten magmas, but to many metallurgists it is a very important factor. The structure of alloys is in many cases attributed to a suspended crystallisation of this nature; not only as they solidify from the molten state, but also during the crystalline changes which take place in the solid alloy with change of temperature, for example in steel and in magnetic alloys.

A LONDON meeting of the Prehistoric Society of East Anglia, under the presidency of Dr. R. R. Marett, will be held at the rooms of the Royal Anthropological Institute, by permission of the Council, on Tuesday, May 24, at 2.30 P.M. A number of papers will be presented and interesting exhibits shown. Mr. J. E. Sainty will report on the discovery of St. Acheul palæoliths at Whitlingham, Norwich, and Mr. Reid Moir will present a summary report on his recent investigations at Hoxne, Suffolk, where he has been excavating with the view of throwing further light on the problems of the boulder clay and its relation to types of palæolithic implements. An account of the 1926–27 excavations at Kent's Cavern, Torquay, will be given by Mr. H. S. Dowie. Miss Layard will exhibit microlithic flint implements from the Colne Valley, Essex, and implements in *grès lustré* from the Forêt de Montmorency. Mr. S. Turner will show exhibits from a late palæolithic site at Stone Cross Farm, Luton, Kent. In the evening the members have been invited to attend a meeting and conversazione of the Royal Anthropological Institute which will be held at the Wellcome Historical Medical Museum, by kind invitation of Mr. Henry S. Wellcome, when Prof. G. Elliot Smith will deliver a short discourse on the medical and magical aspects of the anthropological material in the Museum, and fellows and guests will be invited to inspect the collection.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Friday, June 3, when the Observatory will be open to inspection by invited guests at 3.30 P.M.

THE Rev. T. E. R. Phillips, president of the Royal Astronomical Society, will deliver a lantern lecture on the coming solar eclipse, on May 27 at 8 P.M., at the Polytechnic, 309 Regent Street, London. The lecture is in aid of King Edward's Hospital Fund for London.

AT the annual meeting of the Institute of Physics on May 16, the following officers were elected: *President*, Sir Frank Dyson; *Vice-Presidents*, Prof. C. L. Fortescue, Sir Richard Gregory, Mr. R. W. Paul, Mr. R. S. Whipple; *Hon. Treasurer*, Major C. E. S. Phillips; *Hon. Secretary*, Prof. A. O. Rankine.

THE Prime Minister, Mr. Baldwin, showed his interest in optical work, and the importance he attached to the progress of the British optical industry, when he opened the very successful Optical Convention which was held in London in April of last year. The scientific work accomplished at the Convention has proved to be of wide interest and importance and has been recorded in the *Proceedings*, two substantial volumes running to more than a thousand pages. More than half of the edition originally printed has already been exhausted. Any inquiries with regard to the Convention and its publications should be addressed to the Secretary, The Optical Convention, 1926, 1 Lowther Gardens, Exhibition Road, London, S.W.7.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer in the mathematics and physics department of the Polytechnic, Regent Street, W.—The Director of Education, The Polytechnic, 309 Regent Street, W.1 (May 30). A head of the electrical engineering department of Robert Gordon's Colleges, Aberdeen—The Secretary and Registrar (May 31). A head of the building trades department of the Wigan and District Mining and Technical College—The Secretary of the College (May 31). A director of the Leeds Art Gallery—The Town Clerk, 26 Great George Street, Leeds (June 1). A surveyor of shipping under the Corporation of Trinity House—The Secretary, Trinity House, Tower Hill, E.C.3 (June 1).

A head of the mechanical engineering department, a head of the electrical engineering department, and a graduate assistant in the mechanical engineering department of the Rutherford Technical College—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (June 3). A biochemist, a soil chemist, and a plant physiologist at the University of Bristol Department of Agricultural and Horticultural Research, Long Ashton, Bristol—The Registrar (June 4). An assistant lecturer in the Commerce Department of the Belfast Municipal College of Technology—The Principal of the College (June 9). A principal of Battersea Polytechnic, and a woman head of the Department of Hygiene and Public Health—(1) The Clerk to the Governing Body, (2) The Principal (June 13). The Bernhard Baron research studentship at the Middlesex Hospital on the anatomy, physiology or pathology of the ear, nose and throat—The Secretary of the Middlesex Hospital, W.1 (June 14). A professor of botany in the University of Sydney, N.S.W.—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (June 24). A lecturer in medieval history in the Queen's University, Belfast—The Secretary, Queen's University, Belfast (June 27). A biochemist, an assistant plant physiologist, and an assistant pomologist at the East Malling Research Station—The Secretary, East Malling Research Station, East Malling, Kent (June 30). Test assistants at the Royal Aircraft Establishment, South Farnborough, Hants (quoting A. 174). An assistant in the building trades department of the Halifax Municipal Technical College—The Principal, Municipal Technical College, Halifax. A senior physics master at Merchant Taylors' School, Crosby, Liverpool — The Head Master. Temporary Instructor Lieutenants in the Royal Navy — The Adviser on Education, Admiralty, Whitehall, S.W.1. A junior assistant chemist under the directorate of explosives research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

ERRATUM.—At the end of Prof. Fritz Paneth's letter in NATURE of May 14, p. 706, on "The Transmutation of Hydrogen into Helium," for the date "Mar. 2" read "April 2."

Our Astronomical Column.

COMETS.—Comet Pons-Winnecke was an easy object for small telescopes early in May: both Dr. W. H. Steavenson and Mr. B. M. Peek noted a nearly stellar nucleus and a considerable coma. As the comet is steadily approaching both sun and earth, it should by now be quite conspicuous, but it is well to remember that while the position of comets can be predicted, their brightness is subject to capricious variations.

Dr. A. C. D. Crommelin has revised the orbit elements from observations on Feb. 25 and May 1 (by Merton), Mar. 4 (by van Biesbroeck). The period was assumed known; the other elements are:

T	1927 June 21·0730 U.T.	
ω	170° 17′ 15·3″	1927·0
Ω	98 12 34·0	
i	18 56 43·2	
ϕ	43 16 22·4	
log a	0·5192415 (assumed)	
log q	0·0168982	

Comet Grigg-Skjellerup is not likely to be so bright as Pons-Winnecke, but it is coming near the earth, so should be fairly easy to see. Its distance on June 3 is 19 million miles. Observations of position are desired.

H. Thiele has deduced elliptical elements of Stearns's comet, with a period of 9515 years, but departure from a parabola is not yet certain:

T	1927 Mar. 20·02161 U.T.	
ω	10° 36′ 11·5″	1927·0
Ω	214 35 43·2	
i	87 32 21·0	
log q	0·565875	
e	0·991805	

Observations used were on Mar. 13, 26, April 5. It is fading slowly, but is still a fairly easy object.

Comet Comas Sola is getting rather low in the evening sky, but should be followed for as long as possible.

Ephemerides of these comets for 0^h follow; that of Pons-Winnecke is from earlier elements and will need some correction:

Comet.	Date.	R.A.	N. Decl.	log r.	log Δ.
Pons-Winnecke	May 20	15^h 9^m 20^s	53° 16′	0·0532	9·4648
	28	15 21 0	54 26	0·0383	9·3716
	June 1	15 29 40	54 50	0·0320	9·3147
	5	15 42 8	55 1	0·0268	9·2485
	9	16 0 4	54 59	0·0225	9·1688
	13	16 27 28	54 19	0·0195	9·0712
Grigg-Skjellerup	May 20	7 58 5	31 33		9·3957
	22	8 9 53	35 6	9·9591	9·3757
	24	8 23 34	38 54		9·3572
	26	8 39 39	42 54	9·9656	9·3409
	28	8 58 49	47 0		9·3272
	30	9 21 55	51 6	9·9736	9·3171
	June 1	9 50 2	55 0		9·3106
	3	10 24 5	58 30	9·9820	9·3080
	5	11 4 34	61 20		9·3095
Stearns	May 23	14 19 47	17 48	0·5715	0·4680
	31	14 13 31	19 32	0·5728	0·4820
	June 8	14 8 17	20 57	0·5743	0·4976
	16	14 4 11	22 5	0·5760	0·5139
Comas Sola	May 24	7 36 20	31 57	0·2730	0·3741
	June 1	7 59 32	31 4	0·2790	0·3873
	9	8 22 16	29 52	0·2855	0·4004

RECENT SUNSPOT ACTIVITY.—A large group of sunspots, recently in transit across part of the sun's disc, was the first to be seen with the naked eye since last January. In the interval of four months a number of smaller groups have been seen, averaging at least six daily, but there has been a noticeable absence of very large spots which are usually fairly frequent at this time of the solar cycle. The recent group, consisting of a pair of large, roughly circular spots, began as a tiny spot seen on May 9, and its rapid growth is well shown by the following measures of area, in units of millionths of the sun's hemisphere, made at intervals of approximately 24 hours:

Date	May 9	10	11	12	13	14
Area	5	150	380	870	1000	1350

One interesting feature of the group was the invariable distance apart, 6° in longitude, preserved by the two spots; in the majority of such groups the early rapid growth is associated with a considerable drifting apart of the two chief components, so that at maximum development they are separated by at least 10° in longitude. Other details of this group are given below in the usual manner:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
4	May 9-17	May 11·7	17° N.	1/800 of hemisphere.

Research Items.

THE PICTORIAL RECORDS OF DAHOMEY.—The Institut d'Ethnologie of Paris has inaugurated a series of publications of its own, to be known by the general title of "Travaux et Mémoirs," with two volumes dealing with primitive art. Of these the first, by M. E. M. G. Waterlot, is a description, fully illustrated, of the bas-reliefs of the royal buildings of Abomey (Dahomey). The interest of these polychrome bas-reliefs is dependent not only on their æsthetic qualities but also on the fact that they are historical records of achievements of the king in whose reign they were executed, or of events which took place in that reign. The occurrence in Africa of historical documents of this type, of undoubted authenticity, is a matter of very considerable interest to ethnologists. The drawings here described, of which reproductions have been made for the Musée d'Ethnographie de Paris, are taken from the palace of Agadja (1708-28), of Ghezo (1818-38), and Glélé (1838-1889). As the country over which they ruled had been conquered by their people in the early seventeenth century, and was held by force of arms, these pictorial records not unnaturally deal mainly with their struggles with neighbouring peoples and the punishments meted out to the vanquished. In addition are religious symbols, records of notable dicta of the kings, or allegorical representations of the kings themselves. They are found only on the walls of the private apartments of the kings; they were not found in other parts of the palaces, even in those portions reserved for the mothers of the kings or their representatives, or for the old women to whom was entrusted the guardianship of the tombs of the kings and of the sacred objects of the tribe.

NEW CALEDONIAN ART.—The second of the *Mémoirs et Travaux de l'Institut d'Ethnologie*, Paris, is a study of New Caledonian art by M. G. H. Luquet, based to a great extent upon material collected by Marius Archambauld. M. Luquet, whose studies of prehistoric and primitive art have won him a position as a recognised authority, has analysed the material from the viewpoint of an æsthetic critic and psychologist. After a detailed examination of the specimens and a classification of the motives found in both the petroglyphs and the engravings on wood or bamboo, he concludes that the characteristic feature of the petroglyphic art is not so much the cross in its various forms, as was thought by Archambauld, as the representation of the stylised human form and especially the human face. Nor is he able to agree with Archambauld that the petroglyphs represent the art of a vanished race. They are merely one manifestation, the earliest, of what is essentially a single artistic activity with identical motives, identical spirit, the same tendencies, and the same æsthetic surviving even down to the present day, given certain modifications due to difference in material, and changes in objects represented on the introduction of European civilisation. The proportion of engravings with a religious motive is probably small. The strongest impulse to artistic representation is probably purely æsthetic, with a strong tendency to intentional stylisation, rather than the result of a schematisation due to repeated or careless reproduction of a motive originally realistic. New Caledonian art would appear to afford no support to the view that naturalistic art belongs to hunting peoples, while schematic art is the product of an agricultural mode of life.

VITALITY OF YOUNG ANIMALS.—Mr. E. L. W. Heck, of Cambridge, Mass., in a letter to NATURE, states that in certain experiments relating to the educability of the albino rat, rats from the age of 21 days are trained to avoid an electric shock. During the first two or three days of training the shock seems to have very little effect upon them, but thereafter its effects become progressively more pronounced, so that after two weeks have passed it is not uncommon for the rats to be killed by the shock. For this reason it was found that the greatest care had to be exercised during the fourth and final week of training. These observations, if confirmed, are of interest, since they are opposed to the general conclusions reached by Child, whose experimentation showed quite clearly that with reference to narcotics generally, young animals beyond a certain stage of growth show the highest susceptibility, and that this susceptibility decreases with advancing development. The swing in the degree of susceptibility is related to a change in metabolism from a higher to a lower level.

THE DISTRIBUTION OF ANOPHELINE MOSQUITOES IN SCOTLAND.—In the *Proceedings of the Royal Society of Edinburgh*, vol. 47, Part I. (No. 6), 1927, Prof. J. H. Ashworth discusses this subject and provides some new records. In Scotland the available evidence indicates that *Anopheles bifurcatus* is the most abundant and widespread species, whereas in England *A. maculipennis* predominates. So far, the latter species has been met with only in four localities in the Highlands, while *A. plumbeus* occurs over a considerable portion of the eastern coastal region of Scotland. Details of the only case of indigenous malaria in Scotland since that disease became compulsorily notifiable in 1919, are quoted from the Report for 1919 of the Medical Officer of Health for Glasgow. A woman patient suffering from malaria had resided at Kirriemuir (Forfarshire) at a time when troops were present, and it is surmised that she was bitten by a mosquito which had acquired the malaria plasmodium from an infected soldier. The results presented in this paper constitute data for commencing a survey for Anopheles in Scotland, and the paucity of records of the genus in that country is merely an indication of the small amount of attention that the subject has yet received. It is noteworthy that such records as do exist tend to congregate where observant collectors reside, namely, around Edinburgh and Glasgow.

THE SHOT-HOLE BORER OF TEA.—The Shot-hole Borer (*Xyleborus fornicatus*) has been considered one of the worst pests of tea in Ceylon for the past twenty years. During the last half of this period almost every possible control method has been examined and various recommendations have been made, but without the desired result being achieved. In Bulletin No. 78 of the Department of Agriculture, Ceylon, Messrs. F. P. Jepson and C. H. Gadd discuss manuring in relation to the control of this insect. In Part 1 of this Bulletin (by Mr. Jepson) it is stated that some measure of relief from the depredations of the Shot-hole Borer might be expected from the adoption of special cultural methods and the utilisation of natural enemies. It is with the first method that this Bulletin is concerned, and extensive experiments were set up in order to ascertain the relative values of nitrogen, potash, phosphoric acid, and lime in the control of the pest in question. The interpretation of the results of these trials form Part 2 of the Bulletin (by Mr. Gadd). It appears that none of the treatments exercised any direct effect on the beetles, and the main benefit derived from the application of manure was the accelerated healing of the galleries bored by the insects in the tea plants.

The healing was most marked in the plots treated with nitrogenous manures, this process being complete in 2·9 months, whereas in the control plot healing was not complete until after 3·75 months. It is concluded that the manuring of tea offers a satisfactory method of diminishing the effects of attack by the Shot-hole Borer. Manuring for this purpose should aim at increasing the nitrogenous content of the soil.

COPPER DUSTS AND SPRAYS FOR POTATOES.—The results of trials undertaken to determine the relative efficiency of certain copper dusts and sprays in the control of potato diseases and insect pests are published by O. C. Boyd in Bulletin 451 of the Cornell University Agricultural Experiment Station. With light applications it was found that Bordeaux spray mixture covered a larger area than copper-lime dust containing equivalent copper per unit area, owing to the greater number and surface area of the spray membranes. Retention of the copper also was considerably greater on the sprayed than on the dusted foliage, though the dust adhered better if the potato foliage was thoroughly moistened, and consequently the effectiveness of the dust in disease and insect control was thereby improved. The use of Kayso, a casein spreader, did not increase the adhesiveness of either copper-lime dust or two Bordeaux powders, but it effectively increased the spreading powers of the spray. As regards disease and insect pests, under good working conditions, early and late blight and aphid attack were equally well controlled by copper-lime dust or Bordeaux spray mixture containing equivalent copper, though the spray proved superior in the case of flea beetles, leaf-hoppers, and tipburn. The addition of nicotine to the copper-lime dust increased the effectiveness of this substance against aphids, but an addition of sulphur was useless. Leaf injury resembling that induced by spraying blue vitriol on dry foliage occurred with copper-lime dusts containing 10 per cent. or more copper; lower quantities, however, were not harmful. Heavy applications, whether as dust or spray, were deleterious to plant growth apart from local leaf injury, and mechanical damage by machinery was to some extent unavoidable. The preference seems to be for the use of sprays rather than dusts, the average plant yield on sprayed plots being higher than that of dusted ones, and further, the cost of spraying was slightly less than that incurred with home-mixed copper-lime, and considerably less than when commercial dusts were employed.

PHYTOGEOGRAPHY OF GREENLAND.—C. H. Ostenfeld has added two more papers to his list of publications on the vegetation of Greenland (*Saertryk af Meddelelsar om Grønland*, 68, and *Det. Kgl. Danske Videnskabernes Selskab., Biologiske Meddelelser* 6, 3, 1926). The former memoirs dealt for the most part with the floras of specific localities in Greenland; the two papers just issued now collate and focus the results of the author's several years' investigations and give a comprehensive survey of the whole problem. The immigration of the flora of Greenland has been the subject of discussion by many authors, including such eminent workers as Hooker and Warming, but the knowledge and experience of Dr. Ostenfeld in the field of phytogeography in general and in that of the Arctic and sub-Arctic regions in particular, make his conclusions of a high degree of importance. The author's 15 phytogeographical districts are populated by 390 species of vascular crytogams and phanerogams, falling into three categories, high Arctic, Arctic, and sub-Arctic to boreal. He considers about sixty species as having survived from pre-glacial times somewhere in Greenland, and this may account for the occurrence of some of these species in Arctic countries of both the eastern and western hemispheres. Of the remaining species he comes to the conclusion that 74 are immigrants from Europe, the majority having been introduced by Norse settlers not more than nine hundred years ago. The other 256 species must be regarded as having come from America. In this connexion, among immigration routes, special attention is directed to the narrow Smith Sound and Kennedy Channel route to the north-west. On account of the fact that a post-glacial heat maximum existed, this route could have been followed by more southerly species than at the present day. Mention is also made of immigration from the north-east with the drift ice of the polar current. For the rest, immigration must have been effected by wind and birds carrying seeds across the sea. Special importance probably attaches to the action of the wind in winter, when seeds and portions of plants can be swept along over the frozen straits before the storm. It is considered unnecessary to assume any post-glacial land connexions to the west and east.

DESTRUCTION OF ICEBERGS.—Some interesting records of the effect of the application of high temperatures on icebergs are to be found in an article by Prof. H. T. Barnes in the *Marine Observer* for May. The rapid destruction of icebergs is best effected by the production of an internal disruptive force. In order to produce this force Prof. Barnes used thermit as the explosive, by which a very high temperature can be produced at a selected spot. His experiments were carried out in Notre Dame Bay, Newfoundland, on drifting bergs. One berg was about 100 feet above the water line and 500 feet long by as many wide. The berg appeared to be solid and fresh. A hundred pound charge was let into the ice in a 3-feet boring. The immediate effect of the explosion was much audible cracking and some visible disruption, but it was not until the next day, and the day following, that the full effect of the disruption was visible. Photographs show that within two days the berg, though still formidable, had been very much reduced in size. A smaller berg, about a hundred feet in diameter, was practically destroyed within twenty-four hours by the use of two charges of thermit fired simultaneously.

TECTONICS AND PETROGENESIS.—The attention of petrologists is directed to an important monograph by Prof. W. N. Benson on "The Tectonic Conditions accompanying the Intrusion of Basic and Ultrabasic Igneous Rocks," which is published in the *Mem. Nat. Acad. Sci.*, vol. 19, No. 1, 1926. A world survey of the rocks concerned is made and a provisional tectonico-petrographic classification is suggested. The suites or kindreds that are recognised include the following: the *green rocks* of the Alpine type associated with planes of shearing in former geosynclinal zones; the *spilites* formed on the margin of geosynclines; *laccomorphic complexes* such as those of Sudbury and the Bushveld in which there is no dominating lateral pressure; *cordilleran complexes* in which lateral pressure is a controlling factor; the *dolerite sills*, a uniform group invading broad areas of approximately horizontal strata; the *alkaline plateau group* in regions of vertical block-faulting; and the *alkaline peridotite* dykes related tectonically to the last-mentioned suite. It is concluded that each suite is very generally associated with a definite set of tectonic conditions, and the importance of the latter in determining the morphology of igneous masses and in controlling the processes of magmatic differentiation is emphasised.

PETROLEUM IN PERSIA.—In January last, at a meeting of the Royal Society of Arts, Sir John Cadman gave an interesting account of the development of the petroleum industry in Persia (*Jour. Roy. Soc. Arts.*). So far back as 1872 de Reuter endeavoured to locate oil in that country, but without success; there followed the activities, in the early 'nineties, of the Persian Mining Corporation, which sank two wells at Daliki, not far from Bushire, in the neighbourhood of an oil seepage, but this also proved abortive. W. K. D'Arcy, with whom the beginnings of the Persian oil industry will always be associated, started operations in 1901 and acquired from the Persian Government a concession which covered the greater part of southern Persia; early efforts to locate a commercial store of oil were most discouraging, and it was not until 1908 that the great Persian field was first proved by the bringing-in of a gusher at Masjid-i-Sulaiman, a valley in the Bakhtiari Hills, some hundred and fifty miles from the head-waters of the Persian Gulf. The formation of the Anglo-Persian Oil Company came about in the following year, since when the remarkable development of this great oilfield is a matter of common knowledge. To-day Persia occupies fourth place on the list of oil-producing countries, having an annual output of more than 4,500,000 tons; the proven area of the field is great, in length more than twenty miles, but there is still much unproven and potentially good territory. From the small initial staff (scarcely a score in number) responsible for early developments, the personnel has now swollen to literally a multitude, more than 1000 Europeans, 3000 Indians, and 25,000 Persians being employed. This in itself conveys some idea of the magnitude of operations of the Company in Persia and of the rapid growth of a great industry.

TEETH OF CRETACEOUS MAMMALS.—In the March issue of the *Scientific Monthly*, Prof. W. K. Gregory has published a further account of the very important Cretaceous mammals found in Mongolia by the expedition of the American Museum of Natural History. The article is semi-popular and is of general interest. There are good illustrations of the locality where the finds occur and figures and diagrams of the specimens. For the specialist, the chief interest is in the clear explanation and diagrams of the author's view as to the evolution of the teeth. The old Cope-Osborn tritubercular theory becomes considerably modified in that the 'protocone,' which was thought at one time to represent the original reptilian cone, is now shown to be a secondary cusp. The original single cusp is shown to divide into the paracone and metacone, and the tritubercular tooth is formed not by a rotation of secondary cusps anterior and posterior to the central one, but by a growth inwards from the divided chief cone of a spur on which the so-called 'protocone' arises.

THE SPECIFIC HEAT OF HYDROGEN.—Dr. F. Hund's second paper on the significance of band spectra (*Zeitschrift für Physik*, 42, p. 93, 1927) deals in addition with the closely allied problem of the specific heat of hydrogen between the high temperature region where both rotation and translation occur, and the low temperature region where the former is practically absent. The relative statistical weights of the members of either odd or even rotational quantum levels can be predicted from theory, but there is no correlation between odd and even terms. Comparison of theory with experiment is rendered difficult because the moment of inertia of the molecule is also unknown. The form of the specific heat-temperature curve can, however, be predicted if even terms are assumed to be an arbitrary factor (f) times as frequent as odd terms, and the position of the curve can then be fixed by choosing a moment of inertia so that the empirical and theoretical values of the specific heat are the same at the convenient temperature of $-77°$ C. The factor f is then found by observing which of the theoretical curves agrees best with the experimental measurements. The most concordant results are obtained with f equal to 2, but it is not possible to specify it exactly. The moment of inertia can nevertheless be determined fairly closely, and would only have to be increased by 10 per cent. if even rotational terms were three times as probable as the odd, instead of being twice as probable.

COLOURING OF METALS BY POLISHING.—J. A. Wasik, of the Physical Laboratory at the Polytechnic Institute, Warsaw, communicates the following observations made by him subsequent to his work on the electrical conductivity between polished metal surfaces (see also his papers in *Zeit. f. tech. Phys.*, 5, 29-31, 1924; *L'Onde électrique*, 35, 535-541, 1924; *Zeit. f. Phys.*, 3, 720-21, 1926). In preparing flat polished surfaces of metal, using aluminium oxide as polishing powder and base blocks of different materials such as pitch, glue, shellac, or lime, coloured layers were found to be produced on the metal surfaces, provided the polishing powder was sufficiently fine. Thus with iron the colours gold-yellow, brown, nearly black, clear blue, and green were obtained, the most difficult colour to obtain being that of the metal itself. These layers resist oxidation very well and several of them show exceptional resistance to the action of acids. They differ much in hardness and elasticity. M. Wasik considers that the colours obtained cannot be explained by oxidation or by interference effects, as they undoubtedly depend on the material of which the polishing base block is made, and probably on the nature of the surrounding gases; they are differently disposed (on the surface) from the oxidation colours often obtained with cloth polishing. He believes that the coloured surface films are of the nature of isotropic vitreous enamels filling the interstices between the metal grains, covering the surface and giving it lustre (reference is made to the amorphous Beilby layer); and he suggests that attention should be turned to various phenomena connected with the polished surface of metals, for example, the Kerr effect.

MAGNETIC RESEARCH.—The issue of *Science Progress* for April contains an article on recent developments in magnetism by Dr. E. C. Stoner, which will prove very acceptable to those who have not the time to read Dr. Stoner's recent book on the subject. Starting with the electron rotating about a positive centre of force, he shows how an atomic system in which the magnetic moments due to the electrons balance out will behave diamagnetically, while if they do not balance out it will be paramagnetic. The effects of temperature are then dealt with, and finally the conception of the molecular field is introduced to account for the properties of ferromagnetic substances. On these general principles as a basis, the author goes on to recent work on the magnetic properties of atoms and ions, dealing in particular with the magnetic deflexion of the atoms streaming from heated metals, and with the atomic moments of iron, nickel, and cobalt, and the magnetic properties of crystals. Dr. Stoner does not think that the spinning electron theory helps forward magnetic theory to any great extent, nor does he appear to abandon atomic models in favour of the matrix method or of the undulatory mechanics method of dealing with the properties of the atoms.

Land in the Arctic.

THE study of the Arctic tides attracted wide attention when Harris concluded from his stationary wave-theory in 1911 that an extensive area of land existed within the unexplored area of the Arctic regions. Nansen, on the contrary, inferred the existence of a deep Polar basin from his observations in the *Fram* between 1893 and 1896.

Harris's hypothetical land gave a stimulus to explorers, but their search was fruitless. Stefanson, on his remarkable journeys over the sea-ice north of Alaska, and McMillan on this Crocker Island expedition, both touched the outskirts of the unknown region without finding anything but broken sea-ice. Amundsen in 1926 passed over the central part of the unexplored region in the dirigible *Norge* without seeing any land. Between 1918 and 1925 the *Maud* expedition made numerous tidal observations in the area north of Siberia. These observations, combined with earlier data, have been critically examined by Sverdrup and indicate in this area a tidal wave of the progressive type, differing from the stationary type deduced by Harris; nor do they indicate the existence of any extensive masses of land within the unexplored region.

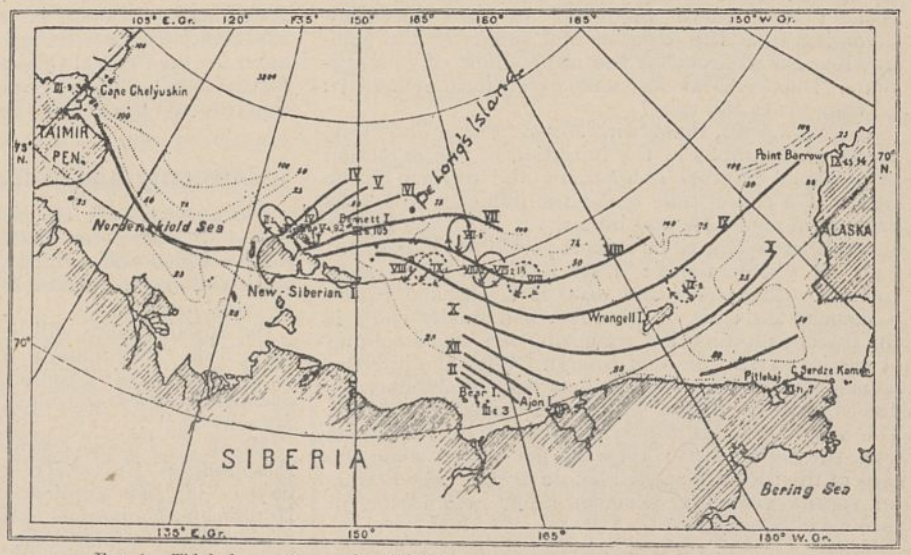

FIG. 1.—Tidal observations and co-tidal lines at spring tide on the north Siberian shelf.

The illustration here reproduced (Fig. 1) from Sverdrup's papers[1] shows the cotidal lines (the times of high water, in terms of Greenwich lunar time at full and new moon), and indicates that the progressive tidal wave from the north Atlantic enters the opening between Greenland and Spitsbergen and crosses the Arctic Sea without meeting any obstruction caused by extensive land masses. The figure reveals that the tidal wave reaches De Long's Island five hours before it reaches Point Barrow, although the direct distance from the Spitsbergen opening to the Island and to Point Barrow is nearly the same. This suggests a shallow sea in the unexplored region north of Wrangel Island and Point Barrow, with perhaps islands in places.

The tidal streams met with were of the rotary type usual in open ocean areas, but they present a striking peculiarity. Below the ice to a depth of some twenty fathoms water of the same density is present, while below this there is a sudden increase in density and later a slow increase on approaching the bottom. In the water layer of equal density the tidal streams ran slow, but in the layer where density increased rapidly with depth the tidal streams were at a maximum, dying away towards the bottom.

The water can be considered as composed of three layers of different eddy-viscosity. In the upper layer of equal density vertical eddies are free to be developed and the eddy-viscosity or 'virtual' viscosity is great. In the intermediate layer of rapidly changing density vertical motion is restrained and the eddy-viscosity is low, while below this, where there is a slower increase in density, the eddy-viscosity is of an intermediate value.

H. W. H.

[1] "The Tides on the North Siberian Shelf: their Bearing on the Existence of Land in the Arctic Sea and their Dynamics," H. U. Sverdrup, *Journal of the Washington Academy of Sciences*, vol. 16, pp. 529-540 (Washington, Dec. 1926).

The Initial Phase in Gaseous Explosions.

WHILE an atmosphere of controversy is not perhaps the best for the calm interpretation of scientific facts, there is no doubt that the clash of opinions gives a zest to research and sometimes speeds up discovery. The slow uniform movement of flame in the initial phase of the explosion of gases—first studied by Le Chatelier—has given rise to such a controversy between Prof. W. A. Bone and his colleagues at the Imperial College of Science and Technology, South Kensington, and Prof. R. V. Wheeler and his colleagues at the Safety in Mines Research Laboratories at Sheffield.

There is no doubt that many explosive mixtures, when lighted at the open end of a long tube, burn with a slow uniform movement for a certain distance, and as a rule this uniformity is more marked the slower the propagation of the flame. When 'limit' mixtures of various saturated hydrocarbons with air, *i.e.* mixtures which would just propagate flame, were ignited at the open end of a tube, Prof. Wheeler and his colleagues found that the flame had an initial uniform movement which was the same for each mixture; and, moreover, when any two of these mixtures were mingled together, the complex was also a 'limit' mixture and burnt at the same rate. So far, we understand, the speed-law is unquestioned. But when the law is extended to non-limit mixtures and to all gaseous mixtures of the same type (*i.e.* with either excess of combustible or excess of oxygen), which have the same uniform speed of flame, the two schools are in disagreement. Prof. Bone (with Messrs. Fraser and Winter) has just published in the *Proceedings of the Royal Society* photographs of the flames initiated in ethylene-oxygen, acetylene-oxygen, and in hydrogen-oxygen mixtures. He finds that such fast-burning mixtures do not always show any

uniform movement, and sometimes give in successive experiments uniform movements of different speeds. No doubt such mixtures are very sensitive to slight changes in the application of the igniting flame and the possible setting up of turbulence, and the length of the tube might affect the result.

Experiments to test the speed-law with blends of an ethylene-oxygen and a methane-oxygen mixture respectively with an hydrogen-oxygen mixture gave results which fell progressively below the predicted rates according as the hydrogen mixture was increased in the blend. It has been pointed out, on the other hand, that the rate of chemical change (and therefore the spread of the flame) is subject to the law of mass-action; the curve predicted by the speed-law diverging from the experimental speeds as the combustible gas approaches the upper limit of propagation. The speed-law has some exceptions, evidently: do they prove the rule?

In Part 3, Prof. Bone (with Messrs. Fraser and Witt) shows photographs of the initiation of the explosion of an equal mixture of methane and oxygen in the centre of a closed tube under the influence of sparks varying in character and intensity. With the feebler sparks there seems to be a short period of 'induction' with no visible flame; then a 'ghost-like' flame spreads with acceleration until it is checked before it reaches the ends of the tube, and finally there is the intense illumination traversing the whole column of gas in waves from end to end. With the intenser sparks the flame spreads at once and luminous striæ describe wavy paths within the ghost-like flame. The very luminous waves are caused by reflections from the closed ends: they are not shown when the ends of the tube are opened before firing. The powerful sparks evidently provoke rapid combustion in their neighbourhood.

A University Centre in London.

A MOST important announcement in relation to the future of university education in London was made at the Graduation Dinner of the University on May 11. Aided by a grant from the Government and a generous gift from the Rockefeller Foundation, the university has been able to arrange for the purchase of the Bloomsbury site of 11 acres, including roads, or 8½ acres excluding roads, north of the British Museum. This site was purchased by the Government in 1920 and offered to the University under conditions which the University was unable to accept, with the result that after five years the site was re-sold to the vendor, the Duke of Bedford, in accordance with the terms of the conveyances.

The Vice-Chancellor, Sir William Beveridge, indicated some of the purposes for which the site will be used, including University offices, Senate House, Library, Ceremonial Hall, Examination Hall, the Institute of Historical Research, a Faculty Club for Teachers, a Students' Union, O.T.C. Headquarters, perhaps one or two colleges, and finally, the beginning of residential quarters for teachers and students. He described in eloquent terms his vision of the future University of London, and appealed for the inspired artist who would embody it in stone and steel, "who will bring into the very heart of London a group of buildings that, raising their towers and pinnacles to the sky, will form a shrine of youth and learning in Bloomsbury to rank with the shrine of our history and our liberties by the Thames at Westminster." Lord Eustace Percy, President of the Board of Education, who was the guest of honour at the dinner, said that the announcement marked a great and historic moment in the history of the University. It will be generally hoped that the change of home will mean a change of heart, and that the feuds and wrangles of the past will soon become a fading memory. "The final decision," the Vice-Chancellor said, "was unanimous and is a pledge of unity for the future."

As to new developments for scientific research, no information was forthcoming. The general policy of university research institutes is still an open question, the discussion of which should now, however, take a new orientation; and a claim to part of the site will no doubt be advanced on behalf of sciences for which at present research facilities are inadequate. Provision should also be made for public university lectures. Referring to the financial position, the Vice-Chancellor said that, after purchasing the site, there was money in hand for the Central Offices. "The rest must wait for further help." The amount of the munificent contribution from the Rockefeller Foundation was not divulged.

University and Educational Intelligence.

CAMBRIDGE.—By the will of the late Prof. A. W. Scott, of Lampeter College, the University is to receive £7000 and a third of the residue of his estate, approximately a further £4000, for the furtherance of physical science.

Sir Josiah Stamp will deliver the Rede Lecture on June 8 on "Stimulus in the Economic Life." Prof. A. E. Taylor, of Edinburgh, will deliver the Leslie Stephen Lecture on June 3, on "David Hume and the Miraculous."

Mr. J. E. Purvis, Corpus Christi College, has been re-appointed University lecturer in chemistry and physics in their application to hygiene, and Mr. A. Hopkinson, Emmanuel College, has been re-appointed demonstrator of anatomy.

LONDON.—Applications are invited for the University studentship in physiology, value £50, which is open to a student qualified to undertake research in physiology. The latest date for the receipt of applications by the Academic Registrar, South Kensington, S.W.7, is May 31.

MANCHESTER.—An anonymous donor has given about £5000 for the endowment of two post-graduate scholarships for research in plant and animal biology.

OXFORD.—The University statutes have been modified to enable the committee for advanced studies to make grants of money for equipment needed by students for the degree of B.Sc.

The great and rapid development of the School of Rural Economy and of the various agricultural institutes affiliated to it from 1908, when it began with a modest grant of £800, to the present time when it has received a total grant of £44,000, has determined the passing of a new statute to redefine and strengthen the functions and powers of the Committee for Rural Economy. The Committee will have general control of the available funds, and will appoint directors and research officers for the two institutes for research in agricultural economics and agricultural engineering and for the advisory institute.

A new medical travelling studentship has been founded in memory of Dr. George H. Hunt. The value will be somewhat less than £100 every other year. Candidates must be graduates in medicine who shall have not exceeded five years from the date of passing their final M.B. examination; they will be expected to travel abroad for a period of not less than three months for clinical study or medical research, and eventually to engage in practice as surgeons or as general practitioners.

PROF. C. A. EDWARDS, professor of metallurgy and acting-principal of the University College of Swansea, has been appointed Principal of the College in succession to Dr. Sibly. Prof. Edwards will continue to act as professor of metallurgy and will supervise the work of honours students and direct research in the department.

APPLICATIONS are invited by the London County Council for two Robert Blair fellowships in applied science and technology, each of the value of £450 and tenable for one year. Applicants must be British subjects and not less than twenty-one years of age. Particulars and application forms (T.2.a./300) are obtainable from the Education Officer (T.2.a.), the County Hall, S.E.1. Forms must be returned by June 18.

THE Ramsay Memorial Fellowship Trustees will consider, at the end of June, applications for a Ramsay Memorial Fellowship for chemical research. The value of the fellowship will be £250 per annum, to which may be added a grant for expenses not exceeding £50 per annum. Applications must be received not later than June 6. Full particulars as to the conditions of the award are obtainable from the Secretary, Ramsay Memorial Fellowships Trust, University College, London (Gower Street, W.C.1).

AT a meeting of Armstrong College Council held on May 16, the resignation was accepted with regret of Prof. J. W. Bews, professor of botany. Prof. Bews, who came to Armstrong College from University College, Natal, in January 1926, has found the English climate unduly trying for both his wife and himself after fifteen years' residence in South Africa, and he is returning to his old post in Natal. The Council has appointed Mr. J. W. Harvey to be professor of philosophy in succession to Prof. A. S. Ferguson, now Regius professor of logic in the University of Aberdeen. Mr. Harvey, who is at present a lecturer in philosophy at the University of Birmingham, was educated at Rugby and Balliol College, Oxford; he has also studied in Berlin and Marburg. He is the English translator and editor of Prof. Rudolf Otto's "Das Heilige," which appeared under the title "The Idea of the Holy," and has collaborated with others in a small book entitled "Competition: A Study in Human Motives," published in 1913. Mr. Harvey is a member of the Society of Friends.

THE project of a university college at Hull, and the steps taken towards realising it, are described by the principal—Prof. A. E. Morgan, formerly of the University of Sheffield—in the April number of the *University Bulletin*. It is hoped that building operations will be started during the summer of this year, but it is doubtful whether the college will be ready to open its doors to students before 1929. The issue also contains an exceedingly interesting letter from Prof. G. S. Brett, of the University of Toronto, on university education in Canada. "The two vital questions seem," he says, "to be numbers and politics. If numbers steadily increase a special effort must be made to distinguish between genuine students and those who merely 'go through' the university. This effort will depend in the last resort on the attitude of those who pay the bill; if they have wisdom and know the value of educational ideals for a country, the otherwise inevitable degeneration will be avoided." The operations of the Anglo-German Academic Board in developing a system of interchange of university graduate students between Germany and England are described, and the address of the president of the Association sums up the work standing to the credit of the Association.

Calendar of Discovery and Invention.

May 22, 1724.—The total solar eclipse which occurred on May 22, 1724 (May 11, O.S.), was the last total eclipse seen in England. A copy of Halley's map of the path of the shadow crossing Ireland, south-west England, France, and southern Germany is to be seen in the Astronomical Gallery at the Science Museum. The eclipse was observed by Maraldi and J. Cassini at Trianon and by Delisle at Paris. At Trianon the period of totality was 2 minutes 16 seconds. Venus, Mercury, and a few of the fixed stars were visible to the naked eye, and it was noted that "a corona of light was seen to encompass the dark body of the moon during the totality of the eclipse." According to a note in NATURE of April 29, 1875, p. 507, an account of the eclipse was given in Stukeley's "Itinerarium Curiosum."

May 22, 1735.—Though Galileo, Halley, and Hooke had discussed the air currents of the world, George Hadley was the first to study adequately the direction of these currents, his views being given to the Royal Society on May 22, 1735, in a paper entitled "Concerning the cause of the General Trade Winds." It was, however, many years before the value of his writings was recognised.

May 24, 1753.—Carl Linnæus, the Swedish naturalist, published the first portion of his celebrated "Species Plantarum," in which he brought into use his "nomina trivialia," or two names, generic and specific, in place of the cumbrous sentences previously employed; the first part consisted of pages 1-560; the rest came out in the month of August.

May 24, 1844.—In 1843 the Senate of the United States voted 30,000 dollars to enable Morse to erect an experimental electric telegraph line between Washington and Baltimore. On May 24, 1844, the first public exhibition of the working of this line took place. Sitting in the Supreme Court of the Capitol in Washington, Morse signalled the words, "What hath God wrought," the message being received and repeated by Alfred Vail at Baltimore.

May 25, 1812.—Davy's beneficent work on the study of mine explosions and the invention of the miner's safety lamp were the direct outcome of the disastrous explosion at Felling Colliery, Sunderland, on May 25, 1812, when 92 lives were lost.

May 26, 1798.—Among many ingenious methods of raising water is that of the hydraulic ram devised by John Whitehurst of Cheapside about 1770, but improved and made automatic by Montgolfier, who patented it in France on May 26, 1798, and was awarded a gold medal at the French Exposition of 1802.

May 27, 1846.—For many centuries the only explosive in use was gunpowder. The first of the modern explosives to be introduced was gun-cotton, discovered by Schönbein and described by him to the Scientific Society of Basle on May 27, 1846. There are, however, earlier references to it in Schönbein's letters to Faraday. In October 1846 the British Government voted £1500 for experiments with the new explosive.

May 28, 1898.—Among the important investigations carried out at the Royal Institution, few have surpassed in interest those on the liquefaction of gases initiated by Faraday in 1823 and continued sixty years later by Dewar. Cailletet first saw liquid oxygen in 1877, and Olszewski also liquefied it in 1883. Fifteen years later, on May 28, 1898, Dewar obtained liquid hydrogen, and the following year at the centenary celebration of the Royal Institution gave a demonstration of his methods.

E. C. S.

Societies and Academies.

LONDON.

Royal Microscopical Society (Liverpool Conference), Mar. 30 and 31.—C. O. **Bannister**: Crystallisation of silver beads and detection of platinum metals by the microscope. In the presence of small quantities of platinum or palladium, the normal crystallisation of silver is displaced by a banded structure. In the presence of iridium, the silver beads are much more spherical in shape and the crystal faces are covered with lines similar to slip bands. With traces of rhodium, a distinct crystallisation of silver results, each face being frequently covered with parallel straight lines quite different from those caused by iridium. With additions of ruthenium, the markings on the crystal faces have a single-sided herring-bone structure.—Conrad **Beck**: The best method of illuminating metallurgical specimens. The most minute structure that has yet been photographed under the microscope with ordinary light is shown in Mr. H. Wrighton's photographs of steel, where the finest lines are about 150,000 to the inch. Mr. Wrighton's method of illumination produces the ultimate theoretical resolution possible; it depends upon the utilisation of the full aperture of the apochromatic object glass in use and limits the beam of light so that although it fills the aperture, it allows no light beyond that forming the image to enter the microscope.—Ruth C. **Bamber** (Mrs. Bisbee): A simple method of demonstrating the anatomy of trematodes. The details given refer to *Distomum hepaticum*:—(1) Wash well by shaking in normal saline; (2) immerse in fresh water for four to twenty-four hours; (3) place in 3 per cent. glacial acetic acid until differentiation is complete; (4) place in fresh water under a piece of glass heavy enough to compress the animal slightly. Examine with a binocular microscope or a hand-lens, and with reflected and transmitted light. The times vary with the size of the specimens. Differentiation is progressive. When complete, all the systems of the body, except the excretory system, show up by reflected light as though painted in Chinese white on a semi-transparent background. The excretory system is seen very clearly by transmitted light early in the process of differentiation.—W. E. **Cooke** and C. F. **Hill**: Pneumokoniosis due to asbestos dust. Although the asbestos industry is more than two thousand years old, only two cases of lung disease due to asbestos dust appear in medical literature. The present case was unique in two respects. First, the particles found in the lungs were large—some measuring 360 microns in length—and were proved to be the brittle iron-containing part of the asbestos fibre. Chemical analyses of the mineral in the various processes of manufacture and of the dust were compared with the microscopical appearances, and it was proved that the dust contained 18 per cent. of iron as ferrous oxide, the raw material 2·1 per cent., and the finished article 0·1 per cent. The second feature was the presence of a fungoid body. Some deny that it is a fungus, others contend that it is an aspergillus. The authors incline to the view that it is a hyphomycete analogous to that found by Dr. H. H. Scott in batrachians, or that it belongs to the family of hyphomycetes described by Ehrenberg in 1818, the Tuberculariaceæ.—R. J. **Daniel**: Method of staining and cleaning crustacea. Briefly, the method consists in taking small or medium sized crustacea, which have been bleached either by prolonged immersion in alcohol (*e.g.* museum specimens) or by the use of perhydrol (Merck), and leaving them overnight in a 0·05 per cent. solution of parabenzo-quinone in absolute alcohol. The specimens are then passed through various mixtures of absolute alcohol and methyl-salicylate, and finally cleared in the latter liquid. The muscles are stained red and the rest of the animal is transparent.—I. S. **Double**: The microscopic characters of certain horizons of the Upper Chalk. The chalk of the eastern counties of England contains 97-99 per cent. of calcium carbonate. The remainder consists mainly of a clay-like substance with a small proportion, less than 0·01 per cent., of detrital mineral grains. Of these, quartz and felspar occur most frequently, a fair number of the quartz grains with diameters of 0·1 mm. to 0·4 mm. being well rounded. Zircon, rutile, mica, tourmaline, and iron oxides are usually present, but kyanite, andalusite, chlorite, sphene, and staurolite are only occasionally present. It is considered that they were wind-blown into the chalk-sea. Very few organic remains are present, the greater part of the chalk consisting of a fine-grained aggregate of calcium carbonate. This is crystalline, for it reacts to polarised light.—R. Ruggles **Gates**: The meiotic phenomena in pollen development were studied in *Lathræa squamaria* and in *L. clandestina*, an introduced French species. The chromatin behaviour shows only minor differences, both species having 21 pairs of chromosomes. The tapetum is peculiar in being constantly binucleate on one side of the loculus and uninucleate on the other. Crystalloids are found in the nucleolus of the pollen mother cell nucleus, and in squizesis the spireme is constantly attached to one or more nucleolar bodies. The spireme does not form a continuous thread but remains a reticulum, in which the chromosomes are formed by flowing together of the chromatin at certain points, producing pairs of chromosomes. The tapetum ultimately becomes plasmodial.—H. E. **Hurrell**: The ecology of the fresh-water polyzoa in East Anglia. Polyzoa are more abundant in the Norfolk waters than in any other part of the country. This is attributed to the fact that the rivers and broads afford a suitable food supply, namely, diatoms, infusoria, and minute algæ. The rivers Yare, Bure, Thurne, Waveney, and their tributaries are all directly connected with Breydon Water, an estuary of the Yare, 3½ miles by ¾ mile, which is a unique culture bed for the diatoms, algæ, etc. Most of the known British species of fresh-water Polyzoa are found. *Victorella pavida* has not yet been discovered, although its usual host (the hydrozoon *Cordylophora lacustris*) occurs in the river Thurne in great luxuriance.

(To be continued.)

MANCHESTER.

Literary and Philosophical Society, April 5.—J. Wilfred **Jackson**: New Carboniferous lamellibranchs, and notes on other forms. The recent resurvey of the coalfields of Lancashire, Yorkshire, and Cumberland by the Geological Survey of Great Britain has provided material for a revision of certain Carboniferous marine lamellibranchs. The collections consist largely of shells belonging to the genera Pterinopecten, Posidonomya, and Posidoniella. These have been studied in association with material from other sources. Several new species of Pterinopecten, all previously ascribed to *P. papyraceus* (Sow.), but coming from lower horizons than that species, are described. Three of these species are from the Millstone Grit series, and one is from the horizon of the Lower Bowland Shales. New species of Posidonomya and Posidoniella are also described and figured from the Millstone Grit series.—S. H. **Straw**: Fish remains from the Upper Silurian rocks of Ludlow. Dermal studs of Thelodus and fragments of "*Scaphaspis*" *truncatus* are recorded from the Whitcliffe Flags of

Ludlow. The significance of these occurrences is discussed, emphasis being laid on the need for caution in the use of fossil fishes in fixing the base of the Downtonian in other areas, owing to the possibility of their occurrence in greater abundance in pre-Downtonian rocks in regions where physical conditions were more favourable to their existence than in the Ludlow district.—Gerald Andrew: Petrographic notes on specimens in the 'David Forbes' collection of rocks in the Manchester Museum. (1) Two specimens from the collection from Leicestershire are described. The first is a specimen (collected in 1856) from the dyke running across the Mt. Sorrel quarry. It is a fresh rock with peculiarities which differentiate it from the melanocratic igneous rocks of the Midlands, containing uniaxial augite, plagioclase—andesine to labradorite. No olivine is seen. Patches of fine-grained material are sporadically scattered through the rocks, with needles of oligoclase in a base which is sometimes glassy and sometimes consists of plates of an alkaline felspar, probably orthoclase. The rock appears to be a new type of lamprophyre. The second rock is recorded from Whitwick Colliery shaft sinking, and is a fine-grained porphyritic, felsitic variant of the orthophyre described by E. E. Lowe (1926), with cognate orthophyric zenoliths. The precise situation in the shaft section is not recorded.

GENEVA.

Society of Physics and Natural History, Mar. 17.—L. Duparc: An amphibole of the glaucophane group. The author has proved the presence, round a normal glaucophane, of an edging where the n_p and n_m axes are inverted. The plane of the y axes is 90° from that of the normal glaucophane. The name of pseudo-glaucophane is given to this variety.—J. Favre: The presence of *Clyplina jurassica*, a calcareous siphon alga, in the Portlandian at various points of the southern Jura. Although proved present, but not previously determined in the upper Portlandian of the Salève, this alga has been found again by the author in abundance at various points of the southern Jura; it may become a characteristic fossil of the extreme end of the Jurassic.—Eug. Pittard: The weight of the skull and of the encephalon of the Boschimans-Hottentots. Measurements made on 139 skulls from the Cape Town Museum have given averages relatively high for a height so small as that of the Boschimans.

ROME.

Royal Academy of the Lincei, Feb. 20.—P. Vinassa: The constituents of the earth's crust and the molecular number. The majority of the substances constituting the air and the waters, rocks, and organic matter of the earth's crust have even molecular numbers.—A. Russo: The germinative power of the somatic cells of metazoa and metaphytes and recovery of the sexual power of the impure gametogens in *Cryptochilum echini* (Maupas) in relation to the behaviour of the nuclei during the cycle of development.—S. Baglioni and A. Galamini: Physiological action of alcohol (iii). Action on the albino rat during growth, insufficient nutrition, fasting, and subsequent nutrition. Ingestion of 1·3 gm. to 4·6 gm. of ethyl alcohol per kilogram of body weight per day produces no definite effect, either harmful or favourable, on the growth of the albino rat or on its resistance to complete abstention from food. It seems, however, to favour increase in weight after the cessation of a fast resulting in loss in weight to the extent of 30 per cent. Alcohol also markedly increases the resistance of the rat to an insufficient sub-protein, sub-lipinic, hyper-carbohydrate diet, but diminishes that to a sub-protein, sub-carbohydrate, hyper-lipinic diet.—A. Luigi Herrera: New imitations of amœbæ in motion. Modification of the procedure previously employed results in the formation of structures resembling amœbæ which develop pseudopods and imitate the movements of the natural amœbæ.—M. Crudeli: The elementary geodetic distance: process of extension of Jacobi's equation to any Riemann variety.—N. Spampinato: New contributions to the general theory of Riemann's matrices.—R. Caccioppoli: Multilinear functionals.—A. Weinstein: A mixed problem for harmonic functions.—J. Dubourdieu: Congruencies of curves.—O. Onicescu: The asymptotic behaviour and the zeros of a class of entire functions.—G. Vranceanu: Geodetic stability. Application to the conservative systems of mechanics.—M. Pascal: The curves which appear in the study of the circuito-translatory current.—U. Barbieri: Determination of absolute azimuth made at Andrate in August 1926.—G. Bozza and G. Devoto: Calculation of chemical affinity on the basis of entropy (ii). The expression previously deduced, permitting of the calculation of the free energy of a chemical process on the basis of the heat of reaction at 298° K., the entropies at 298° of the components in the physical states assured in the equilibrium considered, and the specific heats from 298° to the temperature considered, is applied to a number of reactions. In cases where the available data are trustworthy, the results are satisfactory.—F. P. Mazza and G. Dello Jojo: The rotatory dispersion of certain aspartic esters. It is not certain that, in aqueous or hydrochloric acid solution, aspartic acid has the normal structure, but this is certainly exhibited by the sodium salt and by the dialkyl esters, which are lævo-rotatory. It would therefore appear more rational to indicate by the name *l*-aspartic acid the acid dextro-rotatory in aqueous solution. Dialkyl aspartates show normal optical dispersion, but the mono-alkyl esters present a distinct maximum for the wave-length about 5209 Å.U. In aqueous solutions of the latter compounds, the α-carboxyl group is probably satisfied by the amino group.—L. Fernandes: Researches on sulphosalts.—A. Pieroni: Some derivatives of pyridine.—M. Comel: The influence of the hydrogen ion concentration on the respiratory exchanges of the tissues. The results of experiments on the respiratory changes occurring in frog's muscle or liver in phosphate and citrate solutions of different hydrogen ion concentration appear to indicate that the fundamental factor in the maintenance of a high respiratory exchange is a hydrogen ion concentration below the isoelectric point.

VIENNA.

Academy of Sciences, Feb. 10.—E. Rona and E. A. W. Schmidt: Researches on the penetration of polonium into metals. There is no very great penetration, but on lead a surface effect.—A. Kieslinger: Second preliminary report on geological and petrographical researches in the southern Kor Alps (Styria).—A. Kieslinger: Paramorphosis of disthene after the manner of andalusite.—A. Puschin and D. Barara: The equilibrium in binary systems containing cresols as one component.—W. J. Müller: The current density and potential curves of metals showing passivity, illustrated by the example of iron.—A. Kailan and K. Melkus: On esterisation in ethylene glycol.—L. Schmid and M. Zentner: Dehydration experiments with sitosterine.—R. Grüner, Z. Benes, E. Schubert, and M. Arman: Some triazoles and their derivatives.—T. Kisser: Researches on the influence of nutritive salts on the transpiration, water assimilation, relative shoot and root masses and leaf structure (Parts 1 and 2). Experiments with salts of calcium, magnesium, sodium, and potassium on wheat plants show that there are marked contrasts in the effects of calcium and potassium.

Official Publications Received.

BRITISH.

Proceedings of the Royal Irish Academy. Vol. 37, Section B, No. 20: The Topographical Features of the Granite-Schist Junction in the Leinster Chain. By Anthony Farrington. Pp. 181-192+1 plate. 1s. Vol. 37, Section B, No. 21: Further Records of Collembola from Spitsbergen. (Results of the Oxford University Expeditions to Spitsbergen, 1923 and 1924.) By Dr. George H. Carpenter. Pp. 193-200. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Journal of the Royal Microscopical Society. Series 3, Vol. 47, Part 1, March. Pp. 14+96. (London.) 10s. net.

British Museum (Natural History). Picture Postcards. Set H4: Mediaeval Natural History, Series No. 1. 5 cards in colour. 1s. Set H5: Mediaeval Natural History, Series No. 2. 5 cards in colour. 1s. Set H6: Mediaeval Natural History, Series No. 3. 5 cards in colour. 1s. Set H7: Mediaeval Natural History, Series No. 4. 5 cards in colour. 1s. Set H8: Mediaeval Natural History, Series No. 5. 5 cards in colour. 1s. Set H9: Mediaeval Natural History, Series No. 6. 5 cards in colour. 1s. (London: British Museum (Natural History).)

Queensland Geographical Journal (New Series); including the Proceedings of the Royal Geographical Society of Australasia. 40th and 41st Sessions, 1924-26. Vols. 40-41. Pp. iv+165. (Brisbane: Royal Geographical Society of Australasia.)

FOREIGN.

Publications of the Astronomical Observatory of the Warsaw University. Vol. 3, Part 1: Determination of Latitude by the Method of Equal Altitudes of Different Stars (Piewzow's Method) and the Corresponding Star-Pairs for Northern Latitudes 20°-40° for the Epoch 1930·0. Vol. 1: Northern Latitudes 20°-25°. Part 1: General Statement. By Prof. M. Kamienski. Pp. 53. (Warsaw.)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1926. Pp. xxxvi+308. (Bern: Paul Haupt.)

Annuaire de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique, 1927. 93e Année. Pp. 93+178+4 planches. (Bruxelles: Maurice Lamertin.)

Proceedings of the United States National Museum. Vol. 69, Art. 14: Classification of the Cheilostomatous Bryozoa. By Ferdinand Canu and Ray S. Bassler. (No. 2640.) Pp. 42+1 plate. Vol. 70, Art. 11: New West American Marine Mollusks. By Paul Bartsch. (No. 2660.) Pp. 36+6 plates. Vol. 70, Art. 15: Generic Names applied to Birds during the Years 1916 to 1922 inclusive, with Additions to Waterhouse's "Index Generum Avium." By Charles W. Richmond. (No. 2664.) Pp. 44. Vol. 71, Art. 5: A new Parasitic Nematode from an unknown Species of Bat. By Benjamin Schwartz. Pp. 4. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

Harrap's Reference List of Educational and General Books, including the publications of D. C. Heath and Co. Pp. 94. (London: George G. Harrap and Co., Ltd.)

Analysis of Coal and its By-Products. (Technical Research Series No. 5.) Pp. xvi+136. (London: Baird and Tatlock, Ltd.)

Abbey Mills Papers. Pp. 16. (London: Grosvenor, Chater and Co., Ltd.)

Catalogue of Books on Natural History. (No. 215.) Pp. 98. (Edinburgh: James Thin.)

Union-Castle Continental Holiday Cruises. Pp. 12. Holiday Tours to Madeira or Canary Islands. Pp. 8. (London: The Union-Castle Mail Steamship Co., Ltd.)

Diary of Societies.

SATURDAY, MAY 21.

ROYAL SANITARY INSTITUTE (at Guildhall, Bath), at 10.30 A.M.—F. P. Sissons: Sewage Disposal.

MONDAY, MAY 23.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Prof. W. H. Hobbs: The University of Michigan Expedition to Greenland in 1926 and Plans for the Continuation of the Work during the Coming Season.

ROYAL SOCIETY OF MEDICINE (Odontology Section) (Annual General Meeting) (at Royal College of Surgeons of England), at 5.30.—Sir Berkeley Moynihan: Address.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—A. J. Davis: The Moorish Architecture in Northern Africa (Lecture).

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. C. Singer: The Mediæval Aristotle.

TUESDAY, MAY 24.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the Month of April 1927.—H. A. Harris: The Skull Form and Dentition of the Primates.—W. N. F. Woodland: A Revised Classification of the Tetraphyllidean Cestoda, with Descriptions of some Phyllobothriidæ from Plymouth.—Daphne Aubertin: On the Anatomy of the Land Snails (Helicidæ) *Cepæa hortensis* Müller and *Cepæa nemoralis* Linn.

JUNIOR INSTITUTION OF ENGINEERS (at Showrooms of Holophane, Ltd., Westminster), at 7.—Stage and Colour Lighting (Lecture and Demonstration).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—H. M. Cartwright and F. J. Tritton: Inherent Fog in Photogravure and a Method for its Elimination.—Dr. F. M. Hamer and O. Bloch: The Optical and Photographic Properties of a Series of Typical Cyanine Dyestuffs.

ROYAL ANTHROPOLOGICAL INSTITUTE (Conversazione at the Wellcome Historical Medical Museum, 54A Wigmore Street, W.), at 8.30.—Prof. Elliot Smith: The Medical and Magical Aspects of the Anthropological Material in the Museum.

WEDNESDAY, MAY 25.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine Section) (Annual General Meeting), at 5.—Dr. M. J. Rowlands: Rheumatoid Arthritis: Is it a Deficiency Disease?

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. F. S. Wallis: The Old Red Sandstone of the Bristol District.—Sir Arthur Smith Woodward, on behalf of Prof. Sampat Iyengar: Exhibition and Description of Photographs of a Cretaceous Reptilian Vertebra from Southern India.

BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 8.15.—Dr. E. Hamilton Wild: The Influence of Conation on Cognition.—Dr. A. C. Garnett: A Conative Criterion for the Discrimination of Types of Instinctive Behaviour.

THURSDAY, MAY 26.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (East Midland District Meeting) (at Town Hall, Ilkeston), at 10.45 A.M.

BRITISH SCIENCE GUILD (Annual Meeting) (at Royal Society of Arts), at 3.30.

ROYAL SOCIETY, at 4.30.—Helga Pearson: On the Skulls of Early Tertiary Suidæ, together with an Account of the Otic Region in some other Primitive Artiodactyla.—A. W. Greenwood and Dr. F. A. E. Crew: Studies on the Relation of Gonadic Structure to Plumage Characterisation in the Domestic Fowl. II. The Developmental Capon and Poularde.—Dr. F. A. E. Crew: The Laying Hen with Cock's Plumage. Part III.—Dr. E. J. Salisbury: On the Causes and Ecological Significance of Stomatal Frequency, with special reference to the Woodland Flora.—J. W. Trevan: The Error of Determination of Toxicity.—C. K. Drinker and E. D. Churchill: A Graphite Suspension for Intravital Injection of Capillaries.—Dr. F. W. R. Brambell: The Development and Morphology of the Gonads of the Mouse. Part I. The Morphogenesis of the Indifferent Gonad and of the Ovary.—Dr. A. S. Parkes: On the Occurrence of the Œstrous Cycle after X-Ray Sterilisation. III. The Periodicity of Œstrus after Sterilisation of the Adult.

FRIDAY, MAY 27.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual General Meeting), at 5.—Dr. J. D. Rolleston: The Section and its Work, 1908-1926 (Presidential Address).

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Demonstration: The Production of Splashes by Electric Discharge, by G. L. Addenbrooke.—Communications:—Dr. Ezer Griffiths and E. Griffiths: A Duplex Reversal Key with Mercury Contacts.—L. Hartshorn: The Measurement of the Inductances of Four-terminal Resistance Standards.—Dr. C. Chree: Magnetic Disturbances and Aurora as observed by the Australian Antarctic Expedition at Cape Denison in 1912 and 1913.—K. R. Rao: Series in the Spectrum of Trebly-ionised Tin (Sn. IV).

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section) (Annual General Meeting), at 8.—Dr. W. S. C. Copeman: The Prophylaxis of Measles, with a Suggested Scheme for Dealing with Epidemics.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB, at 8.15.—F. E. Smith: Address.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—H.E. the Marquis de Merry Del Val: Gabriel y Galan, Contemporary Spanish Poet (with Quotations in Spanish).

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District Meeting) (at Newport).

SATURDAY, MAY 28.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—W. S. Armstrong: Variable Speed Gears and their Application for Colliery Purposes.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South Wales District Meeting) (at Newport).

PUBLIC LECTURES.

SUNDAY, MAY 22.

GUILDHOUSE (Eccleston Square, S.W.), at 3.30.—Miss Margaret Murray: Ancient Egypt.

MONDAY, MAY 23.

UNIVERSITY COLLEGE, at 5.30.—R. Johnson: Lord Lister and the Romance of Surgery (only for the members of University College and Medical School).

THURSDAY, MAY 26.

UNIVERSITY COLLEGE, at 2.30.—Sir Flinders Petrie: Recent Discoveries in Palestine: The City of Gerar.—At 5.—Prof. H. Maclean: Insulin in the Treatment of Diabetes and Some Other Nutritional Disturbances.

SUNDAY, MAY 29.

GUILDHOUSE (Eccleston Square, S.W.), at 3.30.—Prof. J. Garstang: Recent Discoveries in Palestine.

CONGRESSES.

MAY 25 AND 26.

FRENCH SOCIETY OF OTO-NEURO-OPHTHALMOLOGY (at Strasbourg).

JUNE 6 TO 9.

CONVENTION OF CANADIAN CHEMISTS (at Quebec).