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## Zimbabwe.

"IT is inconceivable", says Miss Caton-Thompson in a communication dealing with her recent investigations among the ruins of Rhodesia which we print in another part of this issue, "how a theory of Semitic origin [of the Zimbabwe] could ever have originated. Every detail in plan, building, and contents seems African Bantu." This, the latest pronouncement on a problem which has been debated for more than half a century, is an emphatic endorsement of a conclusion at which Dr. Randall-MacIver arrived twenty-four years ago. The spade once more has dealt a final blow at romantic but ill-founded speculation. Yet it is not entirely beyond understanding that an earlier generation should have seen in these massive structures the relics of an alien and advanced civilisation.

Both Miss Caton-Thompson and Dr. Randall-MacIver approached their problem as trained archæologists, without preconception, interested primarily in ascertaining the facts which each site in itself could be made to yield under strict archæological method: earlier observers had not the advantage of the training and the development in the canons of comparative study in archæology which of recent years have been made possible by the prosecution of research in widely separated areas. In fact, when the history of the discovery and the early investigation of the ruins is taken into account, a theory of their Semitic origin seems almost to have been inevitable. At the time when the attention of the learned world was directed to their existence, it was still a common experience in archæological speculation that the interpretation of data should be governed by theory rather than theory formulated by inference from the facts. Just as in Britain all prehistoric remains were once almost automatically referred to the Romans or the Phœnicians, so in Rhodesia, King Solomon, the Queen of Sheba, and the Phœnicians were almost bound to make their appearance. To these views the evidence of extensive gold-working, combined with stories of Punt, of Ophir, and of the wealth of Sofala in early Arab writers, appeared to lend support.

It was already known to the early Portuguese settlers in East Africa, and had long been known to their predecessors the Arabs, that stone-built structures—the palaces and cities of the Emperor Monomotapa, as they phrased it grandiosely—existed in what is now Rhodesia. In passing it may be noted, for what it is worth, that there is nothing in these early accounts to suggest

that the native inhabitants, the Makaranga, in making use of these stone buildings, had usurped a culture not their own. It is far from probable that the accounts of the Zimbabwe and the Makaranga in the early Portuguese writers were the result of first-hand observation. Without any doubt they came from Arab traders. Obvious errors in detail preclude personal knowledge. Later, both missionaries and Portuguese troops penetrated to the interior, and at one time the gold mines were handed over to the Portuguese under a treaty of alliance; but at the end of the seventeenth century the troops were withdrawn. *Monomotapæ Imperium* was recorded in a French map of 1705; but after that it fell into oblivion until the ruins were rediscovered in the middle of the nineteenth century.

Tales of Solomon and the Queen of Sheba and their gold attracted desultory exploration; but the first expedition of any consequence was that of Mauch, the German traveller who explored Great Zimbabwe in 1871. It, however, had already been reached by Adam Renders in 1868. Mauch's wildly speculative theories discounted the importance of his discovery, and it was not until 1890, when E. A. Maund directed attention to the problem of Great Zimbabwe in a paper read before the Royal Geographical Society, that further serious exploration was contemplated. In the following year Theodore Bent was sent out under the auspices of the Royal Geographical Society on his famous expedition of exploration among "the Ruined Cities of Mashonaland". In the course of this journey Bent explored eleven sites, while his colleague R. M. W. Swan made astronomical observations and measured the buildings at Great Zimbabwe. As a result of their observations it was concluded that the purpose of the temple at Zimbabwe was sun-worship, and that the ruins were Semitic in origin, probably dating before the Sabæo-Himyaritic period—a view for which Bent hoped to obtain confirmatory evidence in his subsequent journeys of exploration in North Africa and Arabia. He based his view mainly on the form of the 'temples', the presumed phallic significance of the conical towers, the carved soapstone birds, and the other smaller finds in which he saw a Semitic or Phœnician character.

It would be no advantage to recite here a catalogue of the numerous subsequent explorers of the Zimbabwe ruins, many of them amateurs who have destroyed evidence rather than added to our knowledge. It would be impossible, however, to pass over R. N. Hall and W. G. Neal, to whom Rhodesian archæology owes an enormous debt. They began their joint explorations in 1895. Working over a long period of years, these two explorers, at first jointly, and after Neal's death Hall alone, examined more than two hundred sites, many of them previously unknown. It was largely owing to the interest aroused by their work, and the controversy which arose out of their views, that the British Association sent out Randall-MacIver in 1905. Hall, who held strongly to the early and non-African origin of the Zimbabwe culture, hazarded the opinion that the earliest ruins might go back so far as 2000 B.C. He was able to look for support almost indifferently to any of the current theories, whether they identified Rhodesia with Ophir, or agreed with Keane, who, in opposition to the theory put forward by Karl Peters after his visit to the country in 1899, that the ruins were the work of the Ancient Egyptians, had suggested that Rhodesia was not Ophir, but Havilah, and the source of the gold of Ophir. Undeterred by Randall-MacIver's adverse conclusion, Hall continued his work after 1905 on its previous lines, now making use of his results to attack both the methods and the conclusions of his opponent. He carried with him a considerable body of opinion in South Africa. Hence it was thought worth while, when the British Association contemplated a visit to South Africa, to send out Miss Caton-Thompson—an experienced archæological explorer whose work in the Fayum had placed her in the first rank of younger archæologists—in the hope that, by clearing up doubtful points upon which question had been raised since 1905, and by once more thoroughly examining the evidence which it would be possible to obtain under the most stringent conditions of archæological method, the question of date and origin might be settled.

Miss Caton-Thompson's work calls for little comment here. In the contribution which we print she has set out clearly the position in which investigation stood as the result of Dr. Randall-MacIver's work, and the point to which she herself has carried it. It gives the essentials of her methods and results with a perspicuous clarity of exposition which can be appreciated by anyone with the merest elementary knowledge of archæological argument. The earliest possible date and the origin of the Zimbabwe culture are ascertained by excavation carried down to bed-rock. Apart from imported objects of significance for questions of date only, nothing has been revealed which cannot be referred to a Bantu culture. Typically Bantu pottery is contemporaneous with the lowest

cultural horizon. It is significant that Miss Caton-Thompson points out that in the Great Zimbabwe conical tower the workmanship by no means attains the perfection which has sometimes been attributed to it.

It is apparent from the account of the meeting of the British Association at Johannesburg at which Miss Caton-Thompson's report was presented, that the verdict was received by some of her hearers with disappointment. It may appear more credible—it may even appeal more to the imagination of some—that these ruined stone buildings, remarkably planned, with their labyrinthine passages and communicating chambers, and their impressive size, scattered literally in hundreds through an area more than six hundred miles square, should be the work of one of the great peoples who were the agents of civilisation in early days. But the interest of the problem has not vanished if our attention is turned to Africa. What were the causes which contributed to this unique efflorescence of Bantu culture? Was it wealth? According to one estimate, not less than £75,000,000 worth of gold was taken from the mines. The Makaranga became a degenerate race, broken and overrun by a virile conquering people; but the impression given by the early Portuguese records is that of a vigorous people ruled by chiefs of character and strong personality. Miss Caton-Thompson emphasises the qualities which must have come into play in building up the Zimbabwe culture. It is, in fact, but another example of the force of character and genius for administration and organisation which an African people has shown on more than one occasion, but of which the significance is usually overlooked.

## Munitions of War.

*Textbook of Ordnance and Gunnery.* By Lieut.-Col. Earl McFarland. Pp. x + 625. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 32*s.* 6*d.* net.

THE peace-time problem of preparing for war, remote though we hope war may be, is a task which has to be attacked by the few scientific workers who are specially engaged by their governments. It is a problem which becomes more difficult as reduction in armaments becomes more drastic, and ultimately resolves itself into one of pure research. This follows three broad lines: improvement of existing material, improvement in manufacture, and improvement in method of use. The results of laboratory research are tried out on proving grounds and in arsenals; the latter are maintained as nuclei, ready for expansion, and provide munitions for the peace establishment of the nations' fighting forces.

The dissemination of knowledge so gained is effected primarily by means of text-books and generally through the naval and military scientific journals of the nations concerned. As research progresses, text-books become out-of-date and require renewal; the work under review is such a renewal, replacing the 1917 text-book on the same subject by Col. Tschappat. It is intended to provide cadets at the Military Academy (West Point), in particular, and the line officer generally, with a statement of the fundamental theory of ordnance design and a description of the more important material of the American army. It provides, in addition, an account of research undertaken during the past ten years, and an outline of the most recent manufacturing methods.

Dealing first with explosives, we are given an interesting account of post-War progress towards the production of a smokeless, flashless, and non-hygroscopic propellant. Success in this direction has been remarkable, more especially in reducing the flash. The brilliant flame of nitro-cellulose and nitro-glycerine propellants has been reduced to a dull-red glow, which is invisible at a short distance and cannot be photographed with ordinary plates or films. This result is obtained by a combination of two methods. By incorporating in the propellant relatively inert substances, which absorb heat, the temperature of the gases is reduced; this process has the disadvantage, however, of increasing the smoke. By reducing the size of the pieces of propellant the charge is consumed earlier; more work is then done by the powder gases, and they become relatively cooler. By a judicious combination of size of piece and percentage of cooling agent, the muzzle flash is eliminated without greatly increasing the volume of smoke.

The Picatinny Arsenal method of manufacturing such a propellant, which is a blend of guncotton and pyro-cotton, is given in some detail. There follows an account of high explosives used in the American services, and a brief outline of the theory of explosives; an interesting chapter on nitrogen fixation concludes with the statement that the United States should, within a few years, be independent of outside sources for its fixed nitrogen.

The treatment of the subject of internal ballistics, which deals with the motion of the projectile in the bore, is based on approximations. This we think is unfortunate, since an outline of the theory

could be given in almost the same space; it demands no more mathematical knowledge than is assumed throughout the text, and it would be more in conformity with the rest of the book. The reason given for this departure is that the formulæ obtained are simple to use; this simplicity, however, is secured at the expense of accuracy, while such essential theoretical features as mode and rate of burning, effect of size of grain and general thermodynamical considerations, are sacrificed.

The work at the Aberdeen Proving Ground includes the determination of the ballistic properties of propellants, and is chiefly concerned with the measurement of the velocity of projectiles and the pressure of powder gases.

Since 1922 an improved chronograph for measuring velocity has been in use. It consists of two solenoids, mounted at the ends of a rigid framework which can be hoisted to any convenient position. The projectile is magnetised, and is fired through the solenoids, generating an electric pulse in each; these pulses are recorded, by means of oscillographs, on a moving photographic film, against a time trace derived from a tuning-fork. The time of passage of the projectile between the solenoids is thus measured with great accuracy, and the velocity is at once obtained.

The measurement of powder pressure in a gun is much more difficult. What is required is a record of pressure against time; the pressure rises quite rapidly to the order of 20 tons per sq. in. and thereafter subsides to about 5 tons per sq. in. as the projectile reaches the muzzle; the duration, from moment of ignition, is of the order of 0·02 second. At Aberdeen the piezo-electric pressure-gauge is being used with great success; it exploits the piezo-electric property of quartz and produces an accurate and continuous record of pressure against time.

A series of quartz discs, cut so that their geometrical and electric axes are parallel, are assembled in a hollow cylinder of bakelite. The discs are separated by thin metal plates and have alternately positive and negative faces in juxtaposition. The positive and negative plates are severally connected and the current developed (which is proportional to the applied pressure) is recorded, by means of a mirror galvanometer, on a moving film. Such a gauge will withstand and record a pressure of 22 tons per sq. in. It is calibrated in a hydraulic testing machine in which a high pressure (measured by a standard indicator) is suddenly released.

In an interesting account of a comparative test of piezo-electric and crusher gauges, it is stated that the former gives values very close to the true pressures, while crusher-gauge records are from 15 to 20 per cent lower, the discrepancy being greater for quicker-burning propellants.

A chapter on the properties, tests, and manufacture of gun-steel leads to an account of gun construction. The relative merits of built-up and wire-wound guns are discussed, and the author deduces the interesting result that a wire-wound gun cannot be made stronger than a built-up gun of the same dimensions, if the latter consists of at least four tubes.

An account is given of the new cold-working or *auto-frettage* process. The gun is generally made in one piece and the bore is subjected to hydraulic pressure rising to 45 tons per sq. in. The effect is to increase the tensile strength, more particularly of the inner fibres of the metal, the modulus varying from about 10,000 tons per sq. in. at the bore to about 12,500 tons per sq. in. at the exterior. Experiments at the Watertown Arsenal have proved that the most efficient method is to enclose the gun in a container of sufficient thickness to withstand the working pressure without permanent set. It is estimated that the cold-working process effects a saving, in time and cost of manufacture, of from 25 to 40 per cent, while, for equal weight, the gun will withstand considerably higher pressure than a built-up or wire-wound gun.

A further advance in American gun construction is the removable liner. Owing to rapid erosion of the bore, high-velocity guns have frequently to be relined, a process which necessitates returning the weapon to an arsenal. The removable liner is designed to overcome this difficulty; it enables a worn liner to be replaced by a new one by battery personnel in the field, thus effecting considerable saving in time and cost.

Breech mechanisms are treated in some detail, and an account of the theory of recoil brakes and recuperators is followed by a detailed description of American ordnance. The Waterbury hydraulic speed gear, an ingenious device for transmitting variable rotary speeds, is here described in connexion with the 16-in. gun-mounting. Field-service and coastal gunnery and instruments used therewith are dealt with at some length, but the chapter on anti-aircraft gunnery is disappointingly brief and vague.

An account of recent progress in external ballistics, including Moulton's small-arc method of computing trajectories, is followed by a description of range-tables and their use. A chapter is devoted to tanks and 'Mechanisation'; it appears that

the horse is to be retained with American divisional artillery for the present, while tractors, rather than self-propelled mountings, are to be used for medium and heavy artillery. The work concludes with a description of projectiles, fuzes, small-arms, and grenades used in the American services, and an outline of the methods of manufacturing them.

The book is a valuable contribution to the literature of military science; the diagrams are excellent, the treatment is clear and concise, and, with the exception noted, gives an adequate account of the subject.

## Colloid Chemistry and Biology.

(1) *Colloid Chemistry: Theoretical and Applied.* By selected International Contributors. Collected and edited by Jerome Alexander. Vol. 2: *Biology and Medicine.* Pp. ii+1029. (New York: The Chemical Catalog Co., Inc., 1928.) 15.50 dollars.

(2) *Elektrizität und Eiweisse, insbesondere des Zellplasmas.* Von Dr. Hans Pfeiffer. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 21.) Pp. xii+149. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 10 gold marks.

(3) *Das Permeabilitätsproblem: seine physiologische und allgemein-pathologische Bedeutung.* Von Prof. Dr. Ernst Gellhorn. (Monographien aus dem Gesamtgebiet der Physiologie der Pflanzen und der Tiere, Band 16.) Pp. x+441. (Berlin: Julius Springer, 1928.) 34 gold marks.

(1) A SMALL committee of experts and a great deal of space would be required for an exhaustive review of this volume, in compiling which the editor has evidently been guided by Goethe's maxim: "Wer Vieles bringt, wird Jedem etwas bringen".

A liberal interpretation of this principle has, perhaps unavoidably, led to the inclusion of contributions which fall outside the scope of the volume: papers which have no discernible bearing on biological problems, like that on "Hydration and Viscosity of Sols", by N. R. Dhar and D. N. Chakravarti on one hand, and on the other, articles which the mere colloid chemist will read with an overwhelming sense of his ignorance, like that on "Some Physico-Chemical Aspects of Life, Mutation, and Evolution", by the editor and Calvin B. Bridges. These, however, are extreme cases, and the majority of papers show attempts to apply our present knowledge of such simple disperse systems as can be studied in the laboratory to the problems of biology and physiology.

The proteins naturally receive attention. Wo. Pauli and T. Brailsford Robertson set forth their well-known and highly divergent views in two interesting papers; to give the reader a further choice, Mr. Alexander reprints J. Loeb's Pasteur Lecture on "The Colloidal Behaviour of Proteins", as well as his own very pertinent criticisms of a thesis assuming "that gelatin is a definite chemical entity, which no one has ever demonstrated".

The reader will gain the impression that the study of pure proteins is a sufficiently laborious and difficult task, but he will realise even more vividly, after reading the group of papers on protoplasm, how exiguous a step towards an understanding of the simplest organism all this immense labour represents. "The Physical Properties of Protoplasm" (Wm. Seifriz), "Protoplasm" (L. V. Heilbrunn), "The Colloidal Structure of Protoplasm and Protoplasmic Action" (R. S. Lillie), "The Nature of the Living Cell as revealed by Micromanipulation" (R. Chambers), and "The Physical Basis of Life" (E. B. Wilson), taken together, form a compendium of the subject, the fundamental difficulty of which is summarised in one sentence by H. Handovsky in another paper: "The facts compel us to assume that the manner in which the colloids are united is an essential factor in cell function". The study of such combinations of colloids as this passage contemplates can scarcely be said to have begun.

A curious contrast with the detailed analysis in this group of papers is presented by a vast generalisation like that put forward in "The Colloidal State in Organisms", by A. Lumière, who finds the cause of physiological and pathological happenings in the ageing and the mutual coagulation of colloidal solutions.

Space does not permit more than a brief enumeration of some of the more important remaining contributions. H. Schade deals with "Colloid Chemistry and Internal Medicine", with special emphasis on the properties of connective tissue, and with "Concretions", which are, perhaps, easier to imitate *in vitro* than other products or elements of organisms. Papers by E. Zunz, F. Bottazzi, and P. Lecomte de Noüy are devoted to the surface tension of colloidal solutions, and more particularly of plasma and serum; the last-named author finds that normal and immune sera can be distinguished, even in minute concentrations, by this physical method. Contributions dealing with pathological problems as varied as the treatment of lobar

pneumonia, the entity producing chicken sarcoma, colloid chemistry and malignant tumour, etc., must necessarily make a limited appeal to specialists. So will a "Colloidobiological Study of the Vitamins", by F. V. v. Hahn, in which he arrives at the conclusion—certainly surprising to the outsider—that "the so-called vitamin-containing substances act not by means of a chemical constituent in them, but by virtue of their inherent surface activity".

The preparation of the volume has involved a good deal of translation, which, considering the stylistic difficulties and the *ad hoc* terminology of some of the originals, has been done very well. Equal care has been bestowed on proof-reading and on the preparation of the name and subject matter index. The interesting question, what class of readers can be sufficiently interested in the varied contents of the book to acquire it, need scarcely be discussed on its merits, since the price—though it cannot be called high—will, at least in Europe, probably restrict ownership to libraries and reviewers.

(2) This small volume is one of the 'Forschungsberichte' edited by Dr. R. E. Liesegang, whose general object is to present in the form of concise critical abstracts the most important advances made in various fields of science since about 1914. The somewhat puzzling title is explained by the preface, which describes the volume as an attempt "to group recent literature from the point of view how far electrophysiological relations can to-day be made to contribute towards the comprehension of vital happenings in cells". To facilitate this task, consideration has been confined to the behaviour of the proteins within and without the protoplasts, and the carrying out of the scheme leads to the grouping of a vast mass of material under three main headings: (1) Electric charges on disperse particles; (2) fundamental features of the electric behaviour of disperse protein particles; and (3) the fundamental effects of electrophysiological phenomena in plasmatic protein.

The first two sections give a concise but complete summary of the electric properties of disperse systems in general, and of proteins in particular; the 'non-electric', that is, specific effects of anions and cations, as expressed in the Hofmeister series, receive due attention. The sub-headings of the third section give some idea of its scope: the quasi-stationary state of protoplasm, the co-operation of electric charges in cell functions, and the effect of electric charges on structural elements which have undergone 'dyscolloidal' changes, that is, changes from the normal condition in the direction of peptisation or gelation. The last-mentioned portion contains numerous references to the new technique of the Prague school, some of the methods of which deserve to be known and used more extensively; for example, Fürth's cataphoresis with semi-conducting electrodes, which permits the use of fields of several hundred volts per centimetre without appreciable current.

Owing to extreme condensation the book is not easy reading, but it fulfils the primary object of a collection of abstracts: that of directing the attention of the reader to things he ought to study, while giving him a reasonable summary of what he is going to find.

(3) Prof. Gellhorn's work gives references to about 1400 widely scattered papers—all of them discussed in the text—on a problem of peculiar difficulty. It is, however, much more than a mere collection of abstracts; it is a text-book written in a thoroughly critical spirit. Nothing is more striking than the constant cautions against misinterpretation of experimental evidence or disregard of sources of error, which are certainly numerous in the investigation of permeability.

After a short introduction, the author discusses fully the various methods which have been used for determining permeability and the properties of artificial membranes, especially the dry collodion membrane, which has been the subject of recent important work. The next section deals in great detail with the permeability of plant and animal cells to electrolytes as well as to organic substances peculiar to the cell and foreign to it; with the effect of external and internal factors on these permeabilities; and, finally, with the specific permeabilities of various cells and organs and their functional differentiation.

More than a hundred pages are then devoted to the permeability of various organs; to the general reader, perhaps, the most striking mechanism is that which, in normal conditions, prevents the passage of albumins from the blood into the cerebrospinal fluid.

The final section is entitled "Results". It begins with a summary of the evidence for the existence of "a boundary layer which regulates the permeability of protoplasm", and continues with an admirable discussion of the various theories which have been put forward for the structure of this membrane, "none of which is adequate to account for the variety of phenomena observed with widely different cells". The author sees some hope in a fusion of existing theories, which will ascribe to each single factor an importance varying with each type of cell.

The book, to which (2) is in many ways a useful supplement, should be of great interest, not only and obviously to cytologists and physiologists, but also to colloid chemists. It will provide those who are in the position—at present still uncommon—of having to look for problems with a formidable array of them; it will also make even those who do not share Sir William Hardy's conviction ("Sixth Colloid Symposium Monograph", p. 8 (1928)) that "nothing is to be gained by claiming living matter as colloidal", realise how much remains to be done before their discipline can fully explain even the simplest properties of single cells. E. H.

## Flowers of the World.

*Totius orbis flora photographica arte depicta.* Edited by Hugo Iltis. Vol. 2: *Floral Province of the European 'Mittelgebirge' I.* By Dr. Hugo Iltis and Bert Schulz. Translated by W. C. Worsdell. Pp. 50 + 100 plates. (Brünn: Rudolf M. Rohrer, 1928.) 29 gold marks.

THE authors have set themselves no small task in attempting to provide a pictorial presentation of the natural vegetation of the whole world. The present volume, the second in the series but the first to be published, deals with the phytogeographical region of the European *Mittelgebirge* of Engler's classification. It is stated that some further 'centuries' of photographs are contemplated of this province alone. If the intention is to deal with all regions of the world on the same scale, the work will indeed be monumental, and the cost of so many 'centuries', at twenty-eight shillings and sixpence each, will not be within the reach of many individuals.

Volume 2 consists of a brochure of fifty pages and one hundred photographic prints. The intention and scope of the work is explained, and a general account of the *Mittelgebirge* is given, followed by a more detailed account of the twenty-five 'formations' which the authors recognise as being found in this province. The brochure is published in English, French, and German. An index to the subjects of the photographs is given, and also an index to plants mentioned; the nomenclature adopted is that of K. Fritsch's "*Exkursionsflora*". A map, in colours, gives the principal phytogeographical areas of the western part of Czechoslovakia, and the more important places mentioned in the volume.

Each photograph is separately mounted on a loose leaf which bears a caption in the three languages, giving the vegetation type and the habitat of the subject. The names of the chief plants depicted are given, and, in some cases, a brief enumeration of the principal associates. Individually, the photographs portray the plant in its immediate surroundings, and it is only by a general consideration of the series that an idea is obtained of the vegetation of the whole country.

The selection of the photographs has been made with the idea of illustrating the range of the different units of vegetation comprised in the area. The authors have considered the various general systems of classification in use, but have decided that a judicious combination of the principles generally accepted provides the best basis for the divisions which they have chosen, rather than the adoption of any one particular system. It is obvious that reconsideration will have to be given to this classification with each volume which deals with a new type of vegetation.

The work breaks new ground in presenting a study of the vegetation of a given area in the form of a series of actual photographs of plants in their natural habitat. The authors have an intimate knowledge of the area now dealt with, and, from the list of distinguished botanists mentioned as co-operating with them, it can be guaranteed that many volumes will be published which will provide an equally intensive study of "the flowers of the field" over large parts of the world. The volumes which are to deal with, for example, the little-known immense tracts of the tropics, may require different treatment, and the units of vegetation selected for each volume will require to be conceived on different scales.

In this connexion it is perhaps to be regretted that the terms 'formation' and 'association' have been introduced in the restricted application to which they are committed in the present intensive study of a part of the European flora. It is a little difficult to know what terms can now be used for the large units of vegetation which will be encountered in volumes dealing with other and less known parts of the world.

The volume is well produced, the brochure and loose leaves with the photographs being contained in a stout cardboard box neatly covered with dark green cloth and lettered in gold. The photographs have been carefully selected and admirably fulfil their purpose. The work is scarcely, from its size and cost, one that can be expected in the private library, but it will undoubtedly be of use in universities and institutions engaged in the study and teaching of botany.

## Our Bookshelf.

*Dynamical Systems.* By Prof. George D. Birkhoff. (American Mathematical Society Colloquium Publications, Vol. 9.) Pp. viii + 295. (New York: American Mathematical Society; Cambridge: Bowes and Bowes; Berlin: Hirschwaldsche Buchhandlung, 1927.) 3 dollars.

THIS book comes as a welcome addition to a noteworthy series of volumes—the American Mathematical Society Colloquium Publications—and it contains, with subsequent developments, the material presented in Prof. Birkhoff's Colloquium Lectures at Chicago in 1920.

The work is entirely formal and, while one would not regard it as a book from which to approach the study of theoretical dynamics, anyone who has read, say, Whittaker's "Analytical Dynamics", will not find it difficult. In the first two chapters the author introduces the types of Lagrangian systems in an original way, and discusses some special integrals of the equations. Moreover, instead of restricting himself to equations of Hamiltonian type, he takes the general Pfaffian equations, which have the advantage of retaining their form under an arbitrary point transformation instead of only under a contact transformation.

The third chapter deals with the normalisation of the equations and their general formal solution in the neighbourhood of an equilibrium point and with the case of 'generalised equilibrium', that is, motion about a periodic motion.

Chapter iv. deals with the question of the stability of periodic motions. An interesting result (pp. 115-121) is the connexion between reversibility and complete stability. The author shows that if there is stability of the first order, then reversibility is a necessary and sufficient condition for complete stability.

The remaining five chapters follow the lines of Poincaré's geometric methods, and are concerned with establishing the existence of periodic motions in the vicinity of a periodic motion of stable type. The methods employed are certainly very elegant, though, unfortunately (except in special cases), their application seems to be limited to systems with two degrees of freedom. The last chapter deals with the celebrated 'problem of three bodies'.

The errata, though numerous, are in no case serious, and are mostly of the type which the reader cannot fail to detect and correct for himself. The treatment is rigorous, and much of it is original, and altogether the volume forms a valuable addition to the literature of the subject.

*Greek Thought and the Origins of the Scientific Spirit.* By Prof. Léon Robin. Translated from the new revised and corrected French edition by M. R. Dobie. (The History of Civilisation Series.) Pp. xx + 409. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1928.) 21*s.* net.

WE have already had occasion to direct attention to the attempt which is being made, in this "History of Civilisation" series, to systematise, and to make more generally available, the vast amount of knowledge achieved by modern research in social studies. Prof. Robin's contribution to the series is entirely worthy of the occasion, and will probably rank as one of the finest. For immense erudition combined with perfect clarity of expression the book can have few equals. As M. Henri Berr, who writes a foreword, truly states, the treatment is marked by "discerning and cautious interpretation of doctrines", and "rigorous characterisation of systems and schools". These qualities are especially apparent in the interesting paragraphs which introduce and conclude the several chapters. Most suggestive, for example, is Prof. Robin's comparison between the immense and the living influence of Plato, in whose writings the greatest problems of thought are unravelled and prepared and established in their form for future speculation, and the more external influence of Aristotle, the form of whose writings lends itself so well to literal acceptance as an absolute authority. It was Aristotle whose influence for a long time turned science away from the paths of decisive progress. For the gift of elaboration and presentation is not the same thing as the very spirit of inquiry.

*Thermochemie: Arbeitsmethoden und Analyse der thermochemischen Daten insbesondere in dem Gebiete der organischen Verbindungen.* Von Prof. Dr. W. Swietoslawski. (Handbuch der allgemeinen Chemie, herausgegeben von Prof. Paul Walden und Prof. Carl Drucker, Band 7.) Pp. xi + 253. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 22 gold marks.

PROF. SWIETOSLAWSKI is a well-known authority on thermochemistry and is exceptionally well qualified to deal with "experimental methods and analysis of thermochemical data with special reference to organic compounds". The present volume is the seventh of a series, of which some earlier numbers have already been reviewed in these columns (Mar. 14, 1925, p. 374; Sept. 1, 1928, p. 308). Its three principal sections deal with the methods of calorimetry and of thermochemical measurements, analysis of thermochemical data, and thermochemistry of atomic linkages respectively.

The first two sections have a somewhat specialised technical interest, but the last covers a series of problems in which all chemists are directly interested, since every organic chemist would like to know the heat of formation of various bonds of a carbon compound, and every inorganic chemist would like to know the heat of formation of the ions of an electrolyte. The information which is now available is summarised in the last thirty pages of the book, which will be read with interest by many who have no direct interest in the experimental determination of thermochemical data.

*Protozoology: a Manual for Medical Men.* By John Gordon Thomson and Andrew Robertson. Pp. xiii + 376 + 4 plates. (London: Baillière, Tindall and Cox, 1929.) 30*s.* net.

THE preface of this book states very plainly that it is intended for medical men as distinct from research workers, and that on this account the arrangement

of the groups differs from that usually adopted by zoologists. This precludes criticism from the purely zoological point of view. The authors state concisely most of the information about parasitic protozoa essential for the medical man, but it is a pity that in a book with this definite scope the discussion of immunity and chemotherapy in trypanosomiasis should be so inadequate. A useful account of the pathology of the diseases caused by various protozoan parasites is given. The section on malaria is treated very fully and gives a good description of the conditions created by this organism. The authors have given some account of the more serious difficulties and pitfalls in the microscopic examination of blood and fæces, and there is a brief chapter on methods which will be valuable to clinicians working abroad.

The book is very fully and very well illustrated, which probably accounts for the price, which seems high for a book of this type. The bibliography is slender, but the authors excuse themselves on the score of the lists contained in contemporary treatises, such as Knowles' "Introduction to Medical Protozoology" and Wenyon's "Protozoology". There are some curious printer's errors, and the disease of 'dourine' appears in block type as 'douriee'.

*Cardio-Vascular Diseases since Harvey's Discovery.* The Harveian Oration delivered before the Royal College of Physicians of London on Oct. 18, 1928. By Sir Humphry Davy Rolleston. Pp. vi + 149. (Cambridge: At the University Press, 1928.) 3*s*. 6*d*. net.

THIS richly documented little book, written by one whose father, Prof. George Rolleston of Oxford, delivered the Harveian oration fifty-five years previously, is divided into four sections dealing with the advances since Harvey's discovery in our knowledge of cardio-vascular diseases obtained by anatomical observation, normal and morbid, unaided clinical observation, application of instruments of precision, such as the sphygmomanometer, sphygmograph, and electrocardiograph, and information derived from physiological and pathological experiments respectively. An interesting historical sketch is given of clinical methods, such as percussion and auscultation, examination of the pulse, the therapeutical use of digitalis, and such diseases as angina pectoris and exophthalmic goitre. A bibliography is appended to each section.

*Histoire des fourmis.* Par M. de Réaumur. Avec notes de Prof. Charles Pérez. (Encyclopédie entomologique, Vol. 11.) Pp. 116. (Paris: Paul Lechevalier, 1928.) 40 francs.

A MEMOIR on ants which forms part of Réaumur's famous "Histoire des Insectes" exists in manuscript form in the archives of the Academy of Sciences of Paris. In 1926 an English translation of this work by Prof. W. M. Wheeler of Harvard University was published in London and New York under the title of "The Natural History of Ants". The present publication, issued by M. Paul Lechevalier, is of a somewhat different cadre, since it makes available for the first time Réaumur's observations on ants in the original French, and every effort has been made to reproduce this work in the same style as the "Histoire" to which it properly belongs. The great historical and biological interest attached to Réaumur's observations should ensure a ready welcome being accorded to this essay by entomologists throughout the world. The annotations by M. Charles Pérez and the excellent frontispiece portrait of Réaumur add materially to its interest.

*Ultra-Violet Radiation and Actinotherapy.* By Dr. Eleanor H. Russell and Dr. W. Kerr Russell. Third edition. Pp. 648. (Edinburgh: E. and S. Livingstone, 1928.) 21*s*. net.

THE authors have maintained the previous form of their book in this, the third, edition. The work is a good one for the medical practitioner who wants information about the working conditions in ultra-violet therapy, for here he will find all the necessary details about ultra-violet lamps and their mode of action. He can also find lists of diseases for which ultra-violet radiation can be recommended.

The book concludes with a chapter on the use of these rays in diseases of the organs of special sense and in dental and veterinary practice. Even chicken runs and pig-styes are said to be run more profitably when ultra-violet radiation is supplied to their inmates. The benefit to growing animals is said to be due to an increase in the retention of calcium and phosphorus compared with that of control batches.

*Faune de France.* 20: *Coléoptères; Cerambycidae.* Par Prof. F. Picard. (Fédération française des Sociétés de Sciences naturelles: Office central de faunistique.) Pp. vii + 167. (Paris: Paul Lechevalier, 1929.) 32 francs.

VARIOUS fascicules of the "Faune de France" have been noticed from time to time in our columns. The present part, No. 20, is the first to deal with Coleoptera and provides an excellent guide to the French species of Cerambycidæ. The general introduction deals with the structure and biology of the family and includes, in addition, a most useful list of its Hymenopterous parasites. This is followed by the taxonomic part which forms the main substance of the monograph: the generic and specific key and descriptions are uniform with those of the preceding fascicules and maintain the same clarity and excellence. There is also a useful bibliography and a full index.

*Modern Paper-Making.* By Robert Henderson Clapperton and William Henderson. Pp. xiv + 365. (London: Ernest Benn, Ltd., 1929.) 31*s*. 6*d*. net.

IN this book, "written by practical people for practical people", the raw materials, processes, and machinery used in paper-making are fully described in such a manner as to afford a clear and comprehensive account of the industry at the present day. The book is well arranged, profusely illustrated, and beautifully produced, and it should rapidly win recognition as a standard work on the subject.

## 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.*]

### Palæobotanical Evidence for the Age of the Late Palæozoic Glaciation in South Africa.

IN an article in NATURE of June 22, 1929, p. 946, Dr. H. Dighton Thomas discusses the age of the glaciation which has left its traces in the Late Palæozoic rocks of India and in various parts of the southern hemisphere. He reviews some of the considerable volume of evidence on this subject which Prof. Schuchert of Yale has so fully summarised in a recent paper (*Bull. Geol. Soc. Amer.*, vol. 39, p. 769). Prof. Schuchert concludes that the evidence is in favour of regarding the glaciation as of "Middle Permian and probably Late Middle Permian time". Prof. Schuchert here uses the term Middle Permian for the upper part of the Lower Permian of most authors.

Dr. Thomas considers that the evidence on the whole supports the view that the glaciation was in Uralian (Upper Carboniferous) times, and this is the view generally accepted by most British geologists. Dr. Thomas refers to the work of Prof. A. C. Seward and Mr. T. N. Leslie on the fossil plants found below the glacial beds in South Africa. Representatives of this flora, which has *Gangamopteris* and the closely related *Glossopteris* as its most characteristic plant genera, are also found in beds interstratified with the relics of glaciation in Australia. This flora is found in many parts of the southern hemisphere, where, as Prof. Sahni remarks, the "close relation of the Gondwana plant beds [that is, the *Gangamopteris* flora] with the glacial deposits over enormous areas" is of great significance. We are amply justified in assuming that the *Gangamopteris* flora and the glaciation were approximately contemporaneous. Of these two important plant genera, *Gangamopteris* is more characterisitic of the early (Palæozoic) phase of the flora, while *Glossopteris* has a much greater range and persists into the Mesozoic.

One of the chief difficulties up to the present has been to find points of correspondence between the *Gangamopteris* flora and the sequence of floras of the European type in which no *Glossopteris* or *Gangamopteris* occurs. These floras have a completely different floristic composition and are characteristic of the northern hemisphere, particularly of Europe, with the exception of that part of Russia in which a *Glossopteris* flora has been found.

Recently, I have had the opportunity of examining some fossil plants which Mr. B. Lightfoot found in the Upper Wankie sandstones in the Wankie district in Rhodesia. The majority of the specimens are leaves of various species of *Glossopteris* (*Gangamopteris* is not represented), but the special interest and importance of Mr. Lightfoot's collection is the presence of several species and genera of plants which have not been found associated with *Glossopteris* before but are characteristic of the European type of Upper Palæozoic flora.

The following is a list of the plants which have been identified, *G* indicating that the species is characteristic of the typical *Gangamopteris* flora, *ES* and *EL* of the European Stephanian (Upper Carboniferous) and European Lower Permian respectively, and *A* of the Upper Palæozoic of the Shansi coalfield in China: *Phyllotheca sp.* (*G*), *Sphenophyllum speciosum* (*G*), *S. Thonii* (*EL*), *S. Thonii var. minor* (*EL*, *A*), *S. oblongifolium* (*ES*, *EL*), *Chansitheca sp. cf. Kidstoni* (*A*), *Pecopteris unita* (*ES*, *EL*, *A*), *P. arborescens* (*ES*, *EL*), *P. cf. cyathea* (*ES*, *EL*), *Asterotheca sp.* (*ES*, *EL*), *Cladophlebis sp.* (*? G*), *Glossopteris indica* (*G*), *G. Browniana* (*G*), *G. Retifera* (*G*), *G. tortuosa* (*G*), *G. cf. angustifolium* (*G*), and *Cordaites Hislopi* (*G*). (An illustrated account of the flora will be published shortly in the *Bulletin of the Geological Survey of Southern Rhodesia.*)

Although in the collection the specimens of *Glossopteris* leaves preponderate numerically, it is seen in the list that the European and *Gangamopteris* types are, from the point of view of number of species, equally well represented. It has been suggested that the *Gangamopteris* flora flourished in a rather cooler climate than that of the warm or even sub-tropical type of the European province. The Wankie terrain may have had an intermediate type of climate accounting for the intermediate type of flora which is found there in the Upper Wankie sandstones.

The known vertical distribution of the northern species which form, roughly, half of the collection, shows that the flora is closely related to that of the Stephanian and Lower Permian and is therefore in all probability early Lower Permian in age. The elements of the *Gangamopteris* or *Glossopteris* flora in the collection suggest a close comparison with the Beaufort or somewhat older, Ecca series of the succession found farther to the south in Africa. Now in South Africa the glacial beds with *Gangamopteris* interbedded in them form part of the Dwyka series, which lies below and is therefore older than the Beaufort or the Ecca series, so that the glacial beds are older than early Lower Permian and must be early Lower Permian or even Upper Carboniferous themselves. The evidence furnished, therefore, by the Wankie flora is antagonistic to the view that the glaciation in South Africa is late Middle Permian, but supports the view that it is either early Lower Permian or possibly Upper Carboniferous.

J. WALTON.
Botanical Department,
The University, Manchester.
Sept. 23.

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THE new occurrence recorded by Dr. Walton is of great importance both for showing members of the northern and southern late Palæozoic floras in association and for indicating the age of this and other deposits. To my mind, the age assigned to the Wankie flora by Dr. Walton cannot be questioned. In one respect I should be even more definite than he. His comparison with South African floras is highly suggestive, but, on the strength of such a correlation, I should consider the Dwyka glacial beds with *Gangamopteris* to be definitely Upper Carboniferous in age. This gives independent support to the determination obtained in other ways.

The association of elements of the northern and southern floras in the Upper Wankie sandstones can but prove that the two floras were contemporaneous. Taken in conjunction with the age of the Rhodesian plant assemblage, the association gives, therefore, additional reason for believing that the *Glossopteris* flora first appeared in Upper Carboniferous times, and that the different floral facies exhibited by the northern and southern regions are to be explained by differences in geographical distribution rather than by differences in age. As Prof. Seward has said: "No Upper Carboniferous flora was in the strict sense cosmopolitan" (Presidential address to Section K of the British Association meeting in South Africa, *vide* NATURE, Sept. 21, 1929, p. 450). A certain intermingling of the northern and southern floras is to be expected in an intermediate region, such as Rhodesia appears to be. Doubtless other

mixed floras will be found in intermediate regions, and they, too, will play their part in confirming or confuting the conclusions I have drawn before—though, I believe that they, like the flora referred to by Dr. Walton, will support and not oppose those views.

H. DIGHTON THOMAS.
Department of Geology,
British Museum (Natural History),
Cromwell Road,
London, S.W.7,
Sept. 25.

### Statistics and Biological Research.

IN a letter to NATURE of Aug. 17, Dr. R. A. Fisher has given a clear statement of his reasons for believing that the methods set out in his "Statistical Methods for Research Workers" are adequate to deal with all problems arising in biological research as ordinarily conducted. Those statisticians who, like "Student", feel that there is need for the study of non-normal distributions particularly in connexion with small samples, might perhaps state their position as follows. In the first place, from their own experience they do not feel so confident as Dr. Fisher that the normal distribution and tests based upon it are adequate in *all* forms of biological work; in the second place, they are concerned with many non-biological problems in which forms of variation occur ranging from very slight to extreme degrees of a-normality. It is not, therefore, an academic but a very real problem for them to obtain some more exact appreciation than seems hitherto to have been reached, of the point at which a-normality of distribution renders the tests of 'normal theory' inaccurate or inefficient.

Turning to the more theoretical aspect of the problem, no one who appreciates the lines along which Dr. Fisher has developed the theory of sampling will deny that as the form of variation deviates more and more from the normal, not only may (*a*) the frequency constants or 'statistics' cease to be distributed in random samples according to the 'normal theory' law; but also (*b*), even if they are still approximately so distributed, they begin to lose their efficiency as discriminating criteria. For each form of variation there exists in theory different 'statistics' leading to the most efficient tests for the significance of differences observed on samples. The subject is one of extreme interest, but, as Dr. Fisher writes, this new realm of statistical theory is at present scarcely opened. But whether it were opened or not, I am inclined to think that a fundamental difficulty would still be present. It is this.

In practice the worker in small samples can rarely be certain from the evidence available of the exact form of variation in his population; he must, therefore, use some standard form of analysis, and if he believes from previous experience that deviations from normality if existing are unlikely to be great, he will naturally use the 'normal theory' tests. But, logically, confidence in his results is then only justified if he is certain that deviations from normality of this order will not introduce the difficulties (*a*) or (*b*) above.

As a concrete example, suppose that a biologist wishes to compare the eggs of two groups of a species of bird living in different habitats. He has collected and measured an egg from each of some ten or a dozen nests from both groups. The numbers are small, but would be of value at any rate in a preliminary inquiry. May he now compare the means and standard deviations of, say, length and breadth of eggs, for the two groups, using Dr. Fisher's $t$ and $z$ tests? His samples are too small to give him any information on this point, but he may turn to literature containing egg measurements on a large scale and see whether the variation in length and breadth of eggs is generally normally distributed. He would find, for example, in *Biometrika*:

Length of cuckoo's egg, 1572 cases. Frequency constants $\beta_1 = \cdot0044$, $\beta_2 = 3\cdot3483$
Breadth of common tern's egg (1914), 1592 cases. Frequency constants. . . . $\beta_1 = \cdot2618$, $\beta_2 = 3\cdot5315$
Breadth of common tern's egg (1920), 956 cases. Frequency constants. . . . $\beta_1 = \cdot1624$, $\beta_2 = 3\cdot9276$

(From *Biometrika*, iv. p. 368, xii. p. 348, xv. p. 337 respectively.)

The constants for the common tern's eggs differ significantly from the normal values of $\beta_1 = 0$, $\beta_2 = 3$. If, however, the biologist knew that for deviations from normality as great or even greater than these the $t$ and $z$ tests were still adequate, he would apply them with some confidence to his own data. But at present is there any published evidence which will assist him in deciding this point?

It is not questioned that in a very wide field of biological work the normal distribution is adequate. Those who work within its bounds are fortunate, but they should admit the possibility that others may meet in practice cases of distinctly non-normal variation; and therefore wish to know more precisely at what point the criteria based on means, standard deviations, and correlation coefficients fail to be distributed in sampling according to 'normal theory', and to understand a little more clearly the nature of the consequences of the inefficiency introduced by using these 'statistics'.

A-normality may arise in an infinite number of ways; it is only humanly possible to explore a few of these, but each fresh piece of information makes us more certain of the strength or weakness of our tools. By representing populations by some variable system of mathematical curves, it is possible to examine certain typical forms of deviation from the normal. But it certainly is not claimed that such an exploration would be exhaustive.

EGON S. PEARSON.
University College, London, W.C.1,
Sept. 30.

### West Indian Biota in New Caledonia.

WHEN visiting New Caledonia last year, my attention was directed to the varied representation of the fauna and flora of the West Indies to be found in the island. New Caledonia is a French colony, and is visited by steamers which go round the world, calling at French ports. There has been commerce by way of the French Antilles, and some of the species accidentally brought from thence have been described as supposedly endemic members of the New Caledonia fauna.

(1) The slug *Veronicella plebeia* was described from New Caledonia by P. Fischer in 1868. It is very common in the lowlands of the island; I found it particularly abundant at Bourail. In 1925 Grimpe and Hoffmann decided that it had an extensive synonymy, and existed in localities so remote as Tahiti, Mauritius, Brazil, and the West Indies. I sent Bourail specimens to Dr. H. B. Baker of Philadelphia, and he finds them practically identical with *V. dubia* Semper of the Lesser Antilles. He remarks that all of its near relatives are neotropical. Thus it appears to have been carried from the West Indies to New Caledonia in the early days of the colony, but the earliest and valid name is that based on New Caledonia specimens.

(2) At various places, but in great abundance on

Ile Nou and near Bourail, I found a minute cylindrical snail of the genus *Gastrocopta*, which must have been introduced, as it was wholly unknown to the earlier collectors, and had not been recorded from the island. Mixed with it, but in much smaller numbers, was the well-known *G. pediculus* Shuttlw. When I visited the Bishop Museum in Honolulu, the unknown snail was readily determined (with Dr. Cooke's aid) as *G. lyonsiana* Ancey, common in the Hawaiian Islands. But Pilsbry remarks that a large proportion of the *G. lyonsiana* are quite indistinguishable from the West Indian *G. servilis* Gould, and the indications are that this also is an Antillean species, imported.

(3) More than fifty years ago the French conchologist Crosse described a small slender snail found in gardens at Noumea, New Caledonia, calling it *Geostilbia caledonica*. Pilsbry has shown that this is identical with *Cœcilioides gundlachi* Pfeiffer, a West Indian species. It still flourishes in New Caledonia, and I collected specimens. Apparently the same snail has been found in the Hawaiian Islands, but given a different name by Ancey.

(4) In 1893 I described the mealy-bug *Pseudococcus virgatus* from Jamaica. This I found in New Caledonia last year, but as it is very widely spread in tropical countries, it cannot be affirmed that it originated in the West Indies. In any case, it was surely introduced into New Caledonia.

(5) On June 11, at Noumea, I found the pretty yellow-flowered *Tribulus cistoides*, which used to be so familiar along the streets in Kingston, Jamaica. It is a West Indian weed, introduced.

(6) On the sea-coast near Bourail, under some trees, I came upon a large patch of a small but very beautiful *Salvia*, with red flowers. I thought what a lovely native plant! But on investigation it turned out to be the neotropical *Salvia coccinea*, introduced. Mixed with the normal plants were a few (which I call *Salvia coccinea* f. *pallidiflora*) having the flowers pale pinkish, with dark rosy lip. The specimens are now in the U.S. National Museum.

This list could doubtless be considerably extended, but the above will serve as good examples. While New Caledonia has thus received immigrants from other French colonies, it has been comparatively isolated from other tropical and subtropical regions. So far, it is happy in having no *Anopheles* mosquitoes, and hence no malaria. There is a serious danger that these may be imported from the New Hebrides or elsewhere, with disastrous consequences. It is practically impossible to keep malaria-infected persons out of the island, so that if *Anopheles* arrived malaria would soon be prevalent. On the other hand, the yellow fever mosquito, *Stegomyia argentea*, is present; I collected it at Bourail. But there is no yellow fever, the parasitic organism being absent. Another serious menace is the possible introduction of injurious termites from Panama or Australia. Their presence would be calamitous. There are six endemic species of termites (of the genera *Calotermes* and *Microcerotermes*), two of them only in the adjacent Loyalty Islands. These seem to be harmless, so far as we could observe, frequenting old logs along the coast.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado, Sept. 3.

## Empirical Factors in Weather Forecasting.

IT is an interesting feature of the recent great advance in the art of weather forecasting that it has proceeded in independence of such small store of empirical precepts as had already been gathered in the long ages of crude observation. So far as can be made out by the layman, the official forecasts we see are direct inferences from a number of exactly recorded measurements of air pressures gathered from a very wide area. How far any unmeasurable element, such as could be called a *flair* for the behaviour of weather, comes into the transaction, we do not know. The tendency of scientific meteorology is no doubt and very rightly to discourage dependence on any such aptitude, and there is no reason to suppose that, if it exists, it is any more common among professional meteorologists than it is in the general public. We do not expect a professional psychologist to be especially tactful any more than we expect a professional mathematician to be particularly sharp in counting his change.

At the same time, it may perhaps be suggested that at the present stage of its advancement the art of weather forecasting could make use of certain unmeasurable tendencies of weather that are to be noticed by mere crude observation of its behaviour. It must, of course, be admitted that the help to be got from these sources can never be more than altogether minor and auxiliary, and such as might provide a caution or a proviso to be added to a forecast based on more trustworthy sources.

The occasion, and I hope the justification for these remarks, has chiefly been the impression one has gathered that the general tendency of the weather in a given season can, as it were, override the influence of large-scale pressure distributions and so falsify their ordinary indications. Thus, conditions of pressure which in an ordinary season would certainly bring rain are apt to fail to do so in a dry season, and so we get a repeated falsification of forecasts there seemed the usual reasons to trust. The present year has illustrated this tendency very well. It has been remarkably dry almost throughout, yet the weather has never for long been thoroughly settled in the meteorological sense. The result has been that pressure conditions have seemed repeatedly to promise rain, and on most such occasions the promise has been falsified. On many occasions the expected cloud has appeared and rain has seemed inevitable, and then in a few hours the cloud has thinned and melted away. It has appeared, in fact, as if the dry and heated land had disposed of the cloud before precipitation could occur.

The influence of the land on rainfall seems usually to be regarded as limited to the effect of high ground in causing cooling and precipitation. It would appear probable that a large tract of country dried and warmed by a long drought—as, for example, southern England during this year—can produce a marked land effect in the exactly opposite sense.

The forecasting of the 'summer' thunderstorm is another subject in which the minor factors preceptible to ordinary observation seem sometimes to outweigh the inferences of the expert. To empirical observation, three factors go to the making of a true 'summer' thunderstorm—calm, sun heat, and the season of the year. In the south of England the season during which storms are at all probable begins rather abruptly with the first week in May and continues throughout May, June, and July. From the beginning of August the liability to thunder declines and continues to do so steadily through that month. Thus conditions that in the last week of July would make severe thunderstorms almost a certainty would be unlikely to produce them in the last week of August. To the expert, on the other hand, the forecasting of thunder appears to proceed directly from the pressure conditions. If these are favourable, as, for example, when there is a failing anti-cyclone over England with a shallow depression to the south, thunder is forecast, so far as can be judged by the layman, as confidently at the end of August or even in September as in the middle of July. It is my very distinct impression, though I have no

statistical evidence for the opinion, that the trustworthiness of official thunder forecasts declines steadily throughout August.

These remarks are made with all diffidence and in full recognition of the fact that a mere amateurish interest in the weather is a very different thing from meteorological knowledge. I should be grateful to learn, however, whether the tendencies I have tried to point out are at all generally recognised.

WILFRED TROTTER.

Harley Street,
London.

### A Determination of the Dielectric Constant of the Ground.

IF an electromagnetic wave spreads from a small source situated in free space, then it is known that the amplitude of the oscillatory magnetic intensity ($H$) at any point is inversely proportional to the distance ($d$) of the point from the source, provided that the distance is greater than about 1·5 wave-lengths. Under these conditions, therefore, the product $Hd$ is independent of distance. If, however, the source is situated on the surface of a conducting dielectric, the electrical properties of which can be expressed in terms of a dielectric constant $k$, and a conductivity $\sigma$, then Sommerfeld (*Ann. d. Physik*, (4) **28**, pp. 665-736 ; 1909) has shown, theoretically, that the product $Hd$ is no longer constant, but varies with the distance in a manner depending on the constants $k$ and $\sigma$.

In the case where the source is a wireless transmitter on the surface of the earth, the departure of the product $Hd$ from a constant value can be determined by measuring the magnetic intensity $H$ at different distances from the transmitter. By comparing the resulting 'attenuation curve' with that obtained theoretically from Sommerfeld's theory, assuming various values of $\sigma$ and $k$, it is possible to find a theoretical curve which has the same form as the experimental curve, and thus to fix the values of $k$ and $\sigma$ for the ground. It has been pointed out previously (Ratcliffe and Barnett, *Proc. Camb. Phil. Soc.*, **23**, p. 288 ; 1926) that measurements on long and medium wave-lengths lead only to a value for $\sigma$, and it is not possible to calculate $k$ from them. Up to the present, the only measurements which have been made have been on wave-lengths so long that it has been impossible to deduce from them a value for $k$.

We have recently carried out measurements on a shorter wave-length (30 m.) up to a distance of 1400 m. The resulting attenuation curve, in which $Hd$ is plotted as a function of $d$, shows a maximum when $d$ is about 600 m. This curve has been compared with the numerical calculations on Sommerfeld's theory which have recently been published by Rolf (Ingeniörs Vetenskaps Akademien. *Handlingar* Nr. 96, "Numerical discussion of Prof. Sommerfeld's attenuation formula for radio waves". Stockholm, 1929), and its shape is found to be in agreement with the theory, if we assume the values $k = 20$ e.s.u. and $\sigma = 2 \times 10^{-14}$ e.m.u. for the ground constants. The value for $\sigma$ is in agreement with the values previously found by using longer wave-lengths. The maximum on the curve is the characteristic feature which enables a reasonably accurate estimate of $k$ to be made. No such characteristic feature is present when longer waves are used.

J. A. RATCLIFFE.
W. F. B. SHAW.

Cavendish Laboratory,
Cambridge,
Sept. 19.

### Adaptation.

NOTWITHSTANDING all the discussion that has taken place since 1859 concerning evolution, adaptation, and selection, biologists are still far from agreement, not merely concerning the explanations that have been proposed, but also concerning the things to be explained. Mr. J. B. S. Haldane (NATURE, Sept. 21, 1929) cites evidence that differential survival may be due to physiological differences associated with visible characters not themselves useful or harmful. Prof. D. M. S. Watson, in his presidential address to Section D of the British Association at the recent meeting in South Africa, suggested that structural adaptation may be in many cases imaginary, or may have been the cause of habit, not the consequence. He stated that in extreme cases it was not possible to doubt the special function to which a structure was adapted, but in others a similar habit occurred without any corresponding structural adaptation. As an example of this he referred to the paddle-like limbs of ichthyosaurus as proving that it was an aquatic animal, but stated that there was no indication in the post-cranial skeleton of hippopotamus that it also was aquatic: "its limbs show no swimming modification whatever".

It can scarcely be disputed, however, that the hippopotamus is not an aquatic animal in the sense in which that description may be applied to ichthyosaurus. It is a question of aquatic locomotion : we may conclude from its general resemblance to a whale, and the resemblance of its fore-limb to that of a whale or of a turtle, that the ichthyosaurus lived exclusively in water and probably in the sea, and moved only by swimming. The hippopotamus, on the other hand, spends much of its time walking on land, and when in the water swims neither continually nor rapidly. A horse occasionally enters the water and can swim, but we do not call a horse an aquatic animal.

It seems to me that the important matter is to explain the evolution of such obvious adaptations as those of the fore-limbs of whales, turtles, and ichthyosauri to exclusive aquatic locomotion, not to suggest that the modification of the limbs in these animals is not necessarily and invariably correlated with aquatic locomotion because other air-breathing vertebrates pass more or less of their time in water along the banks of rivers or lakes without similar modification of the limbs. Impartial study of the facts shows that the more constant and specialised the habit the more specialised the adaptation of the structure, while where the habits are variable the structure is more generalised and retains more of its primitive character. This applies to the limbs of air-breathing vertebrates and to vast numbers of other cases.

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Sept. 27.

### Melting Point of Chromium.

No accurate determination of the melting point of chromium has been published recently, so far as we are aware, and the accepted value of 1550° C. usually quoted appears to be based on measurements made in 1907–8.

Various properties of metallic chromium appeared to us to be inconsistent with such a low value, particularly the very slow rate of diffusion of chromium into iron and nickel. We have found (*J. Inst. Metals*, **40**, 273 ; 1928) that even in pressed bars of nickel and chromium powders heated to just below the melting point of nickel (1450° C.) very little diffusion takes place, whereas under the same conditions nickel and iron rapidly form solid solutions. An attempt was made to melt electrolytic chromium in an atmosphere

of hydrogen in an electric furnace, but at the maximum temperature of 1700° C. there was no sign of fusion. Rods of both electrolytic and thermit chromium were therefore prepared and heated by passing a current through them *in vacuo*.

A small hole drilled in the side of the rod enabled the true (black body) temperature of the axis of the rod, as well as the brightness temperature of the surface, to be determined (cf. Pirani and Alterthum, *Z. Elektrochem.*, **29**, 5 ; 1923) by means of a disappearing filament pyrometer calibrated at the melting points of tungsten, molybdenum, platinum, and iron. The difference between these two temperatures at 1600°-1700° C. was found to be 160° C. A number of determinations of surface brightness at fusion gave a value of 1760° C., giving a value of 1920° C. for the melting point of chromium. The experimental errors all tend to make this a low value. More accurate determinations will be made when larger rods of chromium are available.

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### March Rainfall of North-West India and Agra Upper Winds in December–January.

THE strength of upper winds in India promises to be a useful agent for long-range forecasting in this country. About 1926, Mr. J. H. Field (then Director-General of Indian Observatories) found some important relationships between Agra upper winds in September–October and subsequent winter precipitation over north-west India. Further investigations to forecast March rainfall, which I found to be very important for growth of wheat in the Punjab, revealed a correlation coefficient of − 0·82 between the departures from normal of westerly upper winds in a layer 3 km. to 7 km. over Agra during the second fortnight of December and first fortnight of January and the departures from normal of subsequent rainfall in March over the plains of north-west India. North-west India is taken to consist of the Punjab, the North-West Frontier Province, Sind, Rajputana, and Gujarat. The figures for calculated and actual departures of rainfall over this area are given in the accompanying table and are exhibited graphically in Fig. 1. The upper air data are available for 15 years.

| March Rainfall over Northwest India. | Yearly departures from normal. Normal rainfall = 0·45" | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1915 | 1916 | 1917 | 1918 | 1919 | 1920 | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 | 1928 | 1929 |
| Actual | +1·0 | -0·3 | 0 | +0·8 | -0·1 | +0·1 | -0·4 | -0·4 | -0·1 | -0·2 | -0·4 | +0·9 | -0·2 | -0·1 | -0·4 |
| Calculated from Agra upper winds in Dec-Jan. | +0·9 | 0 | +0·2 | +0·3 | -0·1 | +0·1 | -0·4 | -0·4 | -0·2 | -0·4 | -0·5 | +0·4 | -0·1 | +0·4 | -0·1 |

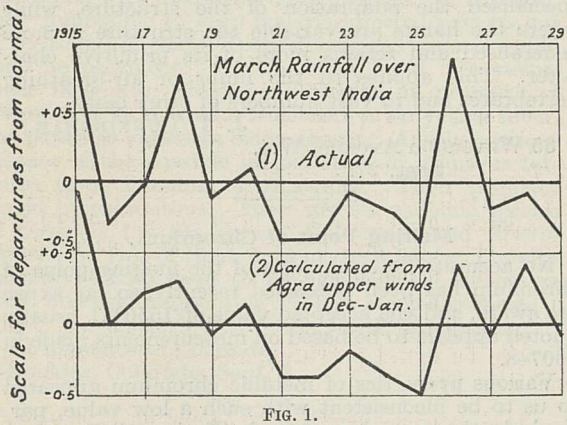


FIG. 1.

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### Science and Engineering.

IN his very interesting presidential address to Section G (Engineering) of the British Association, portions of which appear in NATURE of Sept. 14, Prof. F. C. Lea attributes to J. V. Poncelet the enunciation of " the guiding principles underlying the design of vanes receiving moving fluids ".

I think Prof. Lea will find that it was L. N. M. Carnot (the father of Sadi Carnot) who, in 1787, first laid down the basic rules that water engine efficiency must depend upon the fluid entering without impact, and leaving without energy. General Poncelet published a memoir on water wheels in 1826, and claimed that the design of his wheel satisfied Carnot's conditions. The Poncelet wheel could scarcely be called a turbine, however. In 1827, Fourneyron constructed a machine which, in addition to being a commercially useful reaction water turbine, also went a long way towards meeting Carnot's requirements. Having regard to the date of Fourneyron's pioneering work, and the extraordinarily high efficiency of 87 per cent reached by his first turbine, one cannot help feeling that his name should at least be bracketed with that of Poncelet when tracing the beginnings of turbine development.

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### Band Spectra of the Oxides of Praseodymium, Neodymium, and Samarium.

BY a special arrangement of the oxyhydrogen flame, by which the dissociation of the oxides into metal and oxygen is retarded, I have been able to volatilise completely the oxides of praseodymium, neodymium, and samarium, and to photograph their emission spectra between λ8000 and λ2400.

The oxide of praseodymium shows a band spectrum extending from the extreme visible red to the violet; the most intense groups of bands are at λλ6475, 6282, 6022, 5765, 5692, 5597, 5352.

The oxide of neodymium shows groups of bands between the extreme visible red and about λ6000; the most intense group of which is at λ6580.

The oxide of samarium shows a very complicated band spectrum between λ7000 and about λ5800; the most intense group of which is at λ6506.

No bands in the ultra-violet region have been found as yet. These spectra are very likely to be attributed, at least in part, to diatomic molecules.

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## The Southern Rhodesian Ruins.

### RECENT ARCHÆOLOGICAL INVESTIGATIONS.

By G. CATON-THOMPSON.

SINCE Dr. Randall MacIver investigated in 1905 the problem of the age and origin of the Southern Rhodesian ruins, little evidence on the purely archæological side has been forthcoming, except that Mr. Douslin, then Minister of Public Works in Southern Rhodesia, partially cleared in 1915 the deep deposits in the so-called Western Temple of the Zimbabwe Acropolis. In 1924, Sir Arthur Keith reported that four ancient skeletons found in various gold-mines, and one from Zimbabwe itself, were of Bantu type, but there is no evidence that these skeletons were those of the original miners.

Dr. MacIver, both in Mashonaland and Matabeleland ruins, found at levels considerably lower than the foundation courses of the containing walls, datable Oriental and European imports of medieval age, consisting of Chinese porcelain, Persian faïence, Indian and Venetian beads, and Arab glass. These facts argued conclusively to his mind the general contemporaneity of the buildings with medieval times. With these dated imports was a quantity of native African pottery, metal work and other objects, differing little from those still made by local Bantu tribes to-day. No object datable as earlier than early medieval was found by him, or had indeed ever been found by the too active amateurs who had preceded him, who had had the pick of the untouched ground, but clung without concrete evidence to the idea of a Phœnician or even older South Arabian origin.

MacIver's argument was immensely strengthened by a structural peculiarity of the Rhodesian buildings, namely, the presence of very hard artificial floors of crushed granite (certainly contemporary with the walls), with which the builders furnished their enclosures and which, when intact, offer an absolutely impenetrable barrier against the infiltration of later objects to a lower level. In Zimbabwe's Elliptical Temple alone, MacIver put down seven test trenches through these floors to see what objects lay beneath. The results of six of these tests were as follows: In one case there was nothing; in four cases native objects identical with those found *above* the cement floor with dated medieval imports, were discovered; in one case two pieces of imported white porcelain, in company with an iron spear-head and native pottery, were found. MacIver does not specifically date these porcelain fragments, but classes them in his generalisation as medieval.

The seventh test, which was made in Enclosure 15, has become historic. Mr. R. N. Hall had, in previous years, all but cleared out this enclosure, removing 12 vertical feet of deposits from above the original cement floor, at which level he stopped. His published section shows Nankin china, Arab glass, and native pottery in what he calls his fifth stratum from the top—a stratum immediately overlying the original cement floor; from this fact he inferred its later date. Accidentally or otherwise, Hall left a small section standing. This was found and critically examined by MacIver, who asserts that Hall's stratigraphy was mistaken, and that his fifth layer, containing the medieval china and glass, was, in reality, not a separate stratum, but an integral part of the cement foundations of a hut, forming a stratigraphical unit with the cement floor on which it rested. That being so, the cement would be dated by the objects Hall found in it as medieval. MacIver carried on excavation at this spot through the cement floor down to bed-rock 5 feet or so below. He got no datable objects; but a definite stratum of ash and sand was encountered, its level being some feet below the level of the foundation courses of the Temple walls. This lowest stratum contained coiled bronze wire bangles, native pottery, and spindle whorls, similar to the same objects found associated with the medievally dated products at higher levels.

On inference, therefore, and in conjunction with his positive evidence, MacIver urges the approximate synchronism of the two within a century or two. The evidence bound up in that earliest stratum is obviously extremely important to the whole dating question, and I have concentrated our researches upon it.

At Dhlo-Dhlo, in Matabeleland, MacIver got more evidence of a corroborative nature. Beneath the unbroken cement floor of a platform in the heart of the little stronghold, he obtained Nankin china and Arab glass, lying side by side with typical African native iron and other objects. The midden and other places produced the same result.

My plan of work was as follows: First we tested the stratification over a wide, continuous area, not only down to bottom, but also with particular reference to its behaviour in relation to main walls in order to see if evidence could be collected proving the walls contemporary with a pre-medieval level. Secondly, we checked the results by means of excavations in the deepest undisturbed sections available in other areas, both at Zimbabwe and far afield in distant ruins, as well as by excavations vertically beneath some structure of unquestionable antiquity.

To fulfil the first part of this programme, a site had to be found providing two essentials not easy to come by:

(1) A site unquestionably as old as Zimbabwe's Elliptical Temple.

(2) A site showing an intact cement floor, and yet a site of sufficiently minor importance to warrant the inevitable destruction of that floor.

Dhlo-Dhlo, which I visited and tested on several

occasions, failed under the first heading; the Zimbabwe Temple and Acropolis under the second.

### The Maund Ruins.

I found the spot which seemed likely to meet the case at the Maund ruins in the Valley of Ruins, Zimbabwe. The walls are ruinous, but show all the features characteristic of the Temple—the rounded, bastioned entrances, the grooved doorways, the peculiar concave or convex swing out of the bottom courses to form stepped approaches.

My test pit on virgin ground outside the Maund walls to prove the character of the natural soil showed 12 ft. 6 in. of yellow granite-sand sub-soil of Quaternary age; this was overlain by a layer of red hill-wash about 2 ft. 6 in. thick. This yellow sandy soil forms the sub-stratum of the whole of the Maund ruins, and excavations were not carried below its surface level. The Maund shows the curiously disconnected conglomeration of arcs of elliptical walls, so characteristic of the Rhodesian ruins. Some of these bound enclosures; others refuse to be connected up on any coherent plan whatever. The walls end abruptly, and our excavations, in only one case, revealed a foundation linking up two separated lengths.

Beneath a thin skin of humus we found 10 in.-1 ft. of a hard, yellow, artificial cement formed of pulverised granite. This had been laid as a floor over practically the whole area, and it covered the bottom three or four courses of the walls. This cement, in turn, overlay 2 ft. 6 in.-3 ft. of a brown-red, silty soil of natural origin—hill-wash—but containing charcoal, sherds, and iron tools and slag. Upon this the walls were actually built, and we found this to be the case, with only one exception, in every one of the twenty-nine segments of walls contained in the Maund ruins. (Substantial sections were left standing for examination by members of the British Association.) The red, silty soil passes vertically beneath the walls, which rest directly on it without any prepared foundation. In only one case does a wall rest upon the granite cement floor already described, and this wall appears structurally to be an after-thought. Above the cement floor there was a layer of humus of variable thickness, containing abundant sherds.

In the absence of any established sequence for ancient Rhodesian pottery, it is impossible to say with confidence what objects in this latter position belonged to the period of the cement flooring (the Zimbabwe period, let us call it) or what had shifted down on to it through the humus—or, inversely, what had shifted up into the humus from the surface of the ancient floor beneath. Though the cement flooring is barely covered in some places, in many others there is a large amount of red clay, locally called *dagga*, extensively introduced into these and all other ruins for hut building ('pole and *dagga*' huts). In places the *dagga* clay is piled over the granite cement floor, and in others there are clean cuts through the cement and these are filled with *dagga*. This shows that the *dagga* is later than the cement, but there is little difference in the respective contents, and probably no great length of time separates them.

Beneath the intact granite cement floor 10 in.-12 in. thick, and as hard as stone, we obtained 418 sherds of coarse, gritty, red-brown ware. The rims have a flat lip sometimes decorated with diagonal or other arrangements of shallow, square or round punches in the wet clay. Dr. MacIver figures what appears to be similar ware from the Niekirk ruins near Umtali. It is of interest to remember that he judges the Umtali-Niekirk Inyanga group of ruins to be rather older than Zimbabwe. With this class of rough pottery was a small quantity of plain black polished ware, indistinguishable from that found all through the higher levels. Iron slag and weapons were found throughout this layer, and also fragments of bangles of flat bronze wire coiled over grass fibre. These finds are just what MacIver got in his lowest ash stratum in Enclosure 15 of the Temple.

No case can be established for an occupation before the building period, and all objects excavated from a sealed deposit of this period in the Maund are typically Bantu. In the course of the work, interesting paved pathways were uncovered; these will be discussed when the detailed results of the work are published.

### The Acropolis Sites.

The hill-top fortress shows evidence of many successive additions, of terraces faced by curving walls, around the original centre; it also contains the enclosure called the Western Temple. Two test-diggings revealed the middens of the early inhabitants. One of them reached granite boulders at 18 ft. Here the top 12 ft. 6 in. was *dagga* clay, artificially laid down. It yielded good iron implements and fragments of a soapstone bowl in the top 5 ft. Below the *dagga* was a black midden with ox and other bones, sherds, also two undecorated native pots, six pottery phalli and fragments of bronze wire bangles. On rock-bottom there were two more pots, apparently Bantu, and another phallus.

The other pit, which was dug through a terrace, showed a paving of thin granite slabs 15 ft.-17 ft. below the surface, surrounding a curious stone structure; the objects found in the underlying 5 ft.-6 ft. of black midden are therefore as definitely from a sealed deposit as those from the Maund. This midden, at 18 ft.-25 ft. beneath the present surface, obviously comparable with the other, yielded further types of objects such as three fragments of iron tools, iron slag, a white porcelain bead threaded on thin bronze wire, and eighty other imported beads in opaque glass. Sherds included the usual black or grey ware, but also fragments similar to those in the lowest stratum in the Maund. Here, therefore, there were inhabitants when the building of pavements such as those of the Maund came into use; whilst at some still later period, the area was levelled up to form a terrace, with high retaining wall, by

the introduction of *dagga* and rubble, completely burying thereby the earlier building. This evidence is in harmony with that obtained in 1915 by Mr. Douslin (*Proc. Rhodesia Sc. Assoc.*, June 1921–22).

### THE ELLIPTICAL TEMPLE.

Trenches totalling 260 ft. in length and averaging 5 ft. 6 in. in depth have been made near the Temple, in every case reaching down to the granite rock. The results have been the same everywhere, the finds from bed-rock level being analogous to those from the midden on the Acropolis. These finds give confirmatory evidence but are not of primary value because they do not come from sealed deposits. In one place, adjoining the Mauch ruins, rock bottom is reached at 9 ft., or about 4 ft. 6 in. below the bottom course of poorly built walls. Here there are two superposed stone pavements, and here again the oldest layer, a bed of grey ash and sand 1 ft. 3 in.-1 ft. 6 in. thick, resting on bed-rock, yielded imported glass beads. As this layer passes under the walls, it may be older than they, or it may belong to the period of construction.

Around the Conical Tower have rallied the theories of foreign origins and, with the consent of the Rhodesian Government and the help of a mining engineer, a tunnel was driven under the Tower from side to side, exposing the underlying deposits down to bed-rock. The tower rests, without any prepared foundation, on 5 ft. 6 in. or so of granite-sand. This sand yielded two palæoliths. Above this came a thin layer of reddish silt similar to that in the Maund ruins; this was sieved and washed. The objects recovered are a small iron band or clamp, a tiny gold bead, traces of a coiled bronze bangle, and a sherd of black pottery with metallic polish, similar to the ware found so abundantly in all our other excavations.

The purpose of the Tower remains obscure; no evidence has been found to suggest it was a grave; its workmanship is so haphazard that in a diameter of 18 ft. 4 in. there is a fall of 1·19 ft. That this is not due to later subsidence is shown by the fact that thicker courses to correct the error in the ground courses have been introduced higher up the Tower. This is scarcely the work of high civilization, and this opinion has been confirmed by numerous archæologists and engineers who visited the ruins with the British Association.

### SITES IN THE SABI RESERVE.

This reserve, of about 9,000,000 acres, lies on the watershed of the Sabi and Inyazitza Rivers. Matindere, the best known of the ruins here, has a rare dentelle pattern in its crescentic girdle wall. We made 160 ft. of trenches, reaching granite under about 2 ft. of veldt soil and rubble artificially introduced. The finds were the usual ones, and, in the adjacent midden, more than a thousand glass and shell-disc beads were obtained, as well as nineteen others of metal, bronze, and copper.

Chiwona ruins, unknown to all but four white people, yielded rough pottery phalli, hollow perforated bones such as are known from Khami, imported beads, bronze wire bangles and spindle whorls from the midden outside the walls. The site showed signs of recent occupation. A variety in the rather stale list of finds is a fragment of black polished pottery with a frog modelled in low relief climbing up to the brim.

Mshosho ruins, with relics of massive walls and a true Zimbabwe style of entrance, yielded, both from the midden and from the bottom of a fine rock-passage, recalling that of the Zimbabwe Acropolis, more beads, establishing its age as contemporary with that of the other ruins. Mshosho also had stone foundations for grain bins on its terrace-walls and contemporary with them.

Chibrumani ruins in the Sabi-Deruli district were also examined, and yielded similar results.

Beads have been classified from sites ranging from Dhlo-Dhlo in Matabeleland to the eastern regions of Mashonaland; these beads link up the dating evidence over this wide area.

### DATING.

Two fragments of Celadon glaze were obtained from the foundations of a hut of no stratigraphical importance, and these are said by the British Museum to be of the Sung period, tenth to thirteenth century A.D., but they probably reached this remote spot later on. As to beads, Mr. Horace Beck makes a preliminary statement that some are of south Indian types, not later there than 900 A.D. Other beads are of types found in remains of villages in Malaya, and also in similar sites in Borneo, the earliest dating for which seems to lie between 600 and 1100 A.D. We thus have imports the extreme dating limits of which *in their homelands* lie between 600 and 1300 A.D.: this evidence is supplementary, therefore, to that of Dr. MacIver. I should like to take this opportunity of expressing my admiration for his sound pioneer work.

It is inconceivable to me, as it was to Dr. MacIver, how a theory of Semitic origin could ever have been started. Every detail in plan, building, and contents seems African Bantu. Further, the construction is such that, apart from repairs, not one stone would be standing on another in a period reckoned in millennia and not in centuries. My respect for, and interest in, the Rhodesian ruins is enormously strengthened by these conclusions. Instead of a degenerate offshoot of a higher Oriental civilisation, we have a vigorous native culture showing high organisation, originality, and industry. It is a subject worthy of all the research South Africa can give to it; South African students must be bred to pursue it.

The thanks of the expedition are due to the Governments of Southern Rhodesia and of the Union of South Africa, to the Union Air Force, and to very numerous other helpers. The full results, with plans, diagrams, and other illustrations, will be published in book form.

## The Millilitre.

By VERNEY STOTT, National Physical Laboratory.

THE founders of the metric system sought to establish a simple relationship between units of volume based on units of length and units of volume defined as the space occupied by a specified mass of water. To this end they decided that the kilogramme should be the mass of a quantity of water, which, at its temperature of maximum density, had a volume of one cubic decimetre. Lavoisier and Haüy made a provisional standard kilogramme and Lefèvre-Gineau and Fabbroni were entrusted with the construction of the standard afterwards known as the 'Kilogramme des Archives'. Their work was reported to the Commission des Poids et Mesures in 1799, and the 'Kilogramme des Archives' was accepted as being accurately in accordance with the original definition of the kilogramme. The litre at that time could be regarded either as a cubic decimetre or as the volume, at its temperature of maximum density, of one kilogramme of water.

During the nineteenth century, however, serious doubt arose as to whether the accepted standard kilogramme actually did comply with the original definition of the kilogramme. This was because various determinations of the mass of definite volumes of water, such as the determination in 1821 of the mass in grains of a cubic inch of water, when reduced to metric units, gave very discordant results, as shown by the following table:

MASS OF WATER HAVING A VOLUME OF ONE CUBIC DECIMETRE AT 4° C.

| | | |
|---|---|---|
| 1821 | Shuckburgh and Kater (England) | 1000·475 g |
| 1825 | Svanberg, Cronstrand, Berzélius, and Akerman (Sweden) | 1000·290 g |
| 1831 | Stampfer (Austria) | 999·750 g |
| 1841 | Kupffer (Russia) | 999·931 g |

A proposal to construct a new standard kilogramme brought the whole subject under review in 1872, and the Commission Internationale du Mètre, after full consideration, then decided that the international kilogramme should be a copy of the 'Kilogramme des Archives'. The terms of the resolution were:

Considérant que la relation simple, établie par les auteurs du système métrique entre l'unité de poids et l'unité de volume, est représentée par le kilogramme actuel d'une manière suffisamment exacte pour les usages de l'industrie et du commerce et même pour la plupart des besoins ordinaires de la science;

Considérant que les sciences exactes n'ont pas le même besoin d'une relation numériquement simple, mais seulement d'une détermination aussi parfaite que possible de cette relation;

Considérant enfin les difficultés que ferait naître un changement de l'unité actuelle de poids métrique;

Il est décidé que le kilogramme international sera déduit du kilogramme des Archives dans son état actuel.[1]

Thus the original definition of the kilogramme was deliberately abandoned, and the kilogramme is now simply the mass of the plain cylinder of platinum-iridium alloy known as the International Prototype Kilogramme.

As a result of this decision, the litre could no longer be regarded as equal to both the cubic decimetre and the volume at its temperature of maximum density of one kilogramme of water. The litre, however, was not precisely defined until 1901, when the definition at present accepted was formulated as follows:

L'unité de volume, pour les déterminations de haute précision, est le volume occupé par la masse de 1 kilogramme d'eau pure à son maximum de densité et sous la pression atmosphérique normale; ce volume est dénommé litre.[2]

As a consequence of this definition of the litre and the earlier abandonment of the original definition of the kilogramme, there is now no direct theoretical relationship between the definitions of the litre and of the cubic decimetre. The relation between the two units rests entirely upon experimental determination. As a result of extensive series of experiments carried out with great care at the Bureau International des Poids et Mesures, Sèvres,[3] and a recent small correction introduced by Ch.-Éd. Guillaume,[4] the value accepted at present for the relation between the two units is

$$1 \text{ litre} = 1000{\cdot}028 \text{ cm}^3.$$

Any uncertainty in this equivalent may be regarded as confined at most to one or two units in the last decimal place. Remembering that Lefèvre-Gineau and Fabbroni made the 'Kilogramme des Archives' in the eighteenth century, the smallness of the difference between the litre and the cubic decimetre shows that their work must have been carried out with great care and skill.

It is perhaps unfortunate, but, in view of the great experimental difficulties, scarcely surprising, that the International Prototype Kilogramme does not exactly fulfil the intentions of the founders of the metric system. As a result, there now exist two distinct metric units of volume—the cubic decimetre and the litre—which are nearly equal in magnitude, and confusion has arisen through due regard not always being taken of the distinction between the two units. For most practical purposes the difference is so small as to be negligible, but where high accuracy is necessary it cannot be ignored.

The two units correspond in type to the cubic foot and to the gallon respectively in the British system, and both types of units have their uses. For example, where quantities involving volume occur in mathematical calculations, or when volumes are determined directly from linear measurements, the cube of the unit of length is normally the appropriate unit of volume; many determinations of capacity or volume are, however, most conveniently made by methods involving the weighing of quantities of water or other liquids and the second type of unit is then the more appropriate.

In scientific work involving the use of volumetric glassware, a further source of confusion has been introduced into the question. About the middle of the nineteenth century, at a time when, as we have already seen, the mass of a cubic decimetre of water was not at all accurately known, Mohr[5] suggested, in effect, that the space occupied at 17·5° C. by a quantity of water having an apparent weight in air of one gramme should be taken as the unit of volume for the purpose of calibrating volumetric glassware. His system, therefore, did not involve any knowledge of the weight of a cubic centimetre of water, which was a distinct advantage when accurate data for this was not available, but quite inexcusably he called his unit a cubic centimetre. The system was widely adopted, and the practice still exists to-day of regarding, say a "1000 c.c." flask, as being correct, if, at its own standard temperature, it contains a quantity of water having an apparent weight in air of one kilogramme, this being a stage less definite than Mohr, who did retain a definite standard temperature. Actually such a flask, if its standard temperature were 15° C., would contain 1001·98 cm³. Further, apparatus made on this basis and marked "c.c." exists side by side with apparatus similarly marked "c.c.", but correctly calibrated in terms of the cubic centimetre. Thus of two flasks each marked "1000 c.c.", one might contain 1000 cm³ and the other 1001·98 cm³.

The Joint Committee for the Standardisation of Scientific Glassware found that one of its first tasks was to consider this position, and in 1924 it unanimously recommended :

> That the recognised international metric units—the 'litre' (l) and 'millilitre' or thousandth part of the litre (ml)—shall be used as the standard units of volume, and that standard volumetric glassware shall be graduated in terms of these units and marked 'ml' instead of 'c.c.'.[6]

In the edition of the pamphlet, "Tests on Volumetric Glassware", issued in 1924, the National Physical Laboratory also strongly recommended the use of the millilitre for volumetric glassware.

British manufacturers quickly acted on these recommendations, and for some years past practically the whole of the volumetric glassware submitted to the National Physical Laboratory for test has been marked 'ml' by the manufacturers and calibrated in terms of the millilitre.

A parallel development, also recommended by the Joint Committee for the Standardisation of Scientific Glassware, is the increasing use of the millilitre and the abbreviation 'ml' in publications dealing with methods of analysis. For example, whilst 'c.c.' was used in the first edition of "Standard Methods of Testing Petroleum and Its Products", published in 1924, 'ml' was exclusively used in the second edition published in 1929. The millilitre is also being used in Government publications, for example throughout the section on methods of analysis in Statutory Rules and Orders, No. 421—The Fertilisers and Feeding Stuffs Regulations, 1928. It is also used in papers on analysis in the American official publication, *Bureau of Standards Journal of Research*; incidentally, the Bureau of Standards recommended the use of the millilitre for volumetric glassware in 1916.

Another direction in which the millilitre is being employed in preference to the cubic centimetre is in the use of g/ml as a unit of density instead of g/cm³. In the "International Critical Tables", for example, g/ml is extensively employed. This is a logical development from the fact that ultimately practically all determinations of density involve the density of water, which from the definition of the litre is unity at its temperature of maximum density (approximately 4° C.) when expressed in g/ml. It follows that specific gravities $S_{t/4^\circ C.}$ are identical with densities in g/ml at the temperature $t$. Sometimes, however, specific gravities $S_{t/4^\circ C.}$ are quoted as densities in "grammes per c.c.", even though the number of significant figures given is such as not to warrant the difference between the millilitre and the cubic centimetre being thus ignored.

In general, the millilitre is the most appropriate unit to use whenever the particular determination is such that the millilitre is directly involved in virtue of the weighing of quantities of liquid entering, directly or indirectly, into the determination.

It would probably avoid a considerable amount of very undesirable uncertainty and confusion if the correct internationally approved abbreviations ml and cm³ were systematically employed to represent the respective units and the abbreviation 'c.c.' entirely discarded.

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## Obituary.

### PROF. W. H. PERKIN, JUN., F.R.S.

THE death of William Henry Perkin, junior, on Sept. 17, is both a tragedy and a catastrophe in chemistry. The loss is irreparable : men of his type are not being made to-day ; they cannot be under the prevailing system. He is taken from us, not after he had accomplished his task, but in the fullness of his working powers, as ardent as ever in his enthusiasm for the laboratory bench as the *fons et origo* of all chemical discovery. There have been disturbing signs of late years that he was losing some of his physical vigour. At the time of the Pedler lecture, in May last, he admitted that he felt ill but no organic lesion was discovered and his death has not been assigned to any definite cause. The beginning was severe stomach derangement.

Perkin's career was straightforward and uneventful. Born on June 17, 1860, not with a silver spoon in his mouth but one of horn or bone, full of colour, only four years after his father's discovery (when eighteen years old) of the *first* aniline dyestuff, *Mauve*, he grew up in the healthy atmosphere of rural Sudbury, at first going to school locally, then, at the age of fourteen, to the City of London School, passing at seventeen to the Royal College of Science, whence after two years he went to German universities, first to Wislicenus at Würtzburg, then to Baeyer at Munich. He was five years abroad. On his return he spent a year in the Owens College, Manchester. In 1886 he went to Edinburgh as first professor of chemistry at the newly founded Heriot-Watt College, of which (Sir) F. A. Ogilvie was Principal. Hudson Beare was his engineering colleague. Here Kipping was his assistant—until he became mine. I recollect going north to steal him, because of the reputation the two had already made for themselves. In 1892 Perkin passed from Edinburgh to Manchester, to succeed the great Schorlemmer and become the colleague of H. B. Dixon. In 1912 he was appointed to the chemistry chair at Oxford, in succession to Odling. Odling had quietly collected Dürers and given delightful breakfasts: Perkin at once began to make chemistry hum and, at the same time, played the piano and tilled the soil, with his own hands, with a skill and vigour and bonhomie unimagined up to that time to be possible in the river-valley atmosphere of grassy, wordy, Oxford. Having had relations in Oxford, with whom I often stayed as a youth, I have known the town at least since 1860; I have, therefore, always been specially interested in the University. At the time of Odling's appointment, we—young chemists of the day—foresaw and knew what must be the fate of our subject during his reign.

Excepting the fine work of the Harcourt school, Oxford was chemically dead when Perkin went there: now it is alive—even exploding; alive too in the other sciences; rather eaten up with mathematical vanity, perhaps, yet well upon the upgrade, with many of its early failings corrected (see NATURE, June 16, 1904; June 30, 1921). The chief danger lies in its neglect of the arts. Whereas, formerly, it was all for words, to-day it is unduly neglecting them and fostering the fell disease of the age—specialisation. It is strange that *Universitas* should now spell narrowness. The pendulum of reform will always swing too far. The unholy competition which prevails in the schools, the false motives which guide study, are common to all schools: the starkly staring vice of an age of highly competitive commerce, unrelieved by any higher æsthetic sense. The spirit in which the Perkins have worked is all but dead—the cry of art for art's sake, of science for the sake of science, is seldom heard: instead, bold advertisement extends even unto the most distant stars; the Nobel prize, medals and honours invite. An Epstein ugliness is allowed everywhere. The Epsteins would even restore us to phallic worship, it seems: at least, the railway magnate is actively aiding them to do so. Perkin senior would have loathed to pass through St. James's to-day; his sympathy would be entirely with St. Giles.

As soon as the young Perkin could toddle, to be with his father he will perforce have followed him into his laboratory: to be duly taught how to blow himself up without harm, then left to develop: we know he learnt much at home. There is no record of distinction at school. Perkin jun. took to chemistry as a duckling takes to the water: it was in his blood, it was in his bones. He became one of the most accomplished and productive workers the world has known: like his father before him, he did his work—all the critical part of it—himself. His students were more often than not just his body slaves—employed in preparing endless amounts of difficult raw material, for he had princely ways of working with large quantities: yet could do with microscopic amounts. No Lamarckian influences were the cause of his character: no manganese he ate ever made him black (it's pretty certain it hasn't any moth): he was the purest possible product of an hereditary transmission of genius; his younger brother, A. G., is all but his twin as a chemist, also gifted with 'fingers' of surpassing delicacy.

To understand the sons it is necessary to have known the father. When their characters have been grasped, he and his two sons will stand out as a veritable trinity—one nature in three bodies: necessarily with variations but alike at core, intellectually and morally. It is a matter of interest, that a third son, by a second wife, who also took to chemistry and became a consultant, was purely commercial in his outlook and had none of the holy fire in him which almost consumed his father and step-brothers. I am one of the very few who knew the father intimately but many are left who have known the sons: if we are ever to understand the psychology of the chemist, it behoves us all, without delay, to write down all that we know of the triad, giving such analyses as each of us can—leaving the several accounts to be collated and woven into a memoir by competent sympathetic hands. I already have one invaluable notice, from one of the first to work under him in Manchester. Whoever may write "Father and Sons" will have an opportunity of framing an epic of modern discovery of surpassing interest.

W. H. Perkin the first was a phenomenon. At fourteen he took his own photograph; he also applied to Faraday for a ticket of admission to the Royal Institution and attended his lectures. Less than ten years afterwards, Faraday returned the compliment by being present at the lecture Perkin gave at the Chemical Society (May 1861) on "Colouring Matters derived from Coal Tar". He made his discovery of mauve (1856) when a lad of eighteen: it is true, while a student under Hofmann—but as a private venture, in his laboratory, at home. The primary discovery meant little, it was an accident; the separation of the dyestuff by one so young and untrained was a great feat; a still greater was the persistence he showed in getting it tested as a dyestuff in practice; greatest of all was

the marvellous skill and enterprise he displayed in undertaking its manufacture for dyers' use. The founder of the organic chemical industry, now a colossal enterprise, he was a full-blown manufacturer at nineteen : so magnetic was his enthusiasm, that his father (a builder) was inspired to put most of his capital into the son's new venture, his brother to become his helper, especially on the business side. Almost everything had to be done for the first time —materials got together, appliances designed, processes invented, every detail worked out.

Perkin sen., in fact, was possessed not merely with scientific interests but with an astounding technical *flair*. A few years later, when Graebe and Liebermann made the colouring matter of madder root, *alizarin*, artificially, Perkin joined in the chase and was the first in the field with a practical process, that upon which the most remarkable and intricate industry of modern times has been largely built up. It is noteworthy that Faraday was the first to use the sulphonation method which Perkin adapted to the manufacture of alizarin. Still later, by the discovery of a method of producing coumarin —the odoriferous principle of the Tonka bean— Perkin was to lay the foundation stone of the artificial perfume industry, though by this time he was too tired of the works to develop his discovery ; he also contributed not a little to the artificial production of indigo, the importance of which, of course, he could not foresee.

Nevertheless, successful to a moderate degree as he was as a manufacturer, he was so possessed by the demon of scientific inquiry, that Perkin sen. gave up his business in the early 'seventies and turned his attention once more exclusively to his laboratory. I learnt to know him at this period and became his fellow secretary at the Chemical Society. Great as he was as a manufacturer on the technical side, he lacked the commercial spirit. I have never known a more upright, less worldly man. Herein lies the explanation of the son. The holy spirit of inquiry, which burnt so steadily in the father, flared up in the son, at an early age—probably the fire was greatly fanned by Baeyer. In praise and pursuit of what he always spoke of as Research, Perkin jun. was as mad as several *Mad Hatters*. His joy over each beautiful new substance was extreme— he gloried in constructing. This gave him his power but limited his sense of proportion and his influence. He had no patience with those who did not engage in research : in fact, he thought little of them as chemists. In his laboratory, he was master of a supreme technique. Yet he never displayed the technical *flair* shown by his father. I believe the work he did for the chemical industry, during and after the War, was of no particular moment—he had not really seized its problems and made little contribution to its development, except in details. Of all our chemists, he has been the most human, the most inspiring, in his absolute adoration of the laboratory and its ineffable art— an art fully disclosed only to the few—an art insufficiently encouraged and practised to-day : yet the art upon which alone industry and progress are founded. Hypotheses may be built up in the air and stated upon paper : they can only be tested and developed in the laboratory. Our schools have yet to give proper training in the use of the laboratory—to put it upon a scientific and real footing.

Perkin jun. has set Oxford a great example and a great task : that of organising the teaching of chemistry *as a whole science* and making it effective as such, as the necessary helpmate of all the experimental sciences and as underlying life. Oxford and Cambridge are national universities, not technical schools ; it should be their office to provide general scientific instruction for all—not to rear narrow specialists. They receive between them by far the most important share of the intellectual ability of the country. It behoves them to return this in the highest state of efficiency. Unfortunately, the method which prevailed in the past, especially in literary subjects—coaching in association with competitive examination—has been extended into natural science studies. The result is an artificial system of education which is not calculated to fit the recipients for really efficient service in the world. The coached mind never gains a proper freedom. The work the system entails upon teachers—work that is highly remunerative and therefore popular —can have but one result : that of sterilising the teachers' practical activities as original inquirers. Men coming from universities where coaching does not prevail, on the average, are better trained for public service than are those coming from our two ancient universities. The public schools suffer greatly under the system : having been coached themselves, the teachers they draw from Oxford and Cambridge naturally coach rather than train the young minds they direct. The whole country suffers as a consequence. The funds and administration of the two universities have been made the subject of public inquiry and regulation : far more important would it be to examine into their ethics and raise these in standard. An appointment in chemistry at Oxford to-day is no local affair but a matter of national concern—such is the present and coming supreme importance of the science.

The act by which Perkin jun. made himself most noteworthy in the University of Oxford was in securing the provision of a fourth year, to be spent in learning the methods of research, as necessary for the honours degree. It is a grave question whether this be a wise provision. It involves the assumption, that the years previous to the fourth are not years in which the spirit of inquiry is inculcated and rampant. They should be—yet, if they were, it would not be necessary to set aside the fourth year for the purpose. To begin in the fourth is too late. There are many students who never can become original workers : at least some of these may be trained to be very effective teachers. Men of the Perkin spirit may well have exaggerated the value of the quality which is their inherited and almost divine prerogative.

Perkin jun. has painted a wonderful gallery of chemical portraits—among them several masterpieces : in the polymethylene series, in the terpene series, last but not least in that most fascinating of all—the great group of natural alkaloids. To

discuss these is now impossible: of their permanent great value there can be no doubt. He painted many studies in preparation for larger compositions; he scarcely ever descended to pot-boilers. Probably, he is most deserving of study as a great master of method: the certainty of his touch was most remarkable; the range and extent of his knowledge of past achievement was astounding. Yet he formed no school at Oxford. The fine laboratories he built were largely used for elementary instruction in organic chemistry but men did not go to him from the colleges: those who worked under and with him mostly came from outside. He was no prophet in his own house. The college system must be made to give way to one of unselfish co-operation, if training in chemistry, as a complete science, ever be given in Oxford. The mistake Perkin jun. made in going there was not to make this a condition of his entry—he was strong enough to exact such bargain. The change had already been made in Cambridge. The man appointed to be his successor should be strong enough to carry out this necessary, most vital reform.

Although Perkin's fame among chemists was even greater than that of his father and the value of his work was fully recognised here, it was not everywhere properly rated abroad; the list of his honours is not long. Especially have we to complain that he was never awarded the Nobel prize. His work may be equated with that of anyone who has secured this: very few of the chemists to whom it has been given have done work of the same importance to our science. His work was not merely that of a pioneer and highly original in design and execution: he pulled many plums out of the chemical pie, succeeding not once but often in solving grand problems. Still, there was nothing of the sensational about his work and his modesty ever prevented him from advertising. In this respect he was a simpler man even than his father. The Swedish assessors seem to have no eye for an English chemist—thus, in the past, they have overlooked men such as Crookes and Dewar. "Most injustice is not inflicted deliberately but because people do not take the trouble to think things out. Thinking gives them headaches and, if persisted in, may cause them to change their opinions. So it simply isn't done" (Rudyard Kipling). I have heard it said, that this was because these were not nominated by their countrymen: the excuse will not apply to Perkin jun. If the rules for the race involve this, the sooner they are altered the better: it should rest with the assessors to take all necessary steps to make the award in a scientific spirit, not contingent upon chance nomination. Colleagues, if not countrymen, are too often jealous of each other and inclined to work in companies. Overdue also is an inquiry of the effect of the prize upon our scientific *morale*—whether it have not introduced a wrong spirit into the art of experimental inquiry and whether the money could not be used to better purpose.

Perkin jun. was also overlooked by his father's Livery Company, the Leathersellers. He should long ago have been made an honorary freeman. His father's picture hangs in their Great Hall. The gown he wears is proof that he was appreciated, at least by Scottish learning: the St. Andrews scarlet is made dominant through him in the City of London. I have often said that some day the picture will be the most valuable possession of the Guild. When Master, Perkin grimly sought to make water prevail at their festive board and would have filled the Loving Cup with mere soda-water; perhaps this made the name less thought of than it should have been.

Perkin jun. had a very happy life. He was ever full of *joie de vivre*. He was happy in his achievement, happy in his home. He married in 1887. Kipping, in the course of his studies, had discovered beauty among his cousins in the Quantocks and took the chief with him, in the long vacation, to Bridgwater, to stay with his uncle, W. T. Holland. Perkin at once fell to the eldest daughter; Kipping, a little later, married the second. Afterwards, when Kipping was my chief assistant at the Central Technical College, Kensington, and Lapworth a student with me, visiting Kipping, Lapworth was captured by the youngest sister. Three distinguished chemists thus became intimately linked through their wives. It is a distressing fact that these unions were not all fruitful: only Kipping had children. The two Perkin brothers have no issue, so that the male line comes to an end with them. There would seem to be some influence at work promoting sterility in scientific workers. The problem is one needing close attention, especially by the advanced woman; no birth control seems called for, rather the opposite. Perkin was a man of great physical as well as spiritual energy. Whatever he did was done with an astounding intensity and concentration of purpose—he never spared himself. In Manchester, he played cricket and also tennis with great vigour. Then, when the pace became a little too rapid, he took to gardening and became an expert in the glass-house cultivation of auriculas, carnations and chrysanthemums; he has always been noted as a successful grower of carnations. At Oxford, he gloried in roses and the herbaceous border.

To limn father and sons fully will be to tell a wonderful story of effort and achievement. Such differences as there have been between them are rather of time than of temperament. The father was an early Victorian, with a highly developed vein of narrow Victorian piety—an evangelical, almost a puritan—accentuated probably by his wife's rigidity of outlook. Sons brought up in such an atmosphere naturally tended to go off at a tangent—yet never viciously. It has been told of one brother, that he added to his pocket money by playing the flute in a music hall orchestra: the parents would have thought him to be in the grip of the devil had they known this. The sons have belonged to our modern period, though scarcely to the 'skirt above knee' stage: a display of ankle to the beauty line was sufficient for W. H. jun., who was always the simple æsthete. W. H. sen. was a good judge of wine in his early days and his brother was always the bon-vivant; later he became total

abstainer and vegetarian, probably to his injury. W. H. jun. loved good living and kept a good cellar —college port appealed to him when of the right age. He was eminently hospitable, especially to musicians—entertaining if possible, everyone of musical distinction who happened to come to Manchester or to Oxford, greatly enjoying the opportunity that this gave him of indulging his love for chamber music and playing piano in trios and quartettes. The father played both the piano and the violin—the sons have been little short of professionals, the younger being master of almost every wind instrument.

Sweet were the uses he made of heredity—with it seeing good in many things. His loss is to be bitterly deplored in our science and in our society.

HENRY E. ARMSTRONG.

## MRS. H. R. MILL.

FRANCES MILL, who died Sept. 10, was the daughter of Dr. F. R. MacDonald, and was born at Inverary, Argyll, where for a time she attended the Parish School. The effects of its democratic atmosphere were perhaps discernible in the adaptability and wide sympathies which made her later an accomplished hostess, and enabled her to find points of contact with all sorts and conditions of people. She displayed early a great interest in geography and the kindred sciences, and a visit of about a year's duration to Australia, prior to her marriage to Dr. H. R. Mill in 1889, stimulated this interest, and helped to prepare her for her prolonged collaboration with him in his geographical and meteorological work. She proved a quick and careful proof-reader, prepared the indexes to most of her husband's books, and acquired great skill in the painting of lantern slides for use in connexion with his lectures.

Mrs. Mill assisted in the bathymetrical survey of the English Lakes, carried out by Dr. Mill and Mr. Heawood, in which her quickness, accuracy, and skilful steering of the boat proved of great value. Her powers of observation and keen perception of the unusual are commemorated in the name of the rare Central African monkey *Cercopithecus Francesca*. The skin of this monkey was sent to her with some other furs by a missionary friend, and though it was twice rejected by the authorities of the Natural History Museum as coming from a region too well known to yield anything new, her persistence led finally to an admission that it belonged to a previously undescribed species.

Over a long period of years Mrs. Mill attended regularly the annual meetings of the British Association, and took part in the Canadian meeting of 1897 and the South African one of 1905. She accompanied her husband also in all his travels, visiting every Dominion of the British Empire, in all the continents and over all the oceans. She was a familiar figure at the meetings and social gatherings of the Royal Geographical Society, and enjoyed the friendship of all the great travellers and explorers of the last forty years. In London, at Mill Hill, and after 1914 at Dormans Park, Surrey, her hospitable instincts found free play within a large and varied circle; for wide as her scientific interests were, they by no means exhausted the range of her activities.

## News and Views.

AT the quarterly meeting of the Council of the Royal College of Surgeons of England on Oct. 10, Lord Moynihan, president of the College, announced the foundation of a research scholarship in surgery by Lord Melchett. There is great need for such scholarships, as at present candidates for the staffs of our great hospitals have often to spend their time in coaching and offices of drudgery to gain a livelihood while waiting for a vacancy. The Melchett Scholarship, which is worth £500 a year and promised for a period of seven years, will permit a young surgeon to devote his time to research in one of the basal subjects of surgery—particularly experimental surgery. The Council of the College of Surgeons, by accepting Lord Melchett's gift and by founding another scholarship of like value from its own funds, has taken a step to supply a need which has long been felt in medical London. The laboratory accommodation in connexion with the museum of the college is being extended, and it is proposed that the scholars should be associated with the museum in their researches. The president of the college is also hopeful that a farm for experimental research in surgery and pathology will be established near London and in direct connexion with the museum.

AT intervals reports have found their way into the Press from Germany of some experiments conducted by a pyrotechnic specialist on the discharge of a rocket to very great heights. From a report in the *Times* of October 11 it appears that the Ministry of Communications has given permission to discharge a rocket which is designed to reach a height of some fifty miles in about one minute. There are no recording instruments to be carried; the height will be determined trigonometrically, although some difficulty should be experienced in following an object moving at a mile per second at such close range. The rocket apparently is 30 ft. long and 18 in. in diameter and consists of a double tube of metal which will be filled with liquid oxygen. By some mechanism not explained, four carbon rods immersed in it will be burned and the discharge of the generated gases will provide the propulsive force. The head of the rocket is fitted with revolving steering fins and the tail with stabilising fins. The nose contains a parachute which it is hoped will unfold when the motive power is exhausted and bring the rocket gently back to earth. The rocket will weigh 143 lb. when loaded. From the information published, it is scarcely likely that the optimistic hopes of the inventor will be

realised, but an experiment of this nature is well worth watching, as it may possibly provide a means, if controllable, of investigating the conditions in the upper atmosphere. The inventor, according to the newspaper reports, envisages a rocket post between Europe and America which would make the journey in about thirty minutes, but this may be regarded as optimism with news value. Although there is a tendency to consider the venture and its extravagant claims with a humorous tolerance, the results of the experiment will be awaited with some considerable interest in scientific circles.

AMONG the many attractions of the South African meeting of the British Association one of the most highly appreciated was the opportunity of examining the large number of copies of Bushman rock-drawings and paintings which had been brought together for the visitors' inspection. Especially valuable were those made by Miss Wilman, particularly as many of the engravings recorded by her have now disappeared. At Johannesburg, the collection made by the Frobenius expedition, which occupied three rooms, attracted much attention. The significance of this field of investigation in relation to South African prehistory has yet to be made clear. An opinion, for example, is gaining ground that the drawings may not be the work of the Bushmen but possibly of some other race such as the Korannas. Much more research on the age and sequence of the paintings has to be done before anything like a positive pronouncement can be made. Their resemblance to the palæolithic art of the north has of course often been pointed out; but detailed examination on strictly scientific comparative lines is still to be desired. An indication of the nature of future research was afforded by the communication from the Abbé Breuil which was presented to the Anthropological Section at Cape Town. In discussing the palæolithic art of Spain he pointed out one marked point of similarity between that school of art and Bushman art in the more diagrammatic treatment of the human body as compared with the realism of the animal figures. In this connexion we may mention that Miss Jean Marshall of Rothesay, a member of the Association, in a letter to us, states that while at the Victoria Falls she was much struck by the similarity in action and pose of the distorted shadow of a Kaffir walking in the sunlight to the Bushman figures, and suggests this as a possible origin of their style. The Abbé Breuil gave it as his view that the similarity or indeed identity of the Libyan rock-drawings and the Bushman figures might justify us in regarding Bushman art as a prolongation of the palæolithic art of Spain.

IN continuance of its scheme of development and settlement, the Commonwealth of Australia Government has authorised the construction of the Wyangala Dam on the Lachlan river. The dam will lie about six miles below the confluence of the Abercrombie with the Lachlan where the latter flows in a deep valley. The catchment area above the dam is 3000 square miles. It is estimated that the supply of water will be sufficient to irrigate about 1,357,000 acres along the Lachlan and other streams. Provision will also be made for the generation of hydro-electric power at the dam. In conjunction with a fuel burning plant, the dam will supply power for a distance of 100 miles.

THE Publications Committee appointed some time ago by the Commonwealth Government to administer a small fund for the publication of scientific memoirs of high merit, the printing of which was beyond the resources of local scientific societies and not attractive to commercial publishing houses, has made arrangements for the issue of two works. The first of these is by Dr. Edward Kidson, formerly of the Meteorological Bureau of Australia but now holding a similar office in New Zealand, dealing with the meteorological observations of the first Shackleton (*Nimrod*) Expedition. The observations are some twenty years old and their publication should be of distinct value in connexion with present-day scientific activities in the Antarctic. The second work is by Mr. W. D. Francis, Assistant Government Botanist in Queensland, on the rain-forest trees of Australia, with copious illustrations.

SIR ARTHUR KEITH discusses the antiquity and evolutionary position of 'Peking man' (*Sinanthropus Pekinensis*) in the *Lancet* for Sept. 28 on the evidence of the fragments of skull and the teeth discovered near Peking in 1927 and 1928 and recently described by Prof. Davidson Black of the Peking Medical College. The material available for determining the position of early man in China now consists of a fossil tooth, which formed part of a Chinese apothecary's stock-in-trade, described by Prof. Max Schlosser in 1903; two human fossil teeth identified among fossil material from the cave at Choua Kou Tien near Peking by Dr. Zdansky when working at Upsala in 1926; the unworn crown of a child's lower molar tooth found in the cave in 1927; and (1) several large fragments of the cranial wall; (2) almost the whole of the right body of a lower jaw; (3) the greater part of the lower jaw, including the chin region of a child of seven or eight years; and (4) about 24 isolated teeth. These were discovered by the expedition to the cave in 1928. The fossil animal remains from the site fix the age at early pleistocene.

IT appears from Sir Arthur Keith's inquiry that *Sinanthropus* takes a place with *Pithecanthropus*, Piltdown man, Heidelberg man, and Rhodesian man, but in a sense is more important than any, as it reveals affinities to modern man more than they do and has a better claim to take a place on the line of descent culminating in modern man. The fragments of the cranial wall reveal a brain as large as that of the lower living races; in their dimensions and arrangement the teeth are not materially different from those of the Australian aboriginal. The canine teeth are not apelike as in Piltdown man; yet simian features are to be seen in details of the cusps and crowns of the molars. Changes are, however, to be observed identical with those in the teeth of neanthropic man. The bony framework of the lower jaw reveals stages in the passage from anthropoid to human form. The simian shelf is disappearing and

the true chin is appearing. One feature, however, causes hesitation as to the place of *Sinanthropus* on the evolutionary line—the large size of the pulp cavities of the molars; like the teeth of Neanderthal man, the teeth of *Sinanthropus* exhibit taurodontism. If for this reason he were not to be given a place in the direct line of descent of modern man, *Sinanthropus* stands at the base of the pleistocene root of modern man and very nearly in the line of direct neanthropic descent.

DR. C. V. DRYSDALE, superintendent of the Admiralty Research Laboratory, has been appointed director of the Scientific Research and Experiments Department of the Admiralty, in succession to Dr. F. E. Smith, who was recently appointed secretary to the Department of Scientific and Industrial Research.

As in the case of other subjects, the literature of the preservation and transport of food is now considerable and scattered in a variety of journals, so that it is difficult for workers in different parts of the world to keep abreast of the latest researches. The practical importance of the subject, now that preserved foods form so large a part of the dietary in many parts of the Empire, led the Imperial Agricultural Research Conference in 1927 to recommend that the Low Temperature Research Station at Cambridge should issue from time to time lists of elaborated titles of useful publications. The first of these texts has now been published and covers the period up to January 1929 (Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv + 85. London: H.M. Stationery Office, 1929. 2*s*. net); it is proposed to issue them bi-annually. In a brief historical introduction, the author refers to the more important work carried out before 1927 on the engineering and biological problems of the science of cold storage of food including its transport. In the lists of useful publications, each title is followed by a brief note indicating the salient features of the paper. The different foods are dealt with separately under the headings of meat, pig flesh, poultry and game, fish, eggs, dairy produce, fats and oils, fruit and vegetables, grain, crops and seeds, theory of canning and of freezing and chilling, bacteriology, engineering, and miscellaneous. Each section is subdivided into the following subsections: influence of ante-mortem conditions on storage properties, cold storage, chemical antiseptics, canning, by-products, spoilage and putrefaction, methods of analysis, biochemistry and miscellaneous.

SIR PHILIP DAWSON gives an interesting discussion in the *Electrical Times* for Oct. 10, of the present position and the future prospects of electricity supply in Great Britain. He attributes the fall in the coal consumption per head of population of the industrial nations to the rapidly increasing use of electricity and the more efficient use that is being made of fuel. In Great Britain the coal consumed per capita in 1925 was 9·5 per cent lower than in 1913. In the United States it was 13·7 per cent lower, and in Germany, even including the coal supplied for reparations, it was 17 per cent lower. Still greater reductions were made in Switzerland and Sweden, partly due, doubtless, to the increasing use of hydro-electric power. In Italy the use of hydro-electric power saves nine million tons of coal per annum. We are struck by the large use made of electricity by the German chemical works. The synthetic ammonia industry consumed in 1927 more than 1000 million kilowatt hours. The cyanide industry consumed an equal amount, and the carbide industry 550 million kilowatt hours. This alone equals half the amount sold by public supply companies in Great Britain during 1927. In Germany the total amount of electricity used in 1927 for farming was 750 million kilowatt hours. Of this amount only about eight per cent was used for lighting. Ninety-five per cent of the parishes in Germany are supplied with electricity. Sir Philip thinks that the Electricity Act of 1926 will greatly benefit Great Britain as a whole. In his opinion, the question of distribution differs entirely from that of generation and transmission. It should be left in the hands of those who know local conditions and have their interests at heart. Wherever there is the largest amount of electricity consumed per capita the industrial progress is greatest.

SIR ALDO CASTELLANI has written a valuable survey of the influence of climate, apart from parasitic causes and hygienic conditions, upon the health of Europeans living in the tropics, with a useful bibliography ("Climate and Acclimatisation", *Jour. Trop. Med. and Hyg.*, July 1 and 15). He maintains that although parasites and imperfect sanitation cause the largest proportion of illness and death in the tropics, climate itself has a deleterious influence, being debilitating, diminishing the resistance against disease, probably decreasing fertility and affecting the nervous system. Useful suggestions are given; for example, the painting of buildings a dark red colour, never white or blue, a rose colour for the walls of rooms, the planting of trees for shade along roads, which should be red as white roads are exceedingly trying, and the employment of adequate protection against the sun for the head and spine.

SIR JOHN BLAND-SUTTON, Bt. (Past President of the Royal College of Surgeons), presided at the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on Monday, Oct. 14. The Council renewed the grant to The Cancer Hospital (Free) for the special scheme of radiological research which is being carried out upon the effects of X-rays upon the blood constituents and bone marrow. This work is a comprehensive scheme of research approved of by the Campaign three years ago and is carried out jointly by research workers and clinical workers, with the object of correlating the findings of experimental work with those observed in the treatment of patients suffering from cancer. A further grant of £250 for one year was also made to Mr. E. Nevill Willmer for the continuation of his research work on the relation of the chemical nature of the media in which cultures grow to the growth of the cultures. A report from the finance committee

showed that grants made by the Campaign during the last year for research purposes amounted to approximately £25,000, whilst donations received during that period only amounted to approximately £17,000.

IN *Chemistry and Industry* for Sept. 13, Prof. H. E. Armstrong contributes a very interesting article on the work of Kekulé, who was born in 1829, and is perhaps best remembered for his famous hexagon formula for benzene. Prof. Armstrong has some interesting things to say about the contemporaries of Kekulé, particularly Gerhardt, Williamson, and Kolbe. He points out that, although Kekulé's benzene hypothesis and symbol came just at the right time, when the period of intensive study of the derivatives of benzene was beginning, yet Kekulé himself made little use of them. Molecular formulæ were not then in systematic use. One of the most important researches on the subject, which had a profound influence on the benzene theory, was Körner's, published in 1874 in the *Gazetta chimica italiana*, on the relative positions of the radicals in the substitution products of benzene. Prof. Armstrong's article throws light on a number of places in the history of chemistry in the mid-nineteenth century.

A COURSE of public lectures on "Early Man and his Culture" has been arranged for the coming session by the Council of the Royal Anthropological Institute. On Nov. 1 Prof. G. Elliot Smith will lecture on "The Evolution of Man"; on Nov. 13 Sir Arthur Keith on "Race Building, Past and Present"; and on Dec. 11 Prof. F. G. Parsons on "The Anthropological History of the Modern Englishman". The second half of the session will be opened by Mr. M. C. Burkitt, who will lecture on "Most Primitive Art" on Jan. 15. He will be followed by Mr. Harold Peake, who will lecture on the "Origin of Agriculture", and by Prof. J. L. Myres, who will deal with "The Early Use of Metals". The lectures will be given at 5.30 P.M. on each day in the Portland Hall, Great Portland Street Extension of the Regent Street Polytechnic, Little Titchfield Street, Oxford Street, W. Admission will be free.

THE Annual Report of the Leicester Museum and Art Gallery records the commencement of a three-story extension, designed for the housing of collections illustrating the knitting industry and the history of boots and shoes and for the preservation of ancient documents. But already the Committee announces that still further building will be necessary for the more adequate presentation of works of art, for objects illustrating British history, and for collections of the natural and industrial resources of the city and county of Leicester. It is estimated that the cost will be at least £13,000. Of this, £5000 has already been promised, and the Committee appeals for donations towards the remainder of the amount.

IT is now generally recognised that the value of the collections in a museum is vastly enhanced by a catalogue which is something more than a mere list of exhibits. This principle is especially applicable to an ethnographical collection, and is well exemplified in the new edition of the handbook to the collection of weapons of savage, barbaric, and civilised peoples in the Horniman Museum at Forest Hill, London, S.E., which has recently been issued by the London County Council under the title "War and the Chase" (London: P. S. King and Son, Ltd., 1929. 6*d*.). Since the first edition of the handbook was issued some years ago, the collections have been very considerably extended, necessitating the new edition, which, like the first edition, has been prepared by Dr. H. S. Harrison, the Curator. It does not aim at cataloguing the exhibits *seriatim*, but rather at demonstrating the principles of development, following the main outlines of arrangement, which if not strictly in evolutionary series, does, as the author says in his preface, throw light upon the broad lines of advance in the evolution of weapons and in many cases of individual types.

IN view of the character and purpose of the Horniman Museum, it must be admitted that both the method of arrangement of exhibits and the scope and method of the handbook itself are calculated to be of more service in stimulating interest among the public than the geographical arrangement, which may appeal more directly to the student of specific cultures, but is more appropriate to the larger and more complete collections of a national museum. Apart from its value in connexion with the collections of the Horniman Museum, Dr. Harrison's admirably written handbook might well serve as an introductory textbook to this special branch of anthropology, especially as it takes a very sane view of the highly controversial question of 'independent invention'.

JUST as books of travel are interesting to people who neither have travelled nor intend to travel, so also illustrated and descriptive catalogues of scientific apparatus and fittings have a fascination which is not limited by the length of the year's budget. Messrs. A. Gallenkamp and Co., Ltd., of 17-29 Sun Street, Finsbury Square, London, E.C.2, have recently published a revised catalogue (List *F*) of laboratory fittings, including 'Technico' standard unit type benches, from which the fittings for assembling a complete laboratory can be selected. There are obvious advantages in being able to order, say, a cupboard and two-drawer unit, a bottle-shelf unit, a sink unit, a one-drawer table unit, and a fume-cupboard to fill wall space which is immediately available, with the knowledge that as extension becomes desirable similar and other standard units may be built into the scheme in a very simple and adaptable manner. It is, however, necessary to take into consideration factors other than space when a laboratory is being planned, and a number of details and suggestions which will be found useful in this connexion are set out in the catalogue. The list includes portable and fixed vacuum pumps, steel laboratory furniture, and the Willett petrol air-gas system.

THE "Guide to Current Official Statistics" (London: H.M. Stationery Office; 1*s*. net) makes its seventh annual appearance. This compact volume of some

three hundred pages provides a detailed index of subjects with references to the official publications in Great Britain in which the relevant statistics are to be found. There is also a list, arranged under the heading of departments, of the various publications of the year with full indications of the content of each. The volume should be of great value to workers in many subjects and makes accessible many important statistics that might easily be overlooked.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A research student at St. Mary's Hospital, Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2 (Oct. 22). A temporary full-time teacher of organic chemistry at the West Ham Municipal College—The Principal, West Ham Municipal College, West Ham (Oct. 25). An instrument maker at the Bradford Technical College—The Principal, Technical College, Bradford (Oct. 25). A junior physicist at the Cancer Hospital (Free) for work in connexion with the radiological research scheme of the British Empire Cancer Campaign—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (Oct. 30). A research assistant in the Seed-testing and Plant Diseases Division of the Ministry of Agriculture for Northern Ireland—The Secretary, Civil Service Commission, 15 Donegall Square West, Belfast (Oct. 31). An assistant chemist in the Government Laboratory, Baghdad—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Nov. 7). Keepers, respectively, of Vertebrate Zoology and Botany at the Public Museums of the City of Liverpool—The Town Clerk, Municipal Buildings, Dale Street, Liverpool (Nov. 14). A junior entomologist under the Division of Economic Entomology of the Council for Scientific and Industrial Research of the Commonwealth of Australia—F. L. McDougall, Australia House, Strand, W.C.2 (Nov. 18). A director of the Australian Commonwealth Solar Observatory, Mount Stromlo, Federal Capital Territory—The High Commissioner for Australia, Australia House, Strand, W.C.2 (Nov. 21). A director of the research institute of the Animal Diseases Research Association of Scotland—The Secretary of the Association, Moredun Institute, Gilmerton, Edinburgh (Nov. 23). A professor of economics in the University of Tasmania—The Agent General for Tasmania, Australia House, Strand, W.C.2 (Dec. 1). A resident pathologist at the Perth, Western Australia, Hospital—The Secretary, Perth Hospital, Western Australia (Dec. 10). An assistant lecturer in zoology in the University of Sheffield—The Registrar, The University, Sheffield. An assistant scientific officer for a Rubber Experimental Station—"Rubber", c/o W. Abbott, Ltd., 32 Eastcheap, E.C.3. A principal of the Rotherham Technical College—The Secretary for Education, Education Offices, Rotherham. A laboratory steward in the Bedford School Science Laboratories—C. W. Hansel, Bedford School, Bedford. An assistant in the physiological department of the Research Station at Trinidad of the Empire Cotton Growing Corporation—The Secretary, Empire Cotton Growing Corporation, Millbank House, 2 Wood Street, S.W.1. Research assistants under the British Cotton Industry Research Association, one with special knowledge of the colloid state and some training in mathematical physics, and one to work on the action of light on cotton—The Director of Research, Shirley Institute, Didsbury, Manchester.

## Our Astronomical Column.

**Recent Sunspots.**—The decline of solar activity noted in NATURE of July 13, p. 69, has been apparent during the last few months. A few rather large spots have, however, been seen—two of them recently—and the details of these are given below.

| No. | Date on Disc. | Central Meridian Passage. | Latitude. | Max. Area. |
|---|---|---|---|---|
| 7 | July 9–17 | July 10·7 | 6° S. | 1200 |
| 8 | July 11–23 | July 17·1 | 15° S. | 500 |
| 9 | Sept. 29–Oct. 11 | Oct. 4·7 | 11° N. | 700 |
| 10 | Oct. 6–17 | Oct. 10·8 | 19° S. | 900 |
| 11 | Oct. 7–19 | Oct. 13·4 | 10° S. | 750 |

(Areas in millionths of sun's hemisphere.)

Group No. 7 was one of rapid growth. A magnetic disturbance, with range in horizontal force of 260$\gamma$, was registered at Abinger on July 10. No. 8 was a spot possessing an abnormally large magnetic field. On Aug. 13·0, the spot, much diminished, crossed the central meridian again, and a small magnetic storm commenced at Abinger on Aug. 14 at 16$^h$; an aurora was seen the same night from Sidmouth. No. 9 was a stream growing from a few spots seen first at the east limb. No. 10 was an active stream developing from two tiny spots on Oct. 6. No. 11, a single spot, easily visible to the naked eye. A magnetic disturbance commenced on Oct. 7 and lasted until Oct. 10.

**Comet Schwassmann-Wachmann.**—It is suggested in *Jour. Ast. Soc. Pacific* for August that comet Schwassmann-Wachmann (2), discovered last January, may be identical with minor planet 525, Adelaide, discovered by Wolf in 1904, but not seen since that year; the following are the elements of the two objects :

| | Comet. | Adelaide. |
|---|---|---|
| $T$ | 1929 Mar. 23·655 | |
| $\omega$ | 357° 57′ 6″·6 | 281°·490 |
| $\Omega$ | 126 7 14·4 | 126 ·093 |
| $i$ | 3 43 16·8 | 3 ·250 |
| $\phi$ | 23 22 39·0 | 21 ·778 |
| log $a$ | 0·5386785 | 0·52372 |
| log $q$ | 0·3191540 | 0·32236 |
| | Period (years) 6·42714 | 6·10344 |

It will be seen that $\Omega$, $i$, and $q$ agree closely, $\phi$ and the period are fairly near; but $\omega$ (and therefore the direction of the major axis) differs by nearly a right angle; it seems very improbable that so large a change could have occurred in the direction of the major axis, while that of the node remained unchanged. A further argument against identity may be drawn from the fact that Palisa observed Adelaide several times in 1904 with the large Vienna refractor; he made no note of anything abnormal in its appearance, which he would probably have done if it had been a comet.

## Research Items.

**New Social Survey of London.**—It is now more than forty years since Mr. Charles Booth began his great social survey of London, which occupied seventeen years and was published in a number of volumes. It is of importance to assess the social changes that have taken place in the intervening period and to extend the scope of the work. A new social survey has now been started by the London School of Economics. Some account of the scope, methods, and aims of the work are given in a paper by Sir H. Llewellyn-Smith in the *Journal of the Royal Statistical Society*, vol. 92, pt. 2. The area to be included does not correspond accurately with any administrative area, for these have little relation to present urban growths. North of the Thames it has to be pushed beyond the county of London. As a whole it includes, on the basis of the 1921 census, a population of 5½ millions, of which 4½ millions were then within the county. The methods of the important survey of poverty differ from those used by Booth inasmuch as intensive methods on the lines of Prof. Bowley's 'sampling' will be combined with the older extensive system of indirect information from schools, police, and clergy. Other branches of the survey will deal with industries, especially clothing, boot, shoe, and furniture trades, to which Booth gave special attention; crime; occupations; wealth and the use of leisure. Considerable progress has already been made with the poverty survey.

**Birds of a Prehistoric Kitchen Midden in California.**—The levelling of the Emeryville shell-mound on San Francisco Bay, in connexion with building operations, gave an opportunity for a detailed study of its contents (*Univ. Calif. Pub. Zoo.*, vol. 32, 1929, p. 301). The mound was the kitchen-midden of a prehistoric Indian settlement, and its remaining portion measured 150 ft. and 250 ft. in diameter and 22 ft. in height. A very considerable age is indicated by the size of this accumulation of food refuse, as well as by the fact that the lowest level of the mound was 2 ft. below high tide mark, and although the age cannot be definitely determined, it may be roughly 1000 or more years old. The bird remains were represented by 6700 specimens, of which 4155 were identifiable. Fifty species of birds were recognised, although no discrimination was made in the species of ducks or of gulls. Forty-five of the identified species occur to-day in the San Francisco Bay region, which contains in addition twenty species not represented in the mound. Four species are now absent from the region, though there are records of their presence in historic times, and only one species (*Grus mexicana*) has not hitherto been found in the area. The bones of summer and winter birds show that the habitation of the site continued all the year round, bones of nestling cormorants that an island rookery was raided; the general ensemble suggests that the Indians restricted their hunting to their immediate vicinity, and broken bones indicate either cookery methods or some attempt at making artefacts.

**Measures against White Fly.**—A novel scheme for combating the greenhouse pest, white fly, is being carried out by the Cheshunt Research Station, Herts, under the auspices of the Empire Marketing Board and the Ministry of Agriculture. It consists of the introduction into the infected house of a chalcid wasp (*Encarsia formosa*), which lays its eggs within the young stages of the fly known as 'scales'. The mature wasp is a very minute insect, the female being pale yellow and the male dark in colour. It is entirely harmless to plants. Tomato shoots, bearing scales already parasitised, will be forwarded *free of charge* to any grower experiencing trouble with white fly, on application to the entomologist at the Station. The size of the house is immaterial, but the number of houses and the type of plant infected should be stated. The shoots are tied into bunches and hung up for three weeks, preferably in the shade. If the average temperature is about 70° F., black scales, showing by their colour that they have been parasitised, may be expected after fourteen to twenty-one days on the under side of the infected foliage. At low temperatures the wasp does not lay its eggs so readily on many plants and the percentage of parasitism is accordingly smaller. The most suitable time for starting the parasite is from late March to early June, and unless the greenhouse is kept heated and well stocked with plants throughout the winter, it is not advisable to apply for parasites after the end of July. Should the infestation be very severe, immediate fumigation may be necessary. For this purpose ⅛ oz. sodium cyanide dropped into a jar containing ½ fluid oz. of 33 per cent sulphuric acid per 1000 cubic feet is recommended, since it kills the flies, but is harmless to the scales and the parasites within them.

**Cutaneous Sense Organs in Fishes.**—Mr. Denzaburo Miyadi, in a paper entitled "Notes on the Skin and Cutaneous Sense Organs of some Cobitoid and Gasterostoid Fishes, with Special Reference to the Rudimentary Nature of the Lateral Canal System" (*Memoirs of the College of Science*, Kyoto Imperial University, Series B, vol. 4, No. 2, article 4, 1929), describes his observations on *Misgurnus anguillicaudatus*, *Cobitis buvœ* and other Cobitoid fishes; also on the stickleback *Pungitius Kaibarœ*. In all these fishes he finds that the canal system is rudimentary or absent and probably degenerate, being represented in the *Misgurnus* species and in *Cobitis buvœ* by a short canal or vestiges of a canal on the anterior portion of the trunk only, as is the case in the European stickleback described by Plate. It is a general rule in the development of the lateral canal that the head precedes the trunk both ontogenetically and phylogenetically and, as the author found that in the Japanese stickleback the canal in the head is formed very early when the fish is only 1·5-2 cm. in length, whilst that of the trunk appears only after it has grown to 2·5 cm. or more, he regards it as highly probable that the case of the European stickleback is due to a degenerative process similar to that in the Cobitidæ, and suggests that "In both families Cobitidæ and Gasterosteidæ, when the degeneration of the canal system takes place, it is in the anterior portion of the trunk that this process occurs last of all".

**Snakes and Termites—a New Example of Symbiosis.**—Certain snakes have been found to occur in the nests of termites; even great pythons as well as a species of *Typhlops* occasionally inhabit the mounds of *Termes bellicosus* on the Gold Coast and elsewhere. Lizards have gone even further, and several South American species are known to deposit their eggs in or on termitaries suspended in trees. Up to the present, the egg-laying habit has not been observed in termitophile snakes, and Dr. F. Kopstein's discovery, during an expedition to West Java, adds a notable item of information (*Treubia*, June 1929, p. 467). From a nest of the termite, *Lacessititermes sordidus*, found on

a tree 3 metres from the ground, he saw a small newly hatched snake issue, and in the course of the evening four were found to leave the nest. The snake belonged to a rare species, *Dipsadomorphus jaspideus*, and its newly hatched young had probably never been seen before, but the most interesting point was the association with the termitary. An examination showed that in the centre of the nest, which measured 20 cm. in diameter, were six egg-membranes which still contained fresh white-of-egg. Each egg lay in a cell of its own, encased in a capsule of the material used in the building of the nest. The outer layers of the nest showed no trace of an opening through which a snake of the size of the adult could have entered to deposit the eggs, and the author is of opinion that the eggs were laid in the nest at an early stage of its growth, the termites continuing to build their structure around them. The advantages to the snake are obvious: a high temperature, high and constant humidity for the development of the eggs, and for the young snakes abundant food if they chose to live upon termites, which is not at all certain.

**Chinese Reptiles.**—An account of the reptiles of the mountainous province of Fukien and neighbouring areas has enabled Clifford H. Pope to state many facts and conclusions of wide interest (*Bull. Amer. Mus. Nat. Hist.*, vol. 58, Sept. 1929, p. 335). The collection of 2749 reptiles yielded 6 forms of turtles, 19 of lizards, and 71 of snakes—a remarkably rich fauna for so limited an area. It contains three elements: widely distributed reptiles found throughout great tracts of south-eastern Asia, forms common in Central China, and tropical and semi-tropical forms found on the coastal plains. The general aspect is that of the fauna of China, except for the absence of the desert forms of Mongolia, and a close relationship is evident with the Formosan fauna. Examination of the stomach contents showed that snakes had decided food preferences. Of the aquatic forms some preferred frogs, others added fish to their diet, but closely related species might show distinct differences, *Enhydris chinensis*, for example, being a fish eater, while *E. plumbea* was content with frogs. Amongst the land forms birds, rats, and other mammals, and even snakes, were common diets; but while earthworms formed a natural food supply for burrowing and nocturnal species, such as *Tapinophis* and *Trirhinopholis*, it was less easy to understand why a large diurnal snake like *Liopeltis major* should select the same fare. It is noted that with age a general fading of the most contrasted elements of the colour pattern may take place, and this may produce so different an emphasis upon the different elements in the pattern as to suggest that young and old belong to distinct species.

**Fauna of Streams.**—Few contributions have been made in Britain to the study of the ecology of streams, so that the work of E. Percival and H. Whitehead is specially welcome (*Jour. Ecology*, Aug. 1929, p. 282). They have classified the stream-bed faunas, which they have investigated in the West Riding of Yorkshire, into seven categories according to the nature of the bottom, and this is connected with the general succession of conditions in passing down a stream, and therefore with the speed of flow of the stream itself. Detailed analyses are given of the main constituents of the fauna, for it was discovered that the bulk of the population was made up of a few types of organisms which varied with the environment. Accordingly, the variations have been correlated with the conditions as they affected the density of the population. The chief controlling factor in clean runs of water was the rate of flow, the slackening of the current coinciding with an increase in the number of genera. A very interesting table shows the ecological relationship of the organisms to each other and to the fundamental foods. From this it is evident that conditions favouring the growth of unicellular and filamentous algæ, that is, a stable substratum, aid in the development of a considerable insect fauna, and the reason is that, judging by food contents, 75-90 per cent of the organisms feed mainly upon algæ. Many of the organisms thought to be almost the sole source of food of fish, such as *Limnæa peregra*, *Gammarus pulex*, and *Ephemera* spp., have been found to contribute, in many places, either no part or very little part of the total fauna.

**Mexican Earthquake Sea-Waves of June 16, 1928.**—During the afternoon of June 16, 1928, a strong earthquake occurred off the coast of Mexico. The epicentre was in the Acapulco Deep, about 125 miles south of the Mexican state of Oaxaca. Though the origin was so distant, the coast towns in this region suffered considerable damage. The sea-waves that swept over the shores and added to the destruction were recorded at Hilo (*Hawaiian Volcano Observatory Monthly Bulletin* for June 1928). The first waves reached that station on June 17, 8 hr. 29 min. after the occurrence of the earthquake, the maximum range of the movement being about 16 inches, and the period at first about 22 minutes, or approximately the same as the period of the natural water oscillation of Hilo Bay. The distance of the origin from Hilo being 3860 miles, it follows that the mean velocity of the sea-waves was 455 miles per hour, a figure that agrees closely with the values obtained for other sea-waves across the Pacific, namely, 453 miles per hour for the Japanese earthquake of 1896 and 465 miles per hour for the Valparaiso earthquake of 1906.

**Earth-Tilting by Tidal Loading.**—A valuable contribution to our knowledge of the tilting of the earth's crust caused by tidal loading has lately been made by Mr. R. Takahasi (*Earthq. Res. Inst. Bull.*, vol. 6, pp. 85-108, and vol. 7, pp. 95-101; 1929). Two of Prof. Ishimoto's tiltmeters, constructed entirely of silica, were placed on a concrete platform on the floor of a cave cut in Mesozoic rock at Misaki near the southern end of the Miura peninsula, Sagami Bay. The cave is covered with a thick growth of weeds and a forest of pine-trees, and is so effectually shaded from solar radiation that variations of temperature in the cave are too small to be recorded by the ordinary thermograph. The instrument is 28 feet above mean sea-level, 25 yards from the nearest beach-line, and less than a quarter of a mile from the tide-gauge station of Aburatubo Bay. Mr. Takahasi shows that the tilting of the crust follows quite faithfully the ebb and flow of the oceanic tides, a rise of 13 inches in the sea-level at Aburatubo producing a tilt of 0·22″ at Misaki. The observed tilting is almost entirely the effect of tidal loading, other causes leading to a deflection of less than 0·01″. In the Bay of Aburatubo, remarkable seiches with a period of 15 minutes are sometimes observed, and the record of the tiltmeter is then serrated by minute indentations with a mean period of 15 minutes. The seiches were recorded at various points of the Bay, and it was found that the tiltmeter record follows the curve of seiches obtained at a point 25 yards from the station, but not one at a point 160 yards distant. In other words, the load that is really effective in promoting tilting is that applied at a distance of less than 160 yards.

**Copper Deposits of Michigan.**—*Prof. Paper* 144 of the U.S. Geological Survey, by B. S. Butler and W. S. Burbank, deals with this important subject. The

Michigan copper region is on the southern rim of the Lake Superior basin, which was probably formed during Keweenawan time. Since 1845 the output has been about 35 million tons of copper. In late pre-Cambrian times a series of basaltic flows accumulated to a depth of thousands of feet. The dense rock that forms the greater part of the main flows is everywhere overlain by more open-textured 'amygdaloid'. The tops of nearly all the flows are distinctly red, and it is thought that the oxidation and concentration of the iron were accomplished in large part by the gases given off during the solidification of the lavas. Examination of the freshest flows confirms previous observations that they contain both native copper and chalcopyrite in small amount. It therefore seems probable that at least part of the copper is a primary constituent. The workable deposits are of two main classes—lode deposits and fissure deposits. The former are mineralised beds of either (*a*) felsite-conglomerate interbedded with the lava flows, or (*b*) vesicular or brecciated amygdaloid 'tops'. The fissure deposits are narrow tabular veins along fractures parallel or transverse to the beds. The hypothesis of origin from descending waters is shown to be untenable. The authors favour the view that the copper was derived from sulphide-bearing solutions originating in the underlying Duluth gabbro-magma.

**Climate of the Dutch East Indies.**—The Koninklijk Magnetisch en Meteorologisch Observatorium in Batavia has now published vol. 2, pt. 3 of the monograph on the climate of the Dutch East Indies. This completes the detailed discussion of the meteorological conditions of the islands, and covers Borneo, the Celebes, the Moluccas, New Guinea, and smaller islands. Some of the accounts are necessarily incomplete for want of data, but, taken as a whole, the monograph is most comprehensive. The editor, Dr. C. Braak, promises a third volume, with climatological tables, in the course of time. The monograph is naturally in Dutch, but the English summaries added to all chapters are so full as almost to contribute a condensed monograph in English.

**Flow of Swedish Rivers.**—Some instructive charts illustrating the amount of discharge of Swedish rivers are published in a paper by G. Slettenmark in *Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt*, Bd. 4, No. 5. One chart shows the mean flow of all the rivers that have a discharge of at least 5 m.c. per second. The breadth of the river is made proportional to the flow. The next two charts show the mean flow of the chief rivers at high and low water respectively. The final chart shows the area of the lakes in the drainage area of each river basin. It appears that in spite of the number of rivers in Sweden, 74 per cent of the total drainage is supplied by fourteen rivers. Details of the flow of the principal rivers are given in tables.

**Recombination of Gaseous Ions.**—In the September issue of the *Journal of the Franklin Institute*, Profs. Loeb and Marshall, of the University of California, discuss the bearing of recent research on the theory of the mechanism which determines the recombination of gaseous ions. According to Langevin, it is mainly the attraction of the two oppositely charged ions which determines their recombination. The authors show that recent observations do not accord with this view, but give some support to the Thomson theory that recombination is due mainly to the random movements of the ions due to their heat energy. They point out that the theory is incomplete owing to our want of knowledge of the masses of the ions and therefore of their speeds. They believe that these masses are to a great extent determined by the impurities in the gas, such as organic molecules from the stopcock greases, and that this accounts for the rates of recombination in different gases being found experimentally nearly alike, although from the constitutions of the gases we should expect them to differ.

**Diffraction in Spectrometers.**—Prof. A. G. Shenstone points out in a paper in the first September number of the *Physical Review* (p. 726), that the optical system of a spectrometer is one which is very well suited for the production of diffraction fringes round the positions of maximum intensity—the 'lines' of the spectrum—on the recording plate, and some photographs which he has reproduced show that such fringes are actually present in a well-adjusted instrument. A theory applicable to this effect was given many years ago by the late Lord Rayleigh, but does not appear to cover the numerous anomalies in relative intensity and spacing of the fringes which occur, and these Prof. Shenstone consequently attributes to peculiar forms of aberration in the lenses of modern spectrographs. The presence of the fringes is of considerable practical importance; they prevent the ideal resolving power of an instrument from being attained in the separation of two neighbouring lines of unequal intensities, and could also be easily mistaken for fine structure components of feeble intensity with an echelon spectrograph, whilst in the study of scattered radiation exactly the condition which makes it possible to photograph Raman lines near the exciting line is the condition that brings out the fringes, namely, great homogeneity of the unmodified radiation. In interpreting Raman spectra it is thus essential that the existence of the fringes should not be forgotten.

**Electrical Resistance in Metals.**—The Institute of Metals has published in pamphlet form (price 5*s*.) the interesting May lecture delivered by Sir Oliver Lodge this year. The title of the lecture, "States of Mind which make and miss Discoveries, with some Ideas about Metals", well describes its contents. Zeeman's discovery and Lodge's own failure to discover the Hall effect are convincingly told. Faraday wholly failed to find any relation between gravitation on one hand and electricity and magnetism on the other. Einstein and others are now finding it theoretically and not by experiment. It has to be remembered that the fact that light would be deflected by a gravitational field was first predicted by theory and then verified. The splendid discovery made by Kammerlingh Onnes at Leyden that a few metals became perfect conductors at an excessively low temperature is admittedly of the first theoretical importance. How can a metal offer such a small resistance to an electric current that a current induced in a loop of it, which usually dies out in a fraction of a second at ordinary temperatures, takes hours or even days to die away when the temperature is sufficiently low? Lodge suggests that the crystalline metal arranges itself in chains from one end of the rod to the other. Unobstructed interstices are left along which the electronic 'gas' moves freely instead of being constantly checked and hampered by encountering the nuclei of atoms in its path. In free space an electron can go on for ever, and this is what the amperean currents which constitute magnetism are always doing. It is surmised that there is a perpetual flow of some kind along every magnetic line of force. Methods of experiment which produce intense magnetic fields, such as those used by Kapitza, may lead to the discovery of an actual etheric circulation.

## Research on Motor Fuel.[1]

THE National Benzole Association now presents its sixth annual report embodying the results of certain technological investigations carried out under the auspices of a joint research committee of this Association and of the University of Leeds. The term 'benzole' is used in this report to indicate the mixture of hydrocarbons, mainly aromatic, which is ordinarily recovered from coal gas or coke-oven gas for use as motor spirit.

The study of resin formation in benzoles continues to occupy the major portion of the Committee's attention. It had previously been shown (Report No. 5, 1928) that the tendency of benzole to gum, either on storage or on oxidation, could be greatly diminished if not altogether prevented by the addition of an inhibitor. The particular reagent used in this connexion was tri-cresol. This tri-cresol is a commercial product consisting of a freshly distilled, technically pure, phenolic fraction boiling over a range of 195°-203° C. and having a low sulphur content. Concentrations of approximately 0·03 per cent by weight of tri-cresol were found to give an optimum content of inhibitor. The report for 1929 records an extension of these investigations to large scale and prolonged tests in commercial engines, and it has been shown, although the Committee wishes the results to be regarded in the meantime as tentative, that benzoles stabilised by an inhibitor are little, if any, inferior to those purified by acid. It has further been shown that dilution of unstabilised benzole with petrol retards resinification to a greater extent than would be accounted for by the concentration of unsaturateds. This is an important point, since most benzoles are used to-day as motor fuels in admixture with petrol.

[1] The National Benzole Association. Sixth Report of the Joint Benzole Research Committee of the National Benzole Association and the University of Leeds. Pp. ii+212. (London: The National Benzole Association, 1929.) n.p.

The efficiency of various types of oils for absorption purposes has been examined, and it has been shown that oils from low temperature and Bergius tars have nothing to recommend them for use in preference to oils from high temperature tar, whilst they have the disadvantage of being in themselves much more unstable. An examination of the variation with temperature in the absorption capacity of creosote and gas oils, both in everyday use as wash oils, has also been made and a chart drawn, from which the capacity at any desired temperature can be read off.

The Committee has prepared correction tables to be applied to hydrometer readings and volumes, so that the correct value at the standard temperature of 65° F. can be calculated. These tables will be of great use for commercial and technical purposes.

Tests have also been carried out on the purification of benzoles by the Ufer and Instill processes, which aim at removing either wholly or partially the components which cause resinification. Moreover, the report contains the annual report of the Engine Tests Sub-Committee for 1928, a very full bibliography of all literature relevant to fuels, and is liberally illustrated by tables, graphs, and photographs.

The Research Committee of the National Benzole Association is to be congratulated on the results obtained in these researches on problems of practical importance. To both manufacturers and users of benzole the successful issue of the work carried out by the Committee is of vital interest. The harmonious co-operation of other companies such as the Gas Light and Coke Co., Ltd., and the Staffordshire Chemical Companies, shows the interest exhibited by the trade and ensures the practical utility of the results. Criticism of and contribution to the subjects under investigation are welcomed and should be sent to Prof. J. W. Cobb, the secretary of the Committee, at the Department of Fuel Technology, University, Leeds.

## Carbohydrates and their Digestion.

FOR an accurate system of dieting it is essential to know the content of different foodstuffs in digestible protein, fat, and carbohydrate: analyses by different authors differ somewhat in the case of protein and fat, but diverge widely in that of carbohydrate, where accurate knowledge is essential for the planning of diets for diabetics. Moreover, the analyses are usually only of raw foods and the results are expressed solely in terms of total carbohydrate. Now, as McCance and Lawrence[1] point out, of the total carbohydrate content, part is available and part unavailable as carbohydrate in the body: the former consists of starch, sucrose, glucose, and fructose, and the latter mainly of fibre and the hemicelluloses. They therefore determined to analyse foods for their carbohydrate content, differentiating between the two fractions and taking the foods as eaten, raw or cooked according to the usual custom. The results, in brief, were that the available carbohydrate was found to be much lower than had previously been supposed.

Only vegetables and fruits were analysed, since they form the chief sources of carbohydrate in the diet apart from the concentrated starchy foods, such as bread, etc., earlier analyses of which are reasonably accurate. The food was hydrolysed by boiling with dilute hydrochloric acid for one or two hours, and the digest neutralised and filtered. Total reducing sugars were estimated on the filtrate by Benedict's method, and pentoses by McCance's method: the principle of the latter is the conversion of the pentose to furfural by heating with hydrochloric acid, extraction with benzene and treatment with benzidine acetate, the colour formed being compared with that produced by a standard solution of arabinose similarly treated. The conversion to furfural is not quantitative, so that the result obtained must be multiplied by an empirical factor experimentally determined: the factor used differs also for the various pentoses. In some cases the non-fermentable reducing sugars were also estimated. The available carbohydrate is considered to be the total less the pentose or non-fermentable sugar, except in the case of the inulin vegetables, in which only one quarter of this difference is considered to be available. Full details of the results obtained are given in the original monograph, which should be consulted by those interested: some points of interest are that the pentose and total sugar content are completely independent, that the non-fermentable sugars are chiefly pentoses, that olives alone contain no fermentable sugar after hydrolysis, and that appearance and taste are little guide as to sugar content.

The application of the results to diabetic dietaries is briefly referred to by the authors in the *Brit. Med. Jour.*, vol. 2, p. 241; 1929. Diabetics can now take larger amounts of vegetables; some, such as lettuce,

[1] Medical Research Council. Special Report Series, No. 135: The Carbohydrate Content of Foods. By R. A. McCance and R. D. Lawrence. Pp. 73. (London: H.M. Stationery Office, 1929.) 2*s*. net.

asparagus, and rhubarb, contain so little carbohydrate that they may be allowed as extras. The larger ratio of carbohydrate permitted brings up the actual allowance to the theoretical and provides a better balance for the fat in the diet, with the result that the patients less frequently excrete acetoacetic and hydroxybutyric acids, the products of incomplete fat combustion.

McCance, in the second part of the M.R.C. monograph, takes the opportunity of reviewing the digestibility of the carbohydrate which is unavailable as such to the body: the available may be considered as being completely digestible; it can be removed from a plant by warm water or by diastase. Of the unavailable, the fibre resists the action of dilute acids and alkalies, while the hemicelluloses are hydrolysed by boiling in 1-3 per cent mineral acid.

The fibre consists chiefly of cellulose, with small amounts of oxycellulose, lignin, and resistant pentosans. The hemicelluloses are composed of pentosans—the anhydrides of xylose and arabinose—and other furfural precursors, inulin, and fructosans or other hexosans such as mannans and galactans, or the two acids galacturonic and glycuronic: free pentoses are not found in significant amounts. The different components are present in different quantities in the different foodstuffs: thus inulin occurs chiefly in artichokes, chicory, and salsify. Some of them are of no value; thus lignin, consisting of aromatic alcohols, is not digested at all, whilst the uronic acids may be neglected as sources of energy.

The amounts digested are approximately, for cellulose, 30-85 per cent, depending on the species: herbivora digest the most, carnivora the least. Pentosans are digested somewhat better, fructosans and other hexosans to about 75 per cent of the intake. The mechanism of digestion appears to be similar in all cases but has been most studied in that of cellulose.

The enzyme cellulase, which hydrolyses cellulose to cellobiose and glucose, occurs only in certain invertebrates, such as snails and some insects: none of the higher animals secrete it. It is found occasionally, however, in the alimentary tract, having been ingested with the food when taken in its natural state; but except when large quantities of cellulose-containing foodstuffs are eaten raw, any possible autolysis of the food can be neglected as a method of digestion. The hydrochloric acid of the stomach is too weak to effect much hydrolysis: and little, if any, of these complex carbohydrates is absorbed unchanged. The chief agents effecting the digestion are the bacteria living in the alimentary canal: the products of the reaction are organic acids, lactic, acetic, butyric, etc., carbon dioxide, hydrogen, and methane. In most cases the cellulose is first hydrolysed to glucose, but since this sugar is not found among the products of the reaction nor absorbed from the gut, the second reaction, the fermentation of the glucose, must proceed at a faster rate than the hydrolysis of the cellulose. The same end products are formed when the organisms are grown anaerobically *in vitro*.

The value of these carbohydrates as sources of energy is reduced by the fact that some of the products of their breakdown are gaseous and that numerous side reactions occur together with the main fermentation. For animals with a voluminous large intestine, such as the cow, consuming large quantities of cellulose-containing foodstuffs, 6 to 9 cal. per kgm. body weight per diem may be available from the digestion of cellulose, and 5 cal. from the pentosans consumed: for man, these carbohydrates have a negligible value as sources of energy, about 0·3 and 0·5 cal. per kgm. per diem respectively. They cannot be used to replace other foodstuffs in the diet from this point of view.

On the other hand, they have a definite place in the diet, since they exert a laxative action: this is due either to a direct mechanical irritation of the gut wall, stimulating peristalsis, or to their passing through the gut unchanged and so adding bulk to the fæces, or to their power of swelling in the presence of water. A most important factor, however, is a stimulation of the secretion of the intestinal glands by the products of their digestion, resulting in increased bulk and softness of the fæces.

The unavailable carbohydrates are therefore available in the form of the lower fatty acids in small quantities: of these only lactic acid occurs in the path of carbohydrate metabolism, the others being more closely connected with the metabolism of the fats.

## New Extension of the Polytechnic, London.

THE Polytechnic in Regent Street, London, is assured of the public goodwill, because it was the first important institution to assume that name, through accident rather than by design, and because it has faithfully adhered to its original purposes—a rare phenomenon in English educational history. Founded by Quinton Hogg in 1882, the Polytechnic was and remains "an educational centre and also a club and rendezvous for young people between the ages of sixteen and twenty-six, where every reasonable facility shall be offered for the formation of steadfast character and true friendships; for training mind and body and for leading an upright and unselfish life". In 1910–11 the front portion of the Regent Street premises was rebuilt at a cost of £115,000. On Oct. 10, the Queen opened a new extension off Great Portland Street, an admirable building designed by Mr. F. J. Wills. Apart from a physics laboratory, the new building is to be used for commercial and technical education—domestic science, hairdressing, laundry, dressmaking, tailoring, etc.—and for social purposes. It furnishes a good example of modern methods of building. There is a complete wireless installation for reception and dispatch; a secondary system of lighting; two halls can be formed by the lowering of a screen; and many other new ideas are incorporated in the building.

Of particular interest in the new extension of the Polytechnic is the novel heating equipment which has been installed by Messrs. Sulzer Bros., Ltd. An electric boiler of 1850 kw. capacity is employed, operating directly off the 6600-volt, three-phase, 50-cycle mains. The high tension current is passed directly through the water by means of three iron electrodes, the tank itself being well earthed. The plant is automatic in its operation, changes in load being counteracted by means of three insulating cylinders surrounding the electrodes. These cylinders are raised or lowered automatically by means of a small hydraulic motor, in this way varying the effective distance between the electrodes so as to maintain a constant load on the boiler. The latter feeds the heated water into three large, well-lagged storage tanks, the total capacity of which is 27,000 gallons.

The boiler is only used during the night period, so as to take advantage of the special tariff rates offered by the Borough of St. Marylebone Electricity Depart-

ment for night load. The temperature of the water in the storage tanks is thus gradually raised during the night, for use throughout the following day. The temperature of the water in the radiators and circulating pipes throughout the building is, however, not so high as that in the storage tanks, a certain proportion of cold water being added in order to bring the temperature down to the desired value. In the morning, when the storage tanks are at their hottest, a larger proportion of cold water is needed than later on in the day, when the temperature of the storage tanks has fallen. By suitably varying the proportion of hot and cold water the temperature of the building can be maintained at a constant predetermined figure.

## University and Educational Intelligence.

CAMBRIDGE.—At Trinity College the following have been elected to fellowships: C. F. A. Pantin, M. Black, N. Feather, J. A. Gaunt, and H. D. Ursell.

The Council of Gonville and Caius College has appointed E. P. Weller, University Lecturer in Estate Management, as Bursar.

For the ninth year in succession Trinity College, Cambridge, announces the offer of a Research Studentship open to graduates of other universities who propose to come to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be as much as £300 a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Senior Tutor not later than July 1, 1930.

The same College offers, as usual, Dominion and Colonial Exhibitions to students of Dominion and Colonial Universities who wish to come to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These Exhibitions are of the titular value of £40, but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the Exhibitioner's financial circumstances. If it is made clear that the financial need of an exhibitioner cannot possibly be met by the payment to him of the full amount of his titular emolument, the Council has power, if it sees fit and if funds are available, to award him an additional payment. Candidates must apply through the principal authority of their University, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1930.

MANCHESTER.—The following appointments have been made:—Assistant-Lecturer in Botany: Miss Barbara Colson; Demonstrator in Pathology: Mr. Raymond Whitehead; Lecturer in Metallurgy and Assaying: Mr. Cecil Handford; Assistant-Lecturer in Mechanical Engineering: Mr. B. J. Tams.

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THE Board of Education has just issued a new list (List 111) of the more important recognised institutions of technical and art education and other forms of further education in England and Wales (London: H.M. Stationery Office, 1929. 4*s*.). The list includes technical day classes, junior technical schools, etc. The postal address of each institution is given, and, for colleges and technical day classes, an indication of the courses and branches of study followed. Particulars are given of approved schemes in operation for national certificates in mechanical and electrical engineering, chemistry, naval architecture, and gas engineering.

## Calendar of Patent Records.

October 20, 1830.—The patent granted on Oct. 20, 1830, to Admiral Sir Thomas Cochrane, afterwards the tenth Earl of Dundonald, for "apparatus to facilitate excavating, sinking, and mining" was an important one in the history of tunnelling, the invention being for the introduction of air under pressure into the tunnel for the purpose of keeping back the water and holding up the face of the excavation. The specification included most of the essential features—such as the air-lock before the working chamber—which have characterised the use of the process since the time of the invention. The system was adopted at first only for shaft sinking, the first application being at Chalonnes on the Loire. It was not until 1879 that it was used for tunnel work, in an attempt to tunnel under the Hudson River at New York, and in the same year at Antwerp.

October 21, 1824.—Portland cement was invented by Joseph Aspdin, a stone-mason of Leeds, and was patented by him on Oct. 21, 1824. Aspdin established a factory to produce the cement at Wakefield in 1825, and the success of the industry may be gauged by the fact that the annual consumption in the world to-day is upwards of thirty million tons. In 1924 a tablet, presented by the American Portland Cement Association, was erected in the Leeds Town Hall to commemorate the centenary of the invention.

October 22, 1832.—George Frederick Muntz, of Birmingham, was granted a patent for his invention of "an improved manufacture of metal plates for sheathing the bottoms of ships and other such vessels" on Oct. 22, 1832. 'Muntz metal' entirely superseded copper sheathing in the mercantile marine, though not in the Navy, and brought the inventor a profit of £70,000. The patent was unsuccessfully attacked in the courts, but an application for its prolongation was refused.

October 23, 1820.—The employment of wrought-iron rails for railways in place of the cast-iron rails formerly in use was mainly due to John Birkinshaw, manager of the Bedlington Iron Works, who on Oct. 23, 1820, was granted a patent for "Improvements in the manufacture and construction of a wrought or malleable iron railroad or way". In the specification he describes as his preferred form a T-section rail to be made in 18-foot lengths.

October 23, 1835.—The process under which the 'Baxter' prints were produced was patented by George Baxter, wood engraver, on Oct. 23, 1835. The first publication was in 1837, when Baxter issued his "Pictorial album or cabinet of paintings containing eleven designs executed in oil colours from the original pictures". The life of the patent was extended for five years.

October 24, 1832.—The first commercially successful hydraulic turbine—which was of the reaction type—was invented by Benoit Fourneyron of Besançon, and patented by him in France on Oct. 24, 1832, under the title of "Roue à pression universelle et continue". The original turbines for the Niagara Falls Power Company were of the Fourneyron type, built in Philadelphia, and they remained in service for fifteen years.

October 24, 1850.—The 'mercerisation' process for treating cotton and cotton fabrics is due to John Mercer, F.R.S., who patented the invention on Oct. 24, 1850. Mercer's specification describes the effect of caustic soda in strengthening the fibre and making it more receptive to dyes, but does not mention the 'lustre' effect, which was not discovered till forty years later by H. A. Lowe. Samples of mercerised cotton received special mention at the Great Exhibition of 1851.

## Societies and Academies.

ROME.

Royal National Academy of the Lincei, June 1.—F. Severi: The whole of the singular points of an analytical function of several variables.—Guido Fubini: Further with regard to the canonical cluster.—Q. Majorana: Optical telephony by means of ultra-violet or infra-red rays. Improved results have now been obtained as a result of modification of the arrangement of the apparatus. By means of filtered infra-red light from a 500-watt incandescent lamp, telephonic communication has been established between stations ten kilometres apart, excellent reproduction of the words being obtained.—L. Lombardi and Paolo Lombardi: Behaviour of the moving-coil transformer in constant current circuits.—A. Angeli: The constitution and reactions of the diazo-hydrates. Hantzsch's views on the structure of the diazo-hydrates are refuted, Swietoslawski's thermochemical data being quoted in support of the structures advanced by the author.—G. Tizzoni and G. De Angelis: Immunity against cancer conferred on animals by phenolate auto-vaccine. The results of numerous experiments on white mice show that immunity against Ehrlich's adenocarcinoma may be attained by the use of phenol, which converts the cancerous matter into vaccine. The phenol is administered in 0·5 per cent solution for a period of 24-72 hours, the immunity appearing 11 days later and persisting for more than 4 months.—Giuseppe Levi: A differentiation of nerve cells.—G. Levi and G. C. Dogliotti: The structure of adipose cells. The adipose cells of the adult rat exhibit a very thin cytoplasmic film containing a large number of chondriosomes in the form of granules and short rods, the view that adipose cells are composed of an adipose drop contained in a reticular envelope being hence inadequate.—M. Kourensky: Riccati's equation.—Pia Nalli: A generalised displacement in Riemannian spaces.—U. Cassina: The conception of vectors.—B. Segre: Continuous systems of plane curves with tacnode.—E. Čech: A characteristic property of Fubini's surfaces.—L. S. Da Rios: Wings and helices.—E. Fermi: The motion of a body of variable mass.—G. Viola: Pendular oscillations in the elliptic elements of the variable W Ursæ majoris.—M. Pierucci: Concerning recent experiments on thin metallic films. Results lately obtained support the view that conductors electrically charged undergo a variation in resistance.—D. Graffi: Demonstration of the formula of retarded potentials by the method of functional operators.—F. Neri: The auto-excitation of auto-compensated asynchronous machines.—Remo de Fazi: Syntheses in organic chemistry by means of radiant energy (3). Acenaphthene and benzaldehyde. A benzene solution of benzaldehyde and acenaphthene, exposed in a sealed glass tube to sunlight for two years, yielded a trimeride and a tetrameride of benzaldehyde, stilbene, isostilbene, a resinous substance, and a compound formed by the condensation of one molecule of acenaphthene and one molecule of benzaldehyde with loss of one molecule of hydrogen.—O. Scarpa: Concentration, wholly metallic piles acting at variance with Volta's law. Measurements at constant temperature (18°) of the electromotive force of the cells, platinum-zinc amalgam-mercury-platinum, and platinum-cadmium amalgam-mercury-platinum, give values which vary linearly with the concentration of the amalgam in the case of zinc and almost linearly in that of cadmium within the limits of composition for which the amalgams exist as monophase liquid systems.—G. A. Barbieri: Ferrocyanomolybdates and analogous compounds of ruthenium and osmium. When introduced into ammonium acetate solution, the reddish-brown, gelatinous precipitate obtained by the interaction of a molybdate and a ferrocyanide in acid solution is transformed into a canary-yellow, crystalline compound, $(NH_4)_4Fe(CN)_6$, $2MoO_3$, $3H_2O$. The ready conversion of this into the silver compound, $Ag_4Fe(CN)_6$, $2MoO_3$, $H_2O$, points to the existence of the complex $[Fe(CN)_6, 2MoO_3]$, the structure of the ammonium compound being probably

$$[MoO_3(CN)_3Fe(CN)_3MoO_3](NH_4)_4.$$

The corresponding ruthenocyanomolybdate and osmiocyanomolybdate have analogous formulæ.—G. R. Levi and A. Baroni: Diethyl triselenide, sulphodiselenide, and selenodisulphide. Diethyl triselenide, $(C_2H_5)_2Se_3$, is obtained by the action of selenium oxychloride on selenomercaptan or by that of selenium on diethyl diselenide; diethyl sulphodiselenide, $(C_2H_5)_2Se_2S$, by the action of mercaptan on selenium chloride or oxychloride, or that of selenium on diethyl disulphide, and diethyl selenodisulphide, $(C_2H_5)_2SeS_2$, from either selenomercaptan and thionyl chloride or sulphur and the diselenide. The progressive replacement of the sulphur of these compounds by selenium is accompanied by marked increases in the densities and refractive indices.—L. De Caro: Molecular weight of myoprotein, determined by Du Noüy's surface tension method. Determinations of the surface tension of the myoprotein of the dog dissolved in water in presence of a trace of sodium hydroxide show that the static surface tension, before reaching the corresponding dynamic value, exhibits three characteristic minima at the dilutions 1 : 37000, 1 : 55000, and 1 : 80000. On the assumption that these minima correspond with the formation of monomolecular layers of different orientations, the dimensions of the molecular parallelepiped are calculated to be 225·6, 151·7, and 104·3 A. respectively. The volume of the molecule is thus $3569513 \times 10^{-24}$ c.c., its mass $2644084 \times 10^{-24}$ gm., and the molecular weight 1602843, but other considerations indicate that the last figure is too high for anhydrous myoprotein. Approximately, however, the proportion of myoprotein in muscle suffices to cover the total surface of the myofibrils with a monomolecular layer.—G. Quagliariello: Sodium, potassium, calcium, and magnesium in muscular fluid and in its ultra-filtrate. Examination of the muscular fluid of the dog shows that the whole of the sodium in the fluid, together with about two-thirds of the potassium and three-fifths of the calcium and magnesium pass through a collodion ultra-filter.—L. Maddalena: Geological results of the boring of the tunnel of the direct Bologna-Florence line through the Tuscan-Bolognese Appenines.—G. Martino: Behaviour of the phosphogens in muscular tetanus.—M. Tirelli: Tropism phenomena in the larvæ of *Bombyx mori*.

CAPE TOWN.

Royal Society of South Africa, Aug. 21.—C. K. O'Malley: On the cleaning up of civilisation.—J. H. Ferguson: On living leucocytes. A drop of human blood examined by the dark-ground illumination method in a warm-chamber at 37° C. shows: (1) Colloidal particles and 'hæmokonia' in Brownian movement in the plasma; (2) Red cells; (3) White cells. The leucocyte nucleus exhibits a fundamental degree of lobulation for each cell. Nucleoli are prominent only in young cells. The cytoplasm shows a clear structureless hyaloplasm containing oscillating refractile particles or granules of various kinds. Mitochondria and vacuoles are noted.—B. F. J.

Schonland: A proposed method of locating underground water and some experiments thereon. A beam of short Hertzian waves incident at an angle of 45° upon the interface between dry earth or rock and underground water should undergo reflection, and calculation for a wave-length of two metres indicates that the reflected intensity should amount to about 50 per cent of the incident intensity. Apparatus for the production and detection of such beams is described, measurements being made with a portable galvanometer, on a wave-length of 1·8 metres. Interference between direct and reflected radiation has been observed, which suggests a possible modification of the method.

SYDNEY.

Linnean Society of New South Wales, Aug. 28.—W. W. Froggatt: Notes on gall-making coccids and descriptions of new species. Description of a new species of *Apiomorpha* found on *Eucalyptus pilligœnsis*, and three new species of *Opisthoscelis* found on other Eucalypts.—W. Greenwood: The food plants or hosts of some Fijian insects (3).—I. V. Newman: The life-history of *Doryanthes excelsa* (2). The gametophytes, seed production, chromosome number and general conclusion. The germination of the spores is described with special reference to the part played therein by vacuolation of the cytoplasm. By using its cellulose plugs for identification, the pollen tube is traced from the stigma to the synergids. Fertilisation and triple fusion, though not observed, are inferred. The chromosome number is: haploid 22, diploid 44, triploid (endosperm) 66. *Doryanthes excelsa* is concluded to be primitive among the Amaryllidaceæ and even in the Agavoideæ group of the family.

Royal Society of New South Wales, Sept. 4.—A. R. Penfold and F. R. Morrison: The occurrence of a number of varieties of *Eucalyptus dives* as determined by chemical analyses of the essential oils (Pt. 3). The present investigation is confined to an examination of specimens from Victoria. The type yielding an oil containing 50 per cent of piperitone is the predominating tree in many important areas, whilst in others such as at Blackwood, only var. *A* containing 5 per cent of piperitone was observed. In other localities where it was previously difficult to account for oils containing only 26-36 per cent of piperitone, careful field observations showed both the type and var. *A* were growing together. Samples of leaves and terminal branchlets, and the results of the examination of the essential oils obtained therefrom confirmed the field observations.

## Official Publications Received.

BRITISH.

Journal of the Chemical Society: containing Papers communicated to the Society. September. Pp. iv+1847-2172+x. (London.)

Madras Fisheries Department. Administration Report for the Year 1927-28. By Dr. F. H. Gravely. (Report No. 1 of 1929, Madras Fisheries Bulletin, Vol. 23.) Pp. vii+86+4 plates. (Madras: Government Press.) 14 annas.

Indian Journal of Physics, Vol. 4, Part 4; and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 4. Conducted by Sir C. V. Raman. 15: Bibliography of 150 Papers on the Raman Effect. By Dr. A. S. Ganesan. Pp. 281-348. (Calcutta.) 1.8 rupees; 2*s*.

The Indian Lac Association for Research. Bulletin No. 2: Physical Properties of Shellac Solutions, Part 2. By M. Rangaswami and M. Venugopalan. Pp. 17+6 plates. (Ranchi.)

Transactions of the Institute of Marine Engineers, Incorporated, Session 1929. Pp. 553-620. (London.)

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Salop. A Progress Report of Instructional and Experimental Work in Poultry and Rabbit Husbandry. Pp. 72. (Newport, Salop.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1929-1930. Pp. 96. (Edinburgh.)

County Council of the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1929. Pp. 29. (Wakefield.)

Tanganyika Territory: Geological Survey. Annual Report, 1928. By Dr. E. O. Teale. Pp. 48+4 plates. (Dodoma.) 4*s*.

The Quarterly Journal of the Geological Society. Vol. 85, Part 3, No. 339, September 23rd. Pp. cxxix-cxli+223-388. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year 1928-9. Pp. 54. (London: The Crown Agents for the Colonies.) 5*s*.

Observations made at the Royal Observatory, Greenwich, in the Year 1927 in Astronomy, Magnetism and Meteorology, under the direction of Sir Frank Dyson. Pp. viii+A108+B16+Cix+C139+D62+E46+18. (London: H.M. Stationery Office.) 37*s*. 6*d*. net.

Progress of Education in India, 1922-27. Ninth Quinquennial Review. By R. Littlehailes. Vol. 1. Pp. vii+287+xvii. 1.10 rupees; 2*s*. 9*d*. Vol. 2: Appendices and Tables. Pp. iv+235. 2.10 rupees; 4*s*. 9*d*. (Calcutta: Government of India Central Publication Branch.)

Far Eastern Association of Tropical Medicine. Transactions of the Seventh Congress held in British India, December 1927. Edited by Lt.-Col. J. Cunningham. Vol. 2. Pp. xvi+871+26 plates. (Calcutta: Thacker's Press and Directories, Ltd.)

Durban Corporation. Museum Report for the Municipal Year ended 31st July 1928. Pp. 4. (Durban.)

The Scottish Association for the Deaf. First Annual Report (1928-29). Pp. 19. (Glasgow.)

Annual Report for the Year 1928 of the South African Institute for Medical Research, Johannesburg. Pp. 87+2 plates. (Johannesburg.)

FOREIGN.

Bulletin of the National Research Council. No. 71: Bibliography of Bibliographies on Chemistry and Chemical Technology. First Supplement 1924–1928. Compiled by Clarence J. West and D. D. Berolzheimer. Pp. 160. (Washington, D.C.: National Academy of Sciences.) 1.50 dollars.

Scientific Papers of the Institute of Physical and Chemical Research. No. 200: The Internal Strain of Uniformly Distorted Aluminium Crystals. By Keiji Yamaguchi. Pp. 151-169+plates 4-8. 45 sen. No. 201: Beiträge zur Chemie der Viskose. Von Gen-itsu Kita und Rikimatsu Tomihisa. Pp. 171-192. 30 sen. No. 202: Absorption of Hα Line. By Toshio Takamine and Taro Suga. Pp. 193-197+plate 8. 20 sen. No. 203: The Raman Spectra of Calcite, Aragonite and Water Solution of Potassium Carbonate. By Masamichi Kimura and Yōichi Uchida. Pp. 199-204. 15 sen. (Tōkyō: Iwanami Shoten.)

Japanese Journal of Astronomy and Geophysics: Transactions and Abstracts. Vol. 7, No. 1. Pp. ii+45+10. (Tokyo: National Research Council of Japan.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 11, No. 3: Tertiary Foraminiferous Rocks of the Philippines. By Hisakatsu Yabe and Shōshirō Hanzawa. Pp. 54+13 plates. (Tōkyō and Sendai: Maruzen Co., Ltd.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions, Vol. 59: Vergleich der Fangfähigkeit verschiedener Modelle von Plankton-netzen. Von Cl. Künne. Pp. 37. 1.50 kr. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 1. 24 planches. (Copenhague: Andr. Fred. Høst et fils.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 10, Part 2: The Fishes of Porto Rico and the Virgin Islands. Branchiostomidae to Sciaenidae. By J. T. Nichols. Pp. 161-295. (New York City.)

Technical Books of 1928: a Selection. Twenty-first Issue. Pp. 28. (Brooklyn, N.Y.: Pratt Institute Free Library.)

Berichte über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig, Mathematisch-physische Klasse. Band 80, 1928, Heft 7 (Schlussheft). Pp. xxxvii+497-507. (Leipzig: S. Hirzel.) 1·50 gold marks.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Livraison 4, Avril. Pp. 331-455+plates 6-9. (Buitenzorg.) 2.50 f.

CATALOGUES.

Small Electric Furnaces for Laboratory and Works. (List No. 75E.) Pp. 20. (London: A. Gallenkamp and Co., Ltd.)

Pituitary (Posterior Lobe) Extract B.D.H. Pp. 12. (London: The British Drug Houses, Ltd.)

Microscopes and Accessories, 1930. Pp. 103. (London: C. Baker.)

Cambridge Gas Analysers, Electrical Type. (List No. 144.) Pp. 24. (London: Cambridge Instrument Co., Ltd.)

## Diary of Societies.

*FRIDAY*, OCTOBER 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 4.—Sir Wilmot Herringham: Harveian Oration.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens of Trephining—Ancient and Modern.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. D. Adamson: Presidential Address.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Informal Meeting of Pictorial Group), at 7.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—R. Hamilton: Presidential Address.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Royal Metal Exchange, Swansea), at 7.30.—Dr. A. C. Edwards: The Chemistry of Tinplate Manufacture.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION (at Royal Society of Arts), at 7.30.—Miss G. Burlton: Personal Salesmanship in the Electrical Industry.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—W. A. Willox: Some Recent French Railway Construction.
ROYAL SOCIETY OF MEDICINE (Obstetrics and Comparative Medicine Sections), at 8.—Discussion on Causes of Early Abortion and Sterility.
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Dr. C. A. Robinson: Presidential Address.
SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Dr. Tagliani: The Application of the Locust Beans in the Textile Industry and especially in the Calico Printing Trade.

*SATURDAY*, OCTOBER 19.

HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.—Modern Improvements in Wireless.
PHYSIOLOGICAL SOCIETY (at Guy's Hospital).

*MONDAY*, OCTOBER 21.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. P. G. Wakeley: Demonstration of Specimens illustrating Tumours of the Brain.
TEXTILE INSTITUTE (London Section) (at Clothworkers' Hall), at 6.—R. G. Parker: Woollens from the Launderer's Point of View.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at University, Liverpool), at 7.—Prof. E. W. Marchant: Chairman's Address.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—S. Scott Hall: Safety in Flight.
SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Institute of Chemistry, Leeds Area Section) (at Great Northern Station Hotel, Leeds), at 7.15.—Prof. R. W. Whytlaw Gray: Phenomena Associated with Finely Divided Particles in Air.
KEIGHLEY TEXTILE SOCIETY (at Keighley), at 7.30.—A. T. King: Wool viewed as a Chemical in its Formation and Processing.

*TUESDAY*, OCTOBER 22.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Dr. W. J. Adie and others: Diseases of the Pituitary Body.
NORTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS (at Technical College, Stoke-on-Trent), at 5.
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions to the Society's Menagerie during the months of May, June, July, August, and September 1929.—D. Dewar: The Margaret Pennington Bequest to the Society: Water-colour Drawings of Indian Birds by the late General Sharpe.—R. Lovell: The Bacteriological Findings in certain Fatal Cases of Enteritis occurring in the Society's Gardens during 1928.—Dr. Isabella Gordon: On Species of the Galatheid Genus *Eumunida* (Crustacea, Decapoda).
ILLUMINATING ENGINEERING SOCIETY (at Chamber of Commerce, Birmingham), at 7.—R. Maitland: Architectural Lighting.
ROYAL PHOTOGRAPHIC SOCIETY OF LONDON, at 7.—J. D. Johnston: Presidential Address.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Midland Hotel, Manchester), at 7.30.—T. E. Herbert: Chairman's Address.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at Glasgow), at 7.30.—J. MacLeod: The Steam Turbine Locomotive.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at St. Enoch Station Hotel, Glasgow), at 8.—T. Ramsay, Dr. H. Levinstein, H. J. Pooley, and others: Discussion on The Outlook in Chemical Industry in Great Britain, with Special Reference to the West of Scotland.
WEST KENT SCIENTIFIC SOCIETY (at Wesleyan Hall, Blackheath Village), at 8.30.

*WEDNESDAY*, OCTOBER 23.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—R. D. Oldham: Historic Changes of Level in the Delta of the Rhone.—R. W. Pocock: The *Petalocrinus* Limestone Horizon at Woolhope (Herefordshire).—Dr. P. K. Ghosh: The Carnmenellis Granite: its Petrology, Metamorphism, and Tectonics.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Science Museum), at 5.30.—C. O. Becker and A. Titley: Valve Gear of the Newcomen Engine.—L. F. Loree: Josiah Hornblower and the First Steam Engine in America.
INSTITUTION OF AUTOMOBILE ENGINEERS (Manchester Centre) (at Engineers' Club, Manchester), at 7.—Prof. W. Morgan: The Member and the Institution.

*THURSDAY*, OCTOBER 24.

FEDERAL COUNCIL FOR CHEMISTRY (at Burlington House), at 4.30.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Rev. C. Grant: Co-education.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Col. Sir T. F. Purves: Presidential Inaugural Address.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Capt. N. MacMillan: The Art of Flying Land and Sea Machines.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch), at 7.30.
ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—F. Jeans: Urological Statistics as a Criterion of Progress.
ABERNETHIAN SOCIETY (St. Bartholomew's Hospital).—Sir Leonard Rogers: Climate and Disease: Forecasting Epidemics in connexion with Smallpox, Cholera, and Plague.
ROYAL AERONAUTICAL SOCIETY (Yeovil Branch) (at Yeovil).—B. Martin: Steel Wing Construction.
INSTITUTE OF BREWING (Midland Counties Section) (at White Horse Hotel, Birmingham).—C. W. Moeth: The History of Yeast Making in Distilleries during the last Fifty Years.
INSTITUTE OF RUBBER TECHNOLOGISTS (Annual General Meeting) (at Manchester Café, Ltd., Manchester).—F. Walker: Application of Electricity in the Rubber Industry.

*FRIDAY*, OCTOBER 25.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—F. C. Connelly: Some Additional Lines in the Secondary Spectrum of Hydrogen.—Dr. E. G. Richardson and E. Tyler: The Transverse Velocity Gradient near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established.—B. K. Johnson: Resolving-power Tests on Microscope Objectives used with Ultra-violet Radiation.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Dislocations of the Hip-joint—Congenital and Acquired.
INSTITUTION OF CHEMICAL ENGINEERS (at Institution of Civil Engineers), at 6.30.—Dr. W. H. Hatfield: The Fabrication of Acid-resisting Steel Plant (Lecture).
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Annual General Meeting) (at Newcastle-upon-Tyne), at 6.30.—L. E. Smith: Presidential Address.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—P. C. Dewhurst and others: The Requirements of Overseas Locomotive Engineers in Respect of Locomotive Design and Details.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—The Work of the British Electrical Development Association.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. Bruff: Electric Welding as applied to Bridges and other Structures on the L. and N.E. Railway.
ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Dr. S. P. James: Modern Aspects of the Epidemiology, Prevention, and Treatment of Malaria.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University).—Col. E. Briggs: The Chemist in Industry (Chairman's Address).

## PUBLIC LECTURES.

*FRIDAY*, OCTOBER 18.

KING'S COLLEGE OF HOUSEHOLD AND SOCIAL SCIENCE, at 5.—Prof. V. H. Mottram: Human Nutrition. (Succeeding Lectures on Oct. 25, Nov. 1, 8, 15, and 22.)
ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinative Bio-chemistry of the Cell and Tissues: Cell Surfaces (Harben Lectures) (I.).
UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Glory of Greece.
LONDON SCHOOL OF HYGIENE AND TROPICAL DISEASES, at 6.—Prof. T. J. M. Madsen: Diphtheria Toxin and Antitoxin.

*SATURDAY*, OCTOBER 19.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—D. M. Roberts: London in the Middle Ages.

*MONDAY*, OCTOBER 21.

UNIVERSITY COLLEGE, at 2.—A. Stratton: Houses in Tudor Times.—At 5.30.—Prof. J. Macmurray: The Philosophical Approach to Modern Social Problems. (Succeeding Lecture on Oct. 28.)
EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—Sir John Russell: Recent Field Experiments and their Lessons.

*TUESDAY*, OCTOBER 22.

GRESHAM COLLEGE, at 6.—A. R. Hinks: The Greater Universe. (Succeeding Lectures on Oct. 23, 24, and 25.)

*WEDNESDAY*, OCTOBER 23.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—J. C. Stobart: Broadcasting and Health.
KING'S COLLEGE, at 5.30.—Prof. A. W. Reed: Language and Literature (The Contribution of King's College to the Advancement of Learning during the Century 1829–1928).—Dr. F. A. P. Aveling: Personalism: a Psychological Approach to Reality:—The World of Empirical Experience.

*THURSDAY*, OCTOBER 24.

UNIVERSITY COLLEGE, at 5.—Dr. E. A. Gardner: Greece and Greek Sites (Yates Archæological Lectures). (Succeeding Lectures on Oct. 31, Nov. 7, 14, 21, 28, Dec. 5 and 12.)

*FRIDAY*, OCTOBER 25.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 5.—Prof. R. A. Peters: Co-ordinate Biochemistry of the Cell and Tissues: The Ministers of Metabolic Change (Harben Lectures) (2).
UNIVERSITY COLLEGE, at 5.30.—C. S. Elton: The Future of Animal Ecology. (Succeeding Lectures on Nov. 1 and 8.)

*SATURDAY*, OCTOBER 26.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. C. Ainsworth Mitchell: Faces and Finger Prints.

## CONFERENCE.

OCTOBER 24 AND 25.

INSTITUTE OF FUEL (at Institution of Mechanical Engineers).
*Thursday, Oct.* 24, at 11 A.M.—Sir David Milne-Watson: Presidential Address.
At 2.—C. J. Jefferson, W. M. Whayman, H. E. Yarrow, and Dr. G. E. K. Blythe: Papers on Pulverised Fuel for Marine-type Boilers.
*Friday, Oct.* 25, at 10.15 A.M.—J. S. Atkinson: The Installation and Operation of Gas Producer Plants for Industrial Furnaces.—E. C. Evans: The Economics of Coke-oven Gas Utilisation in Industry.
At 2.30.—E. H. Lewis: Heat Insulation.—A. J. Dale and A. T. Green: (*a*) Fuel Control in the Ceramic Industry; (*b*) Refractories in Application to the Fuel Industries.