Nature

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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

SATURDAY, JULY 2, 1927.

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Scientific Worthies.

XLV.—RICHARD WILLSTÄTTER.

"For all flesh *is* as grass"—1 PETER i. 24.

"A child said, *What is the grass*? fetching it to me
with full hands;
How could I answer the child? I do not know
what it is any more than he.
I guess it must be the flag of my disposition, out
of hopeful green stuff woven.

"Or I guess the grass is itself a child, the produced
babe of the vegetation.
Or I guess it is a uniform hieroglyphic
And it means, Sprouting alike in broad and narrow
zones.

"And now it seems to me the beautiful uncut hair
of graves."

WALT WHITMAN, *Leaves of Grass*.

CHEMISTRY is both a craft and an art, one of the finest of arts—perhaps the art of arts, a veritable "sword of Aklis," wherewith the threads are cut which hold the secrets of our material world and the nature and character of its component units disclosed; it has a wondrous psychology of which but few as yet have gained feeling, mastery and reverence. A science only in the second degree, because so much of its burden cannot be quantified, chemistry is none the less a premier science, through the exquisite finish of the enviable craftsmanship exercised by the men of genius who have been successful in its service. Among the craftsmen who have most adorned our ranks, we can place none higher than the subject of this memoir, for he has reached to the highest pinnacle of technical proficiency to which our art has been carried. A striking

feature in his conquests has been the sureness and swiftness of his approach, the courage of his attack and his deft handling of situations which previous workers have failed to master.

A biographer writes :[1] "It is an open secret to the few who know it but a mystery and a stumbling block to the many, that Science and Poetry are twin sisters : insomuch that in those branches of scientific inquiry which are most abstract, most formal and most remote from the grasp of the ordinary sensible imagination, a higher power of imagination akin to the creative instinct of the poet is most needed and most fruitful of lasting work."

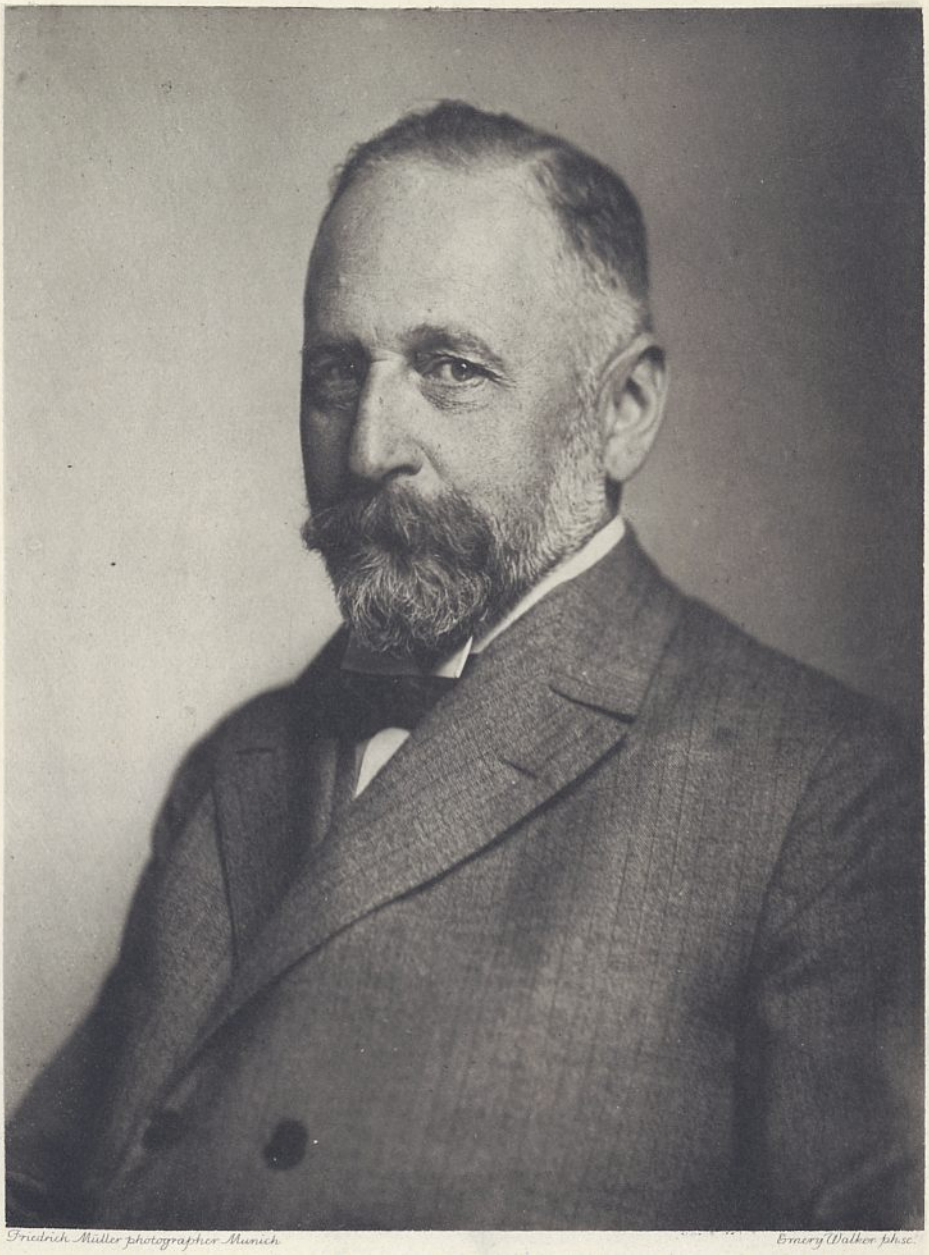
The chemist who can teach so much of grass, who can go so far towards answering the question put by the child to which the poet confessedly had no answer, who can also lay bare the secret of colour in flowers, may be placed even above the poet. The poet but deals with the superficial and with fancies ; at best he is a mere painter. The full beauty of Nature, the structure of her wondrous mechanism, is patent only to the chemist : he is fast learning to interpret her 'uniform hieroglyphic' in terms which admit of no dispute. Now that we can think in terms of the Ångström unit, our vision is become ultra-microscopic. Our science of chemistry, in fact, is no twin sister of poetry but poetry itself and at its highest. Its mysteries are as deserving of attention and as marvellous as are those of even the densest stars. Indeed, the saga of the universe is before us in grass, if we will but read it : we know that "all flesh *is* as grass." The alphabet in which the story is told, in reality, is one of remarkable simplicity and that so few care to make the attempt to master our shorthand, the language in which our story of flowers is told, is surprising, to say the least. The outward beauty of the flower is patent to every one—the inward beauty of its mechanism, to the seeing eye, is marvellous beyond compare—the man who has done so much to interpret its character may well be deemed worthy among us.

Richard Willstätter was born in Carlsruhe (Baden) on Aug. 13, 1872. At first, he was educated there but afterwards, on removal of his parents to Nürnberg, at the Realgymnasium of that town. When eighteen years old, he entered the University of Munich, where he began the study of chemistry under the great Adolf von Baeyer, a master of laboratory craft, known to the world as the first to prepare indigotin artificially, the colouring matter of the indigo plant. The fifteen years of his career were spent there as student and privat-docent, and finally, from 1902 onwards, as extraordinary professor and head of the organic chemical department. In the spring of 1902, he was appointed full professor (ordinarius) at the noted Zürich Technical High School. After spending seven years in Zürich, in 1912 he returned to Germany to take charge of the Chemical Research Department established by the Kaiser Wilhelm Society at Dahlem, Berlin. It was here that he carried out most of his work on plant-colouring matters. Ultimately, he became professor at Munich, in succession to Adolf von Baeyer. He was elected a member of the Prussian Royal Academy of Sciences in 1915 and received the Nobel Prize in 1920.

It appears to have been Willstätter's ambition, from an early stage in his career, to undertake the study of vegetable and animal pigments and he advisedly entered upon a considered course of original study to acquire the necessary technical proficiency in preparation for this task. Beginning with the vegetable alkaloids, atropine and cocaine, which he was able to prepare artificially, he passed to the study of the quinones, a class of compound to which at least a majority of dyestuffs belong. He made a notable addition to knowledge by his discovery of orthobenzoquinone. He then entered upon his great inquiry into the nature of chlorophyll. He next devoted himself to the study of the red and blue colouring matters of flowers. Of late years he has been engaged in the attempt to isolate enzymes. These, however, are only the main lines of inquiry which have occupied his attention. A German professor, especially if he be a man of established repute, is called upon to provide subjects for a large body of young workers : hence it comes that Willstätter has touched a great variety of themes other than those referred to above. He has thus been led to solve a number of problems of special interest and more than ordinary difficulty. Among the inquiries, that on hydrogenation under the influence of platinum may be referred to as one of prime importance.

The studies of the green colouring matter of plants are described in twenty-four memoirs, published in Liebig's *Annalen der Chemie* during the years 1906–14, and in a book written in conjunction with A. Stoll (Berlin, 1913). It will be remembered of Shibili Bagara that he "pre-

[1] F. Pollock in Leslie Stephen and Frederick Pollock's Lectures and Essays, by W. K. Clifford.



Friedrich Müller photographer Munich. Emery Walker phsc.

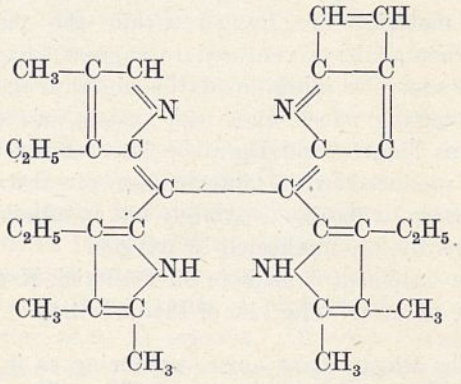
Richard Willstätter.

pared a rapid lather and dashed it over Shagpat and commenced shaving him with lightning sweeps of the blade (Aklis). 'Twas as a racing wheel of fire to see him." So Willstätter with chlorophyll. When he began the inquiry, the view prevailed that chlorophyll was but a group name and even that each plant might contain its specific chlorophyll. Not the least remarkable outcome of his work has been to show that, in more than two hundred species of Cryptogamic and Phanerogamic plants, the same mixture is to be found, in slightly different proportions, of two closely related compounds, which he has termed α-chlorophyll and β-chlorophyll, the former being blue-green, the latter yellow-green. This result is surprising in view of the fact that no two animals contain the same hæmoglobin, although one hæmatin is common to all, the globin (protein) component varying from species to species. Willstätter has further shown that, in the cell plastid, as indeed Sir G. G. Stokes first pointed out in 1864, the two chlorophylls are associated with two 'yellow' colouring matters, one the well-known hydrocarbon *carotene*, $C_{40}H_{56}$, the other a previously unisolated compound, *xanthophyll*, $C_{40}H_{56}O_2$, apparently a derivative of carotene. The Phæophyceæ alone also contain a third carotinoid, *fucoxanthin*, $C_{40}H_{56}O_6$.

The method of separating the chlorophyll compounds adopted by Willstätter is that originally proposed by Stokes and involves the use of more or less immiscible solvents, particularly petroleum spirit and aqueous alcohol. Being soluble in a mixture of petrol and alcohol but insoluble in petrol, α- and β-chlorophyll are precipitated when the alcohol is washed out of the solution. The method is one by means of which the pigments may be extracted from either dry or fresh leaves as easily as may an alkaloid or a sugar. The two chlorophylls are separated by fractional crystallisation from methylic alcohol and petrol. They are usually present in the proportion of about three molecules of the α- to one of the β-compound. Their composition is remarkable, that of the α-compound being represented by the formula

$$C_{32}H_{30}ON_4Mg(CO_2CH_3)(CO_2C_{20}H_{39}).$$

The β-compound differs only in containing an additional atom of oxygen. It will be seen that they are dicarboxylic derivatives. Significant constituents are magnesium and the radicle $C_{20}H_{39}$ of the complex alcohol, *phytol*, $C_{20}H_{39}$. OH, about one-third of the weight of the molecule consisting of this component. The condition of the magnesium is peculiar, as the metal is not displaced by the action of alkalies, though readily by that of acids. Its behaviour, therefore, is similar to that of the iron in hæmoglobin. The carboxyl-free mother substance of α-chlorophyll is a complex pyrrole derivative (*ætioporphyrin*) and the magnesium is probably associated with the nitrogen in this complex. This derivative is represented provisionally by the formula



Ætioporphyrin is a compound of outstanding interest as it is also obtainable from hæmoglobin. It is noteworthy that Fischer and Klarer have recently prepared a compound synthetically from 2 : 4-dimethyl-3-ethylpyrrole which appears to have the properties of Willstätter's product. That primary functions of life should be exercised, both in the plant and in the animal, by compounds of similar parentage is more than remarkable. The function of hæmoglobin, apparently, is that of a mere oxygen carrier—it is little more than a gasholder. Chlorophyll plays a far more complex part, as it in some ways promotes the absorption of solar energy that is involved in the reduction of carbonic acid to formaldehydrol, $CH_2(OH)_2$, and the concurrent elimination of oxygen, in the primary process of assimilation.

Willstätter and his co-workers have shown that the chlorophylls remain unaltered in amount throughout the process and that they can enter into loose conjunction with carbonic acid : possibly the connexion is established through the magnesium and the carbonic acid thus made part of the energy-absorbing system. Once formaldehydrol is produced, passage to the sugars is a simple matter : yet this must be a directed operation, as the aldehydrol gives rise to only one of the two optically opposite forms of hexose. Those who talk glibly of the artificial imitation of the life process forget these little peculiarities and limitations—and so mislead the public into unjustifiable

beliefs. Whatever the process, there is no reason to believe that carbonic acid is more than half reduced and the oxygen that is liberated is probably not derived from the carbon dioxide but is formed by the electrolysis of water. The operations are carried on within the chlorophyll plastid in presence of carotene and xanthophyll, both highly oxidisable substances; it is surprising that oxygen should be liberated within such a system and be without effect upon it, the more as various oxidisable materials are formed within the plastid. Elsewhere, I have ventured to suggest, that the yellows serve to inhibit oxidation and thus exercise a protecting effect upon the system—an effect such as Moureu and Dufraisse have shown to be often produced by the 'interference' of substances which are oxidisable separately but in admixture, apparently, are unaffected by oxygen.

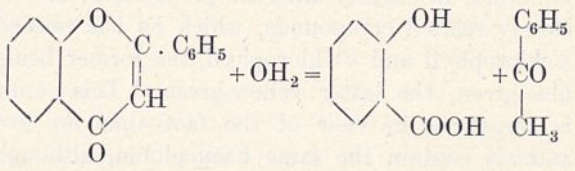
The statement is made in Sir Frederick Keeble's recent work on "The Life of Plants" that

"The wheat plant alone, producing as it does a world crop containing some 70 million tons of carbohydrate, 'handles' each year about 114 million tons of carbon dioxide and liberates to the atmosphere over 80 million tons of oxygen. The energy-value to the plant of the carbohydrate produced during photosynthesis may be computed on the basis of the amount of heat found by experiment to be liberated when a given amount of starch is caused to undergo combustion. The combustion of one ounce of starch liberates 116 calories and it is, therefore, only a matter of calculation to discover the energy value in terms of calories of the carbohydrates of the world's wheat-crop. The heat which would be produced by the combustion of the 70 million tons of carbohydrate would suffice to raise to boiling-point all the water of an ice-cold lake four miles long, four broad and of an average depth of forty fathoms."

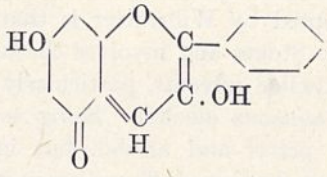
As all plants, through their leaves, exercise a similar activity, chlorophyll does some work in the world—we, therefore, might well learn to look upon it with respect, even take some little interest in its character and functions.

Of what value, however, is colour in the flower? Who shall say what the significance of colour may be? We are most of us alive to its æsthetic charm and value—what of insects: are they? If attracted by it and the fertilisation process be in large measure an outcome of such attraction, then indeed it is of utmost consequence to life.

The patterns of the colours in flowers have been deciphered with surprising skill and surprising swiftness by Willstätter and he has shown, moreover, that they are of remarkable simplicity. He has dealt with the reds and blues, which he has termed anthocyans; the yellows have been fairly well studied by others. In many plants, yellow and orange are due to xanthophyll and carotene: in other cases, they are mostly traceable to the presence of hydroxy-derivatives of flavone, present as a white meal upon the leaves and flower stalks of many of the Primulaceæ. Flavone, as shown by Hugo Müller, may be resolved into acetophenone and salicylic acid—two simple substances:



The anthocyans are mostly glucosides, yielding on hydrolysis either glucose or galactose or rhamnose together with the coloured component or *anthocyanidin*, which in some cases is a methylated derivative. They are resolved by the action of alkali into the trihydroxybenzene, phloroglucinol, either parahydroxybenzoic, protocatechuic acid or gallic acid or maybe a methylated derivative of one of these. The parent substance may be formulated as an orthoquinonoid derivative, thus:



In many respects their properties are peculiar but it is impossible to discuss them here. The reds are but acid forms of the blues. As in the flavones, the intensity of the colour increases with the number of hydroxy groups in the lateral phenyl group. Much might be said on the relation of colour to structure in these compounds were space available—no more fascinating subject could be entered upon.

Willstätter's work has of course been followed by a synthetic repercussion. In recent years, Prof. Robinson, in Manchester, has most skilfully developed methods with the aid of which it is possible to prepare anthocyanidins in the laboratory in any desired quantity: so to-day we can paint the lily with its own pigments.

Passing now to Willstätter's most recent work, that on enzymes, we are brought into a troubled field, one which, however, we must contemplate

with wonder, as their activities lie behind the mysteries of life.

The colouring matters of plants appear to be without functional significance—they seem to be mere dress effects. Chlorophyll, however, is life at its outset, as by its agency the bricks are shapen which Nature hands to the plant: not only so, for with its aid energy is captured from the sun, which the plant not only uses to its own ends but also passes on to us. What of the enzymes, Willstätter's latest subject of study? Life, we know, in the main involves only two processes—on one hand, that of hydrolysis and its reverse; on the other, that of oxidation (hydroxylation) and its reverse. Oxidation, apparently, is determined and controlled by agents which are limited in their range of action but not specifically selective and, therefore, are not to be counted with the enzymes. The enzymes are the agents in charge of the hydrolytic process, whether this be downgrade or upgrade. They apparently are the templates which regulate constructive metabolism, both in plants and animals, for they are strictly selective agents. Hitherto they have been elusive entities, only characterised by their effects. Willstätter's efforts have been to prepare them in the individual state, so that they may be further characterised and their nature determined. The task is one of extraordinary difficulty. He has shown that they may be handled with far greater impunity than had been supposed and has devised methods of purifying them whereby he has greatly raised their activity but without arriving at any definite result. The final picture he has drawn for us of the enzyme is that of a colloid carrier of a group which is the active component: a picture drawn by my son and myself in 1913; indeed, we went further, in showing the colloid in attachment with a directing group, in addition.

I perhaps more than any one can appreciate the value of work so varied yet always in logical connexion—can wonder at the genius displayed and the self-sacrificing devotion of the worker to his task. Only the few among us can be aware what such inquiry means, what it involves—what are its joys—what its pains. Perhaps, some day, these matters will come home, in some slight measure, to those who in the arrogance of their ignorance pretend to rule the world—I say this because I should like to think that "the flag of my disposition [is] out of hopeful green stuff woven" and that the moral value of inquiries such as have been referred to may not always remain unknown to the public. HENRY E. ARMSTRONG.

Corrosion—Some Causes and Remedies.

The Corrosion of Metals. By Ulick R. Evans. Second edition. Pp. xvi + 259. (London: Edward Arnold and Co., 1926.) 15*s.* net.

TWO years ago (May 23, 1925, p. 793) the first edition of Mr. Evans's book was reviewed by the present writer in the columns of NATURE. Its good qualities have evidently been widely recognised, since a second edition has recently been published. The author states in his preface to this that progress made during this period in the understanding of the processes of corrosion has made so many additions necessary, that it has taken him longer to write the second edition than the first. The same general arrangement has been preserved, and he has adhered to the policy of giving a concise statement of the subject in the text accompanied by numerous references in the foot-notes to papers where further details can be sought on any particular point of interest. The net result is the production of a book some forty pages longer than the original volume and the published price has been slightly increased.

We learn from the chapter on the corrosion of copper and copper alloys, that an interesting protection process has recently been adopted by the Cunard Steamship Company, Ltd., which consists in spraying the interior of the condenser tubes with a bituminous composition. Austin, who has described the process in detail (*Trans. Liverpool Eng. Soc.*, **46**, 1925), states that the vacuum is reduced by $\frac{1}{4}$ to $\frac{1}{2}$ inch (owing to the decrease in the thermal conductivity of the coated tubes) but the over-all efficiency is not affected. Mr. Evans suggests as the reason for this, the increased cleanliness of the boiler heating surfaces and turbine blades. So far the experiment has proved very successful, only 21 tubes out of 28,500 having failed since its installation. As yet the process has not been tested in ships sailing in warm waters. The electrochemical process for protecting condenser tubes is stated to be somewhat of a disappointment, and the latest reports from many trustworthy sources indicate that in many cases little or no benefit has been obtained where it had been installed. Dr. Honegger states that in some cases the process has failed completely, while in other cases it has proved very useful. It seems quite possible that in the latter cases this has been achieved by the deposition on the tubes of a film of iron compounds derived from the anode rather than by true cathodic protection. Bengough and Stuart have pointed out that the weak feature of the method

lies in the impossibility of securing the distribution of the current over the whole of the tube surface. Mr. Evans directs attention in a foot-note to the fact that there is no fundamental reason why cathodic treatment should put a stop to corrosion and that cases are known where mild cathodic polarisation—by keeping the metal active—may actually accelerate attack.

In Chapter xi., entitled "Protection against Corrosion," we notice the statement that "the employment of sodium silicate (water glass) as an inhibitor is increasing." It finds application as an addition to plumbo-solvent waters prior to their entry into lead pipes. It is used in cleaning aluminium. Both in liquid and solid form it is also being used to prevent the destruction of iron pipes by water and, in many cases, has been found to reduce corrosion considerably. In recent years the same material has been used in increasing quantities in boilers. Here, however, other questions are raised, *e.g.* the possible effect of the protective film (which is probably silica or a silicate) on the heat-transfer, the possible increase of foaming and the action on the brass fittings. Further research on all these points would be of value. Hall, who has made a long study of boiler scales, points out that a calcium silicate scale has a most pernicious effect in a boiler. It is therefore not advisable to add sodium silicate to a hard water rich in calcium.

It is interesting to notice the author's statement that the electro-deposition of chromium as a protective coating is now being utilised. This metal does not adhere well to steel if deposited directly, but satisfactory results have been obtained if a thin layer of copper or nickel is first deposited on it. The chromium plating then follows, usually from a bath containing chromic acid and chromium sulphate, which must be kept cool. It is stated that plated articles manufactured in this way withstand corrosion by sea water, and also exhibit resistance to tarnishing. The hardness of chromium is a considerable additional advantage. It may be that this metal will prove a serious rival to nickel in spite of the greater expense involved. Later on in the same chapter we observe a reference to the operation known in Germany as *Nitrierung*, which consists in protecting iron by heating it in ammonia, a process which produces a very hard nitride layer. Actually this process is mainly applied for increasing hardness, but it does afford some protection against corrosion.

Several processes have been worked out for producing protective coats upon metals by subjecting them to anodic treatment in suitable solutions. Special reference should be made to the work of Bengough and Stuart, who have devised a method for the protection of aluminium and its light alloys such as duralumin which has given most promising results. The articles in question are made the anodes in a 3 per cent. solution of chromic acid at about 40° C. The cathode consists of carbon. The applied E.M.F. is gradually raised to a value depending on the nature of the alloy and the composition of the bath. After treating for some time in this manner the surface of the metal becomes covered with a semi-opaque uniform white coating. This seems to consist almost entirely of aluminium hydroxide in a glassy adherent form. Possibly it is hydrated to some extent, but the amount of hydration cannot be large, since the coating can be heated to 350° C. without changing in appearance or density. Not only does this coating afford considerable resistance to corrosion, but it also acts as an excellent basis for the application of protective paints or varnishes which are not very satisfactory if applied to untreated aluminium. The anodic protection of duralumin is finding wide application both in the aircraft industry and in the protection of artificial limbs against corrosion.

The final chapter on corrosion-resisting materials contains the latest information on the many varieties of stainless steel and stainless iron now available. The alloy manufactured in England under the name of 'Staybrite' contains no less than 18 per cent. chromium and 8 per cent. of nickel; the German material known as V2A contains from 20 to 25 per cent. of chromium and 6 per cent. of nickel. Unlike ordinary stainless steel, which has a duplex structure, these alloys, as Mr. Evans points out, consist of a single phase. The iron is in the austenite (gamma iron) condition. Accordingly the materials are ductile and can be wrought into almost any form. It has even been found possible to weld them. Reference may also be made to stellite, which is the most important corrosion-resisting alloy of cobalt. It is a very composite alloy containing considerable quantities of cobalt, chromium, and tungsten, and smaller quantities of iron, carbon, and possibly silicon and manganese. It combines good anti-corrosion properties with great mechanical hardness.

In conclusion, it may be stated that the second edition of Mr. Evans's book is even more serviceable than the original volume, and the demand for it will probably be at least as great. We hope it will be even greater.

H. C. H. C.

A Projected Art of Light.

Colour-Music: the Art of Light. By Adrian Bernard Klein. Pp. xvi + 287 + 24 plates. (London: Crosby Lockwood and Son, 1926.) 36*s.* net.

THE project of an art of light, analogous to music, threatens to become an obsession, recurring in every generation, attacking indiscriminately philosopher, artist, and empirical scientist. It is particularly insidious because it cannot be flatly dismissed as a mere chimera. There may be something in it, and there is no alternative but to think the matter out.

Other than Major Klein probably no one has combined so firm a belief in the possibility of this art with so comprehensive a group of the relevant scientific data, or with so frank a recognition of the difficulties in the way. His work will certainly rank for a long time as the standard authority on the subject, and it leaves no excuse for future exponents ignoring their predecessors' errors. An enormous amount has gone to its compilation. Approaching the question from an historical point of view, the author has studied every important contribution, examined every instrument, and canvassed every opinion. (The bibliography ranges from Aristotle to the provincial press reports on the touring colour organ.) Not every opinion is equally important, and the author would not have been blamed if he had dealt more fully with some of the central issues at the expense of some of this historical material. But even in the bewildering byways of speculation he himself is critical and alert.

Theoretically, the abstract possibility of an art of light is reasonably established. Colours presented in succession can produce a definite æsthetic effect. But this is obviously not enough. Pyrotechny is a sort of art of light; but what is projected is something more profound, something really comparable to music. This is a further and more difficult issue, raising a host of technical, practical, and æsthetic questions.

Scientific interests enter in two ways. First, adequate theoretical foundations must be secured. The physical properties of the spectrum provide a tangible starting-point, but the scales of colour must apply to every dimension of the colour octahedron (or whatever schema is ultimately adopted) and must be empirically determined with due regard to the individual variations of differential threshold, and for all the facts of colour sensitivity arising from the peculiarities of the cerebro-retinal mechanism. A technique for establishing such scales is, of course, at hand in Fechner's psycho-physical methods, but scales so established would not imply 'intervals' of the type required. On this crucial point the whole inquiry has been given an unfortunate twist by two curious phenomena which, in virtue of their peculiarity rather than their importance, have impressed the imagination of most inventors of an art of light. One of these is the psychological curiosity of synæsthesia; the other is the, after all, surprising fact that harmonious 'intervals' experienced in awareness of tones are physically paralleled by certain simple ratios between the frequencies of the vibratory stimuli. The combined effect of these two facts has been to foster a number of fruitless attempts to accompany music by synæsthetic lights or even to translate music directly into colour, and to encourage a great deal of specious but wholly unconvincing argument to establish harmonic colour scales on the basis of the ratios of the frequencies of waves of light.

It is one of the solid merits of Major Klein's work that he refuses to be ensnared in this inversion of the natural and logical order of investigation. After a careful analysis of these theories he comes unambiguously to the conclusion that the intervals of colour must be independently established. Independently established, but how? The author, it seems, is not enamoured with the method of paired comparisons, preferring to await the birth of a colour musician who will divine the laws of colour harmony by the unaided light of Nature. That would be eminently desirable, but the point is, we rather urgently require some preliminary evidence that the laws are there for him to divine. What we know at present with regard to the harmony of co-presented colours cannot (owing to the factor of spatial configuration) be applied *simpliciter* to colour sequences. The fact that no adequate research has been directed upon the problem of colour 'melody' constitutes a serious weakness in the theoretical foundations of this art.

A second strain of purely scientific interest enters in connexion with the provision of technical devices for the control of colour stimuli. For good, though not conclusive, reasons, Major Klein has committed himself to a policy which will engender serious practical obstacles to the cultivation and diffusion of the projected art. He requires a specially constructed hall and an elaborate type of projecting spectroscope controlled by a keyboard embodying the principles of the theoretical colour scales. Now, the art of sound has had the advantage that the human organism is itself a musical

instrument and potent instinctive tendencies have motivated its use and exercise. *Per contra*, the art of light lacks this natural basis—and simple instruments fail to achieve any very impressive effects. But even a tom-tom or a simple pipe can produce a distinct effect, and without them we should have had neither orchestra, composer, nor audience. Inventions of the art of light have pursued many analogies, but not the biological. What is the counterpart in colour music to the folk-song or the country dance? When his instrument is to cost £10,000, how is the colour musician to acquire facility in his art? Perhaps the failure of simple instruments points to a certain weakness in our reactions to mobile colour. The emotional possibilities may be too limited to support a vital art, and some centuries of further cultivation may be required. Perhaps, too, the author has unwittingly aggravated his difficulties by applying to a new and infantile art æsthetic theories derived from modern and sophisticated spheres. But on æsthetic theories each man may hold his own opinion, and these at any rate fall outside the scope of the present review.

The objections are not final. To prophesy a negative is as difficult as to prove one; and a new approach may completely change the situation. In any event the author has performed a useful service in presenting the problem in a clear and definite way.

C. A. MACE.

Recent Literature on Enzymes.

(1) *Die Fermente und ihre Wirkungen.* Von Prof. Dr. Carl Oppenheimer. Nebst einem Sonderkapitel: Physikalische Chemie und Kinetik, von Dr. Richard Kuhn. Fünfte, völlig neu bearbeitete Auflage. Lieferung 9. Pp. 1205-1392. 17·40 gold marks. Lieferung 10. Pp. 1393-1568. 17·10 gold marks. Lieferung 11. Pp. 1569-1744. 17·10 gold marks. Lieferung 12. Pp. 1745-1871. 17·45 gold marks. Lieferung 13. Pp. xvi+1873-2037. 19 gold marks.

(2) *Lehrbuch der Enzyme: Chemie, physikalische Chemie und Biologie.* Von Prof. Dr. Carl Oppenheimer. Unter Mitarbeit von Prof. Dr. Richard Kuhn. Pp. ix+660. 33 gold marks. (Leipzig: Georg Thieme, 1927.)

(1) WE have already dealt with Parts 1-8 of this work, and now that it has reached completion with Part 13, including an author and subject-matter index, it seems desirable to review the entire work.

The first edition of "Die Fermente" appeared as quite a modest volume twenty-five years ago, and since that time the immense amount of work which has been carried out on the subject of enzymes has necessitated the publication of several fresh editions, the task culminating in the compilation of the present extensive treatise, dealing in an exhaustive manner with what is now one of the most important branches of biochemistry. The last edition of Prof. Oppenheimer's book has been out-of-print since 1918, and it was decided by the author to recast the whole work, retaining only here and there those portions of the previous text, without altering its general plan. In view of the large additions to our knowledge during the past decade, it has been found necessary to omit some of the older observations, which in the opinion of the author are obsolete. In adopting this course he points out, however, that he has paid due regard to the necessity of preserving the character of the work as giving a complete account of the subject.

We know very little at the present time concerning the chemical nature of an enzyme, but as a result of the most recent work, among which that of Willstätter stands out prominently, enzyme preparations have been purified and their activity thereby increased enormously, whilst at the same time some of them have given indications that they consist of chemical entities. But in all probability an enzyme will be found to constitute a system rather than a single chemical substance. In this connexion, however, attention may be directed to the recent work of Sumner (1926), who shows that a crystalline globulin from jack bean exhibits the activity of a urease. He states that it may be recrystallised by solution in water and addition of acetone up to 30 per cent. concentration and gradual treatment of the solution at 0° with potassium dihydrogen phosphate of pH 6·1. Here, however, we have the presence of the phosphate to be taken into account, which probably does something more than adjust the hydrogen ion concentration. What may be called the nucleal part of this system is the zymogen, which under certain conditions is rendered active. The chief of these conditions is the hydrogen ion concentration and the presence of certain electrolytes. Machaelis regards enzymes as amphoteric electrolytes or ampholytes; and this theory, developed by Bjerrum, is dealt with fully in the treatise.

The entire work is spread over 2037 pages and is divided into two volumes. The first volume, covering 775 pages of text, deals with the general chemistry of enzymes, the kinetics of their actions and the biology of the subjects, the concluding

part of the volume being devoted to the esterases (lipase, etc.), the carbohydrases, and the nucleases. The second volume is concerned with amidases, aminoacidases, proteases, and a group of enzymes connected with oxidations and reductions, to which the author has given the name desmolases, including zymase, the various oxidases and autoxidisable substances such as glutathione.

The author classifies enzymes according to the substrata on which they act: thus esterases, including the lipases, carbohydrases, proteases, and desmolases, including zymases and the respiratory enzymes. He admits that if in the future some knowledge be forthcoming of the constitution of a given enzyme, a fresh classification will have to be elaborated. In this connexion we may quote his remarks: "It can only be hoped that the work on the chemical nature of the ferments which Willstätter has so happily inaugurated, will lead to clear and definite results. If the structure of one of the ferments is cleared up, this will soon be extended to the whole class, just as with the hormones as exemplified in the case of adrenaline," and he might have added thryoxin, which, however, has been synthesised by Harington since the publication of this treatise.

Under physical chemistry and kinetics, ultrafiltration, kataphoresis, complexes with heavy metals, surface tension and adsorption phenomena, and reciprocal precipitation of colloids are discussed. Reaction velocity and catalysis are fully dealt with. Discussing the thermochemistry of fermentation, it is shown that the theoretical quantity of heat envolved per gram molecule of glucose fermented is 28·2 *K*, whereas Rübner found experimentally 24 *K*. No reference is made, however, to the determination of the heat of fermentation of maltose by the late A. J. Brown, whose results were derived from practical data in a brewery.

The interesting observation of Kuhn (1923) is recorded that the invertase (sucrase) from yeast (bottom fermentation) and from *Aspergillus oryzæ* respectively behave differently towards sucrose. In the former case the hydrolysis is slackened by the presence of *d*-fructose, whilst in the latter case it is slackened by the presence of *d*-glucose.

That a treatise of so comprehensive a character as that before us was much needed, no one will deny, but much as we value it we are bound to say that the text is needlessly diffuse and abounds with repetitions. The lipase of seeds is said to be distinguished from that present in the liver and tissues of animals in being insoluble in all solvents, and this statement is repeated several times. Many other similar cases could be cited. We are surprised to find the statement that, during germination, amylase is rendered soluble without altering its functions. Amylase of raw grain (barley) is probably partially insoluble, and the maltase which accompanies it is insoluble, but amylase of germinated grain will act on amylopectin, whereas that of raw grain merely depolymerises it.

The best way to judge a book of the kind before us, however, is to use it, and it gives the present writer pleasure to state that he has found the treatise invaluable as a book of reference on which to base his lectures on enzymes and to serve as a guide to original papers on the subject.

(2) The authors have prepared this work from the larger treatise "Die Fermente," of which it is a shortened edition, to serve as a students' manual. That such a manual was needed there can be no doubt. However, the text of the larger treatise has been to a great extent retained, the difference being that whole parts have been excised and that fewer references are given to the literature. The names of those responsible for the observations cited in the text are given in some cases without references. In our opinion it would have been much better if the work had been entirely re-cast, as it would then have been possible to reduce the size of the volume considerably and to obtain a better logical sequence in the text, which is specially desirable in a book intended for students. The subject matters are arranged in the same order as in the larger treatise, but many pieces of work which have appeared since the publication of the earlier parts of the latter are referred to, thus bringing the book up-to-date.

ARTHUR R. LING.

Our Bookshelf.

The Reproduction of Life: a Handbook of the Science of Reproduction in Nature and Man. By A. J. Cokkinis. Pp. xvi + 287. (London: Baillière, Tindall and Cox, 1926.) 10*s*. 6*d*. net.

THE author states in his preface to this book that his aim in writing it has been to fill the need of a simple, yet accurate, scientific account, intelligible to the adolescent boy or girl, of the phenomena of the reproduction of life. The problem of selection and presentation of material for a book of this kind is a difficult one, as any one who has had experience of teaching hygiene to school children will appreciate, and Mr. Cokkinis has not been very successful in solving it. He has attempted to cover an unnecessarily wide field. Those sections on plant and animal reproduction, in which he describes and figures, often inaccurately (see, for

example, Figs. 59 and 69), the reproductive organs in plants, and in the more important classes of the animal kingdom, can be studied in any elementary text-book of biology, with this advantage, that they are there set forth with correctness of detail. A short account of the cellular basis of living organisms, with a clear description of the differences between asexual and sexual reproduction, oviparous and viviparous development, would have been sufficient introduction to the study of the question in man. The great difficulty which the average individual naturally experiences in visualising, with any clearness, the position and relation of the organs of the body, makes it absolutely essential that these points should be illustrated by careful, large-scale drawings. Isolated diagrams of partially dissected systems, such as are given in this book, convey nothing to the untrained mind.

H. E. B.

The Principles of Petrology: an Introduction to the Science of Rocks. By Dr. G. W. Tyrrell. (London: Methuen and Co., Ltd., 1926). 10*s.* net.

THIS is the first of a geological series of books to be published under the general editorship of Prof. J. W. Gregory. Two others are promised. After reading the book one feels that the author could himself have contributed three separate books on petrology. In this small volume, igneous, sedimentary, and metamorphic rocks are all dealt with, and the space is quite inadequate to the subject. The author is very widely read, as his numerous and excellent abstracts published in *Science Progress* prove, and he has endeavoured to include in his book every recent contribution to the science of petrology. It is indeed, to quote the author's preface, "a conspectus of the present state of the science of petrology," but it is a little doubtful whether the workers in other branches of geology or "students who have acquired an elementary knowledge of the science" will know quite how much to believe when they have read it all.

The descriptive parts of the book are very clear. Metamorphic rocks are dealt with in seven chapters describing the various processes and their products. Only six chapters can be devoted to "Secondary" rocks, classified as residual, sedimentary, and chemical. Good chapters under Part I. (Igneous Rocks) describe forms and structures, and textures and microstructures. The author develops some of his own ideas on classification, and has some very interesting remarks on distribution in space and time. The suggestion to use the terms 'kindreds,' 'tribes,' and 'clans' for groups or series of rocks showing different degrees of close relationship may be useful if every one uses the terms in the same sense.

Soviet Union Year-Book, 1927. Compiled and edited by A. A. Santalov and Dr. Louis Segal. Pp. xxiii+453. (London: George Allen and Unwin, Ltd., 1927). 7*s.* 6*d.* net.

WITHIN reasonable compass this well-arranged volume gives a great deal of information about present conditions in Russian territories in Europe and Asia. The extensive bibliography of Russian works indicates that the facts and figures have been taken from the most recent official sources. No other than Russian publications find a place in the list. The agriculture, mineral resources, and trade of the Soviet Union are treated in great detail. The regulations for foreign trade are given, and particular attention is paid to the trade with Great Britain. Another section explains the policy and gives the regulations for concessions and the attraction of foreign capital to Russia. Many pages are devoted to the political organisation and the constitution of the Soviet Union, the regulations for labour, the organisation of finances, and the principal clauses of the civil code. In fact, the volume is an authoritative treatise on the country and as such is of considerable interest. It is mainly a statement of fact, and very few expressions of opinions have crept in. There are two coloured and two black-and-white maps. The present volume is the third annual issue.

Properties of Inorganic Substances: a Second Revision and Enlargement of Tables of Properties of over Fifteen Hundred Common Inorganic Substances. By Wilhelm Segerblom. Pp. 226. (New York: The Chemical Catalog Co., Inc., 1927.) 6 dollars.

ORIGINALLY published in 1909 and revised in 1916, these handy tables for the working bench have now been considerably enlarged by the inclusion of new descriptive matter and by the treatment of some hundreds of additional substances. The arrangement is convenient, the abbreviations are self-explanatory, the letterpress clear, and the paper serviceable. Not the least useful part of the book is the index, which includes the common names of the compounds referred to in the tables. With the exception of some forty pages devoted to non-metals and rare metals, the scope of the compilation is confined to the metals and acids commonly employed in the study of qualitative analytical chemistry.

A. A. E.

Pheasant Jungles. By William Beebe. Pp. xiii+248+47 plates. (New York and London: G. P. Putnam's Sons, 1927.) 3 dollars.

MR. BEEBE, who is Director of Tropical Research of the New York Zoological Society, travelled to Ceylon, India, Burma, the Malay States, and Borneo to search for rare pheasants and to study their habits. The results of his explorations have been published in technical papers. The present book deals with a few of his adventures, and is not a connected account of his travels. The reader receives an impression of a cheerful and intrepid explorer, who was undaunted by any dangers, difficulties, or hardships. His success was probably chiefly due to his sympathy with the wild tribes who live in the remote jungles that harbour the rarer pheasants. Without their help he could scarcely have reached his goal.

Mr. Beebe has generous praise for the few British who administer the remote jungle areas, and whose methods of handling the native races won his admiration.

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.*]

Barrier Reefs as a Sign of a Subsiding Coast Line.

IN my letter on the recession of the Tahitian coral reefs published in NATURE of April 23, proof is given of the original continuity of the present barrier reef from shore to ocean slope. The absence of a lagoon from parts of the coasts of both Tahiti and Moorea should alone prove that barrier reefs can no longer be taken as an index of subsidence without independent proof from the adjacent land, and the completion of the proof that barriers may be formed from broad reefs of the fringing type should be decisive. Further, I propose shortly to publish proof that in the adjacent but older island of Moorea there has been a tilting, resulting in subsidence of the south coast, which, though it took place during the growth of the reefs, has not made any difference to their form off that part of the island. The investigation of reef problems owes much to the numerous papers by Prof. Davis, which insist upon, and explain, the geological factors which it is essential to take into account. The biologist must, however, join in these researches, and it is much to be regretted that this side has been entirely neglected in Davis's work. One also misses any detailed local descriptions of the great series of reefs, old and new, which he has visited, that of Tahiti being the only one I have seen ; this appears in French in *Annales de Géographie*, 1918. In this Prof. Davis gives reasons for believing that the island has undergone a large subsidence, with which conclusion, after much consideration given to the subject on the spot, I am quite unable to agree.

The evidences given are (1) the flats at the mouths of valleys, (2) certain bays on the south coast The former is inconclusive, the latter wrong in fact. The figure given of one of these valley flats, apparently the Reine Valley just west of Papeete, shows a practically sea-level flat penetrating far into the hills. In fact, the largest of these flats goes but a few hundred yards inland, and in no case is it level, all the streams having a rapid flow throughout their course. It is also interesting to note that two of the largest flats are partially cut off from that outside the line of the old marine cliffs, by spurs projecting across the valley from one side. This is not shown in the figure given, but its presence very greatly reduces the extent of the flat which can be regarded as a drowned valley. The evidence from these flats leaves the question open, unless corroboration can be found elsewhere. This is supposed to be found in (2) the bays of the south coast, which failing, we are justified in adopting the explanation of the formation of the flats which Davis mentions only to dismiss, namely, the wanderings of the streams from side to side of their valleys when they find their exits more or less blocked by beaches thrown up by the waves, or by incipient coral reefs.

(2) There are *no* bays in Tahiti or the peninsula of Taiarapu. I am surprised to see that Davis quotes 'Port Phaeton,' on the west side of the isthmus which joins the two volcanic cones, and certain much smaller which are connected with it. Now Port Phaeton is not a bay in the ordinary sense at all, being merely the space left between the two volcanoes which is closed at the east end by the isthmus, which is mainly formed by a long lava flow from the southern and smaller cone. This space is further narrowed into a valley-like outline by the growth of reefs, and the alluvial flats which they support. It seems extraordinary that this origin of the bay should have been overlooked, since it is patent that there never was here a stream large enough to cut what would be the broadest valley in the islands.

The little bays which open out of Port Phaeton on either hand are very peculiar, but consideration of their formation requires more space than is at present possible. They are certainly not drowned valleys, nor ordinary stream valleys at all. Those not filled by alluvium or marsh are extremely shallow, while some of those on the south side of the 'Port' are merely patches of reef, covered with a foot or two of water, which were left when most of the surface was converted into land by banks, some of alluvium, others of coral debris.

(3) Charts of the whole coast of these islands have been made with great detail and accuracy, and on a large scale, yet no scrutiny has revealed submarine evidence of submergence.

I also regret that Prof. Davis did not combine his geological observations with detailed examination of the reefs, and so discover how very partial, and even inaccurate, are the accounts given by his predecessors, whose views he discusses at length. He personally examined the undersea banks within the reef, which is evidently what I term the submerged flat, but there are two important mistakes in his description. The bank is not mainly composed of sand, which covers coral rock thinly and is often absent altogether, and, of the hundreds of the blocks of stone with which they are strewn and which I have examined, *all* are colonies of the coral Porites, more or less dead and often much decayed. They are *not* "arrachés au récif par les vagues de tempête." Though sometimes moved about, or thrown ashore where the barrier affords no protection, they all grew in this part of the lagoon, and they are never found on the outer slopes. There are no 'negro heads' on the actual edge of the reef anywhere, and I know of only four pieces of reef rock which have been tossed on to the surface from an overhanging edge. Porites colonies are common *on shore reefs* exposed to heavy surf, though judging from the slowness with which they blacken and decay, the addition of another to their number is a rare event.

The origin of the lagoon by the hollowing out of a once continuous reef is dealt with as follows. "But the hypothesis of the formation of the lagoon by the progressive dissolution of a reef continuing to develop on its outer border is in contradiction with the luxuriant growth of corals inside the lagoon, where it forms little islands, and with the deposit observable in many places in the lagoon, of debris brought from the reef and volcanic materials of the island." Coral growth, in most of the Tahitian lagoons, is greatly restricted. It is *conspicuous* near Papeete as the reef surfaces are covered in a remarkable way with corals, but there is practically none at all on the side of the reefs, and the long projecting shelves, which have been taken as evidence of rapid extension, are exactly the reverse. That the lagoons are slowly shoaling may be admitted pending proof ; that they are becoming narrower is certainly untrue in many cases, doubtful in others.

Tahiti is not unique. Moorea differs in several ways but is a variation of the same type. Davis seems to have missed the cliffs of the northern part of this island, which are equally evident, and on the north-west are higher than the average of those of Tahiti. His criticism of Daly's theory of glacial control therefore fails in this case.

The four other islands visited are not described, and of their structure I can give no information. They are all older, and probably, as in Rarotonga, their cliffs have been disguised by subaerial denudation.

Much exploration remains to be done in this group, which I should consider myself fortunate to be able to attempt. CYRIL CROSSLAND.

The Zoological Laboratory,
Cambridge.

The Variability of Long Diffraction Spacings in Paraffin Waxes.

So much interest is being manifested in the polymorphism of long chain compounds, particularly the fatty acids (Piper, Malkin, and Austin, *J. Chem. Soc.*, 1926, 2310. de Boer, NATURE, **119**, 50, 635; 1927. Thibaud, *Compt. rend.*, **184**, 24, 96; 1927. Müller, *Proc. Roy. Soc.*, A, **114**, 542; 1927), that it seems advisable to report the results of some X-ray experiments with ordinary commercial paraffin waxes. Only one mention of X-ray studies of these complex mixtures of many hydrocarbons has been made, that by Piper, Brown, and Dyment (*J. Chem. Soc.*, **127**, 2194; 1925), who found that the lines of the C_{28} hydrocarbon appeared alone for a paraffin wax, although this fraction furnished only 16 per cent. of the mixture and other members as high as C_{32} were probably present.

In the present investigation samples were prepared from waxes melting at 135°, 130°, 125°, and 120° F. by solidifying on glass plates and photographing in an oscillating spectrograph with copper $K\alpha$ rays. Solidification took place under identical conditions, since cooling from above the melting-points to just below occupied 30 minutes. Remarkably sharp lines for three orders only were obtained corresponding to single long spacings, besides the 'side spacing' lines. These were all measured with greatest care and checked against photometric curves. The results are as follows:

Wax m.p.	d_1.	No. C Atoms indicated.	Side Spacings.		
			d_2.	d_3.	d_4.
135° F.	39·42 Å.U.	29	4·24 Å.U.	3·73 Å.U.	2·56 Å.U.
130°	38·58	28·5	4·17	3·73	2·51
125°	35·22	26	4·44	3·88	2·44
120°	34·38	25	4·23	3·93	2·33

Particular care was taken in the measurement of the side spacings in order to discover any possible regularity in the slight variations running parallel with the change in the principal spacing. These were further studied with pinhole diagrams and molybdenum $K\alpha$ radiation. There is apparently no such regularity.

Some experiments demonstrated that the rate of cooling of the liquid wax film was a determining factor in the spacings. The 135° wax was studied further in this respect with the following result:

Cooling.	d_1.	d_2.	d_3.	d_4.
Instantaneous .	36·64 Å.U.	4·12 Å.U.	3·82 Å.U.	2·58 Å.U.
2 min. . .	37·84	4·16	3·82	2·60
10 min. . .	38·24	4·21	3·86	2·63
30 min. . .	39·42	4·24	3·73	2·56
60 min. . .	40·20	4·13	3·82	2·60

It is evident that the longer the time given the molecules for orientation the greater the spacing for the *same* wax.

The presence of addition agents in small amounts also affects the spacings, when the solidification conditions are kept constant, as shown by the following results on 135° wax with cooling during 10 minutes:

	d_1.
Wax alone	38·24 Å.U.
„ +1 per cent. α-naphthylamine	38·315
„ +1 per cent. diphenyl oxide .	39·75
„ +0·5 per cent. indigo . .	40·70
„ +1 per cent. lead oleate .	37·5

It is interesting to note that the translucency of the films measured with a Martin polarising photometer varied directly with the spacings, a property of practical importance in the manufacture of transparent waxed paper. The single exception is the wax containing soap. Lead oleate itself has a spacing of 37·5 Å.U., and when added to paraffin wax even in so small amount as 1 per cent. seems to impress its own spacing upon the layers. It is still a matter of astonishment, not only that the principal spacing of a paraffin wax may be varied within limits almost at will, but also that these mixtures of as many as eighteen hydrocarbons with widely differing molecular lengths form equidistant parallel diffracting layers at all. The explanation of the variability of the long spacing for the same wax is complicated by the fact that under different conditions different molecular lengths in the mixture predominate and also varying tilts of the molecules to the diffracting layers are possible. GEORGE L. CLARK.

Massachusetts Institute of Technology,
Cambridge, Mass., U.S.A., May 12.

Biological Fact and Theory.

IT may seem scarcely sporting to intervene in a discussion between two such masters of controversy as Dr. C. Walker and Prof. J. S. Huxley, but there is a danger that ordinary biologists, in watching the clever play of these two duellists, may overlook the fact that the Mendelian theory so skilfully wielded by both is really a powerful weapon for the attack of biological problems.

Dr. Walker recognises that in many cases "the usual mode of distribution of the chromosomes between dividing cells before" (and after ?) "fertilisation, provides a perfect mechanism for the distribution of 'genes' . . ." He then proceeds to criticise the 'Neo-Mendelian' theory on account of some apparent exceptions to this method of distribution, but this appears to be a hypercritical attitude. Exceptions are said to prove rules, and this "distribution of the chromosomes" is present in most cases of fertilisation. The exceptions are extremely interesting, of course; they should be and are being investigated, but what is the explanation of the normal behaviour of chromosomes before and after fertilisation? Dr. Walker would not claim that these very peculiar processes of reduction and fertilisation are present merely to mislead investigators, but he seems to think that they appear to be a perfect mechanism for the distribution of the genes and yet are not really such.

The transmission of paternal characters by the spermatozoon is not denied by Dr. Walker, and if he doubts the transmission of these characters in some way through the chromatin material of male sperm cell, there is very little left in the sperm. That would appear to make the problem more difficult still, and unnecessarily so. Admittedly it is difficult to imagine the potentialities (or half of them) for the development of an animal as being contained in the microscopic spermatozoon, but the facts of heredity indicate that they actually are. Then is it much more difficult to

believe that these potentialities are arranged in some sort of order in the individual chromosomes, since we know that both the potentialities and the chromosomes are there? The work of Morgan and others tends to show that certain facts in heredity are most easily explained by adopting such a theory, and there is no inherent impossibility in it in most cases, only there are apparent exceptions or difficulties in some instances which certainly require explanation, but these need not be regarded as fatal to the whole theory.

Dr. Walker objects to the expression 'law' instead of 'theory,' and there, of course, most would agree with him. Taught by past painful experiences most scientists to-day would refer to any attempted explanations of natural phenomena as 'theories,' not 'laws,' but by all means let us make use of these theories so long as they are useful.

J. S. DUNKERLY.

Penetration of Radio Waves.

SINGULARLY little seems to be known as to the extent to which radio (wireless) waves will penetrate into the ground, and yet information on this very point has become quite desirable inasmuch as there are now two or three geophysical methods of ore prospecting which definitely attempt to use radio waves for the detection of ore beneath the earth.

Experiments by one of the present writers, and others, in a mile-long tunnel at Montreal have indicated clearly that 40-metre waves could not be detected, at either end, when only a few hundred feet within the tunnel. Broadcasting waves (400 m.) appeared to do better and were detected, with the help of good amplification, throughout the tunnel under an overload of 700 feet of limestone and igneous rocks. Longer waves (10,000 m.) were detected yet more readily. But it remained uncertain whether these waves came into the tunnel through the air, or along the rails and electric wires, or whether they came through the rock. The only sure thing is that the 40-metre waves did not penetrate to the centre of the tunnel by any of these means. Experiments by the U.S. Bureau of Mines at a mine near Pittsburgh indicate similar results, for although initial experiments seemed to point to the passage of radio waves through rocks, yet further experience showed that rails or wires were acting as carriers.

Experiments with submerged submarines prove that radio waves will not pass more than about 50 or 60 feet into seawater, no matter what the wave-length. But the question of penetration into fresh water, damp rock, and dry rock remains uncertain. Moreover, in ore prospecting, distances are used immensely less than the wave-lengths employed, and it has been asked whether we have to contrast radiation and induction, a convenient distinction well brought out in Dellinger's paper ("Principles of Radio Transmission," Sci. Papers, Bureau of Standards, vol. 15, p. 441), although of course at a given point and instant there can be but one electric vector and one magnetic vector.

The real object of this letter is to express the hope that some wireless enthusiasts may have the opportunity of making experiments underground in cave, tunnel, or mine which is absolutely devoid of wires or other conductors, and where the windings from the entrance are sufficiently devious to preclude the passage of waves through air down to the receiving apparatus consisting of coil, amplifier, and receiver only. Accurate measures of signal intensity would be still more valuable.

A. S. EVE.
D. A. KEYS.

Bureau of Mines,
Washington, June 7.

Meiosis in a Triploid Tulip.

BRIDGES AND ANDERSON (*Genetics*, **10**, 418-441; 1925) have shown by genetic experiment that in Drosophila trisomic in respect of the X chromosome, the chromosomes concerned are in the two-strand stage at the time crossing over takes place, that any strand may cross over with any other strand and that "two strands which have crossed over with each other are as free to cross over with a strand from the third chromosome as with a strand from the original two chromosomes."

Synapsis in triploid Drosophila has not been figured, but the description of crossing over given above applies exactly to the mode of pairing of the chromatids in Fig. 1, which is a diagrammatic drawing of a pachytene trivalent chromosome in a triploid tulip. Fig. 2 is a commoner form of trivalent in the same variety, and indicates the probability of a diminution in crossing over towards the middle of the chromosome as compared with the diploid if crossing over is indeed

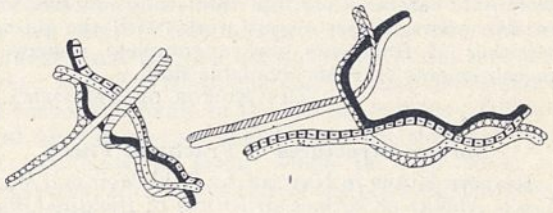


FIG. 1. FIG. 2

associated with pairing. A diminution from one end towards the middle region has been shown (Bridges and Anderson, *loc. cit.*).

It is not possible to suppose that this chiasmatypy or exchange of partners among the chromatids, whether in triploids or diploids, is a direct cause or consequence of genetic crossing over. The agreement between what is observed in the cells and what is required by the crossing-over hypothesis would, however, be explained if (1) pairing is a condition of crossing over, (2) pairing takes place between chromatids, not between whole chromosomes, and (3) chromatids remain together in pachytene and diakinesis for that portion of their length where they have been paired.

A full description of meiosis in various triploid tulips and hyacinths, together with a discussion of the points raised, will be published later.

W. C. F. NEWTON.
C. D. DARLINGTON.

John Innes Horticultural Institution,
Merton, S.W.19.

The Hythe Skulls.

I FEAR Prof. Parsons (NATURE, June 18, p. 893) has not recently consulted his own paper.

Miss Hooke writes (*Biometrika*, vol. 18, p. 22): "The Hythe crania are in all probability those of Kentish men, dating back to the fourteenth and fifteenth centuries."

Prof. Parsons wrote in 1908 when publishing his memoir (*Journal of the R. Anthropological Institute*, vol. 38, p. 422): "It is probable that we are dealing with the remains of Kentish people most of whom lived in the fourteenth and fifteenth centuries."

Miss Hooke writes (*loc. cit.*): "Measurements were made on 590 crania selected from at least double that number."

Prof. Parsons wrote (*loc. cit.*): "It may not be out of place to say here that the 590 skulls which have been measured consist of those which were picked out of the stack in 1851 and placed upon shelves, where they are now shown."

The Oxford Dictionary's first equivalent for 'pick out' is 'select.' Miss Hooke neither directly nor indirectly suggests whether the selection was a 'random selection' or a 'biased selection.' I do not know what her views on that point may be. Personally, I think a series of crania extracted from a much larger heap for show on shelves is liable to be biased. Prof. Parsons wrote: "It was evident from the debris that women's and children's skulls had, owing to their fragile nature, suffered more seriously than those of men, and this fact no doubt accounts largely for the excess of male over female skulls on the shelves." What Prof. Parsons wrote in 1908 would apply equally well to the more slender and lightly built crania of men as well as of women. It is a sound rule of craniometry that all fragments should be pieced together where possible, and all broken crania should have their available measurements taken, otherwise the selection is far from a random sample, but consists of the thicker and very often the larger crania. The Hythe crania are worthy of careful study, but that study involves four or five years of continuous work, with the piecing together of fragments and a complete system of measurements on every available skull.

THE EDITOR OF *BIOMETRIKA*.

Surface Structures of Fractured Flints.

RECENT letters in NATURE by Reid Moir and W. J. Lewis Abbott on surface structures of fractured flints prompt this note.

We had hoped to learn, by a study of the patina, the elapsed time since the original chipping was done. In some cases the patina seemed to be due to dehydration, but in any case it is caused by 'weathering,' and the depth of the patina depends on climate and time. The velocity coefficient of such reactions should be determinable, and an extrapolation for local conditions might give at least interesting results.

We found the flint to be of so many varieties, when judged by surface changes due to heating, that no orderly report is possible. But a peculiarity in the case of English flints from Grime's Graves may be of interest. The surfaces of these old flints received from Mr. Reid Moir are nearly white (weathered). The interior is transparent to translucent and is seal-brown in colour. After heating at 600° C. for several days, a fresh-cut surface of this flint apparently remains unaltered, or takes on a clear, varnished appearance. A surface having the patina of age retains it on heating, but discloses the transparent, varnish-like layer beneath.

The mass of the flint, except for these surface effects, is completely changed to a white, opaque material. In other words, high temperature in the case of this particular flint exactly reverses the apparent effect one might expect from weathering. The white patina of Nature is replaced by a transparent surface, and the inner mass appears 'weathered' or white. Can this be due to the rupturing forces of contained water? It does not occur in American so-called flints.

W. R. WHITNEY.

General Electric Company,
Schenectady, New York, June 3.

Smooth Electrodes for *p*H and Conductivity Measurements.

A COMPARATIVE study of different electrodes for the determination of the concentration of hydrogen ions has shown us that quite excellent results may be obtained with platinum electrodes covered electrolytically with gold and with a quite thin smooth metallic layer of platinum, iridium, rhodium, or palladium. A constant potential may be reached in a much shorter time than with the same metals in the form of a black deposit.

This led us to try the same electrodes for conductivity measurements. Electrodes coated with gold and metallic platinum proved to be much superior to electrodes coated with platinum black. Under conditions where with platinum black electrodes it was difficult to find the minimum of sound, with platinum-gold-metallic platinum electrodes the minimum (even in methyl-alcohol solutions) was extremely sharp. On the other hand, electrodes coated with gold and rhodium gave us unsatisfactory results. We are not quite sure yet about iridium and palladium electrodes.

In this connexion it is interesting to note that a platinum foil coated with gold and metallic platinum acts catalytically on a mixture of hydrogen and oxygen, whereas iridium, rhodium, and palladium under the same conditions do not act catalytically or very feebly. We hope that a further study of these thin layers of metals of the platinum group will permit us to establish more clearly their catalytic properties.

I. I. SHUKOFF.

University, Leningrad,
June 11.

Florentium or Illinium?

MY attention has been directed to the statement of Prof. Rolla in NATURE for April 30, p. 637, in which he claims priority for the name florentium for element No. 61. He says: "We believe, then, that the priority in the discovery of element No. 61 belongs instead to those who first had sure data as to its existence."

On this basis the name illinium deserves priority. The fact that Prof. Rolla deposited a *plico suggellato* instead of publishing his paper, demonstrates that he was not, at that time, sure of his discovery. When Harris, Hopkins, and Yntema published their paper and gave to element No. 61 the name illinium, they were *sure* of their results on the basis of four independent lines of evidence: (1) The 135 spectral lines referred to in NATURE (Feb. 26). (2) The concentration of illinium in rare earth fractions between neodymium and samarium. (3) An absorption spectral band characteristic of illinium. (4) The X-ray spectra.

W. A. NOYES.

Urbana, Ill., June 4.

Specimens of Tropical Timbers.

IT may perhaps interest some readers of NATURE who are concerned with the study of tropical timbers, to know that a certain number of duplicate timber specimens from the Burma type collection are available for distribution to museums or research institutions.

The specimen blocks, which are 6 in. × 4 in. × 2 in. in size, have been made from trees which have been individually identified botanically, with check identifications at the Forest Research Institute, Dehra Dun, and at Kew, the original sheets being in the forest herbaria at Maymyo and Dehra Dun or in certain cases at Kew.

No charge will be made for the specimens except for packing and freight.

A list of the species available can be obtained from the undersigned.

W. A. ROBERTSON.
(Conservator of Forests.)

Utilization Circle, Burma,
46A Dalhousie Street, Rangoon,
May 3.

Irrigation and Crops.[1]

THE deleterious effect of irrigation on the soil, and therefore on the crops grown when it is not duly balanced by drainage, are described simply and clearly in an important memorandum drawn up by Dr. B. A. Keen, of Rothamsted, for the Empire Marketing Board. The memorandum is the work of an experienced soil physicist, and deals in summary form with the chemical and physical reasons for the accumulation of soluble salts on the surface of the ground, usually but somewhat erroneously described as 'alkali.' Such concentration can, obviously, only take place where there is great evaporation of soil moisture, but little or no rain to wash the salts away, and the parts of the world where these conditions prevail are somewhat clearly defined. Taking the rainfall map as our guide, it can be seen at a glance that the amount of rain falling in the temperate and tropical regions is generally what may be called ample for crop production. But, round about and just outside the tropics of Cancer and Capricorn, belts of little rain or deserts are met with in the Old World, while in the New such tracts are confined more or less to the western sides of the continents. These conditions are due, in the main, to the distribution of the ocean winds and currents. Clear skies are met with in these tracts, which in the local summer are connoted with intense heat and great evaporation of the soil moisture; whereas within the tropics the amount of cloud is much greater, the retarding force of the sun on vegetation is less, and a greater amount of rain falls.

Dr Keen points out that it has been estimated that one-third of the earth's surface receives 10 inches or less of rainfall in the year, while another third has under 20 inches; also, that at least 100 million acres of the world's crops, or 7 per cent., are under irrigation. This latter figure appears to us to be an extremely conservative figure, that is, if 'irrigation' has the usual meaning. For rice alone would probably account for a good deal more than the area named. In India the great bulk of this crop is irrigated, and there are 80 million acres of rice grown, while there are vast tracts in China and the East generally to be added.

It is, however, evident that it is the first-mentioned third that Dr. Keen has in mind while discussing alkali. He enumerates the factors concerned in the development of successful irrigation projects, and divides these into three main classes: economic, engineering, and scientific. The latter he rightly regards as fundamental, although the others may, in practice, easily become limiting; and classes them, roughly, as the composition of the water used for irrigation, and the chemical and physical properties of the soil, these factors being significant, both in schemes newly laid down and in old-established systems.

The chief part of the memorandum is devoted to the discussion of the importance of these scientific factors. Dr. Keen summarises and arranges, in an illuminating manner, the results obtained by the scientific workers on the spot, chiefly Russian and American, as to the causes of alkali and the scientific methods of fighting it. The effect on alkali land, when irrigation is commenced, is then elaborated in some detail. One important result is the chemical change induced in the constitution of the clay particles, that is, those which, though minute, are capable of aggregation into groups by what is called flocculation—which, indeed, is or should be the object of all cultural operations. Here the 'calcium clay' is in danger of being converted into 'sodium clay,' because of the large proportion of this latter element in the soluble surface salts now let loose in the soil. This change renders flocculation difficult, and the soil becomes sticky and unworkable: and, if it is not checked in time, the presence of carbonic dioxide in the soil air induces a further and more dangerous change, namely, the formation of carbonate of soda, which is both toxic to vegetation and destructive of the physical character of the soil.

The tolerance of plants to alkali is briefly described. The crops mentioned are chiefly those of sub-tropical and warm temperate regions; and Dr. Keen quotes Russell, as giving maize the place of high sensitiveness to alkali, with barley and lucerne less so, while the date palm is mentioned as the least sensitive of all crops grown. The corresponding plants in warmer regions are given as sorghum, cotton, rice, and berseem: this correspondence cannot, of course, apply to the order of sensitiveness, which would probably be rice, cotton, berseem, and sorghum, the latter being among the most resistant cereals to alkali.

In a discussion of the dangers of deterioration in irrigated areas, attention is directed to the harmful effect of the change, from basin irrigation in the Nile Valley, with its beneficent summer fallow, or 'sheraqui,' to perennial irrigation, rendered possible by the larger supplies of summer water made available by the erection of the Assouan dam. It is pointed out that the gradual rise in the water table, lowering as it does the root range of the crops, shows once for all the importance of adequate drainage being provided in all new irrigation schemes. Attention is also directed to the tendency towards the application of excessive quantities of water to the crops, when this is left in the hands of the farmers, the example given being the interesting experiments conducted by the Howards on the growth of wheat in the Quetta valley.

Dr. Keen concludes his paper with brief references to the importance of the study of the duty of water for each crop grown under irrigation, with especial reference to the quantity needed at each stage of growth: the maintenance of tilth in irrigated land and its hindrances; and certain cases where alkali is not responsible for cultivation

[1] Irrigation in the Empire. Memorandum and Questionnaire. By Dr. B. A. Keen. (London: Empire Marketing Board, May 1927.)

difficulties. We presume that the troubles attendant on an undue proportion in alluvial lands of silt particles, that is, those too small to be flocculated, would come under this head. This is one of the main difficulties in many alluvial lands in the tropics.

Dr. Keen thus includes only a part, although an important part, because of the costly irrigation projects entered into, of the irrigated areas within the British Empire. This is probably because the Marketing Board has in view other discussions on the remaining portions. But the author has probably purposely limited himself to the rain division mentioned above, and confined himself in India to the rainless Indus plain, thus leaving out the greater part of the Gangetic plain, where alkali conditions have probably been the bugbear of agriculturists almost since prehistoric times. Leaving, then, these narrow limits, some further remarks may be made on alkali conditions found within the tropics, and then on some further lessons which may be learnt from irrigation generally in other lands in the tropics.

Alkali is of much less importance within the tropics, partly for the reasons already mentioned, but also because of slope, and the washing-out effect of the greater volume of rain falling every year. But it is just as liable to present itself, wherever the rainfall is scanty and the evaporation great, as it is in the typical desert regions dealt with by the author. The writer of this article had the interesting experience, during the last seven years of his work in India, of fighting this evil; and growing sugar cane, one of the least resistant of crops, on saline land the irrigation of which was from a series of more or less brackish wells. It would be a mistake to assume that the people of India, with their highly developed systems of agriculture, have made no effort to counter the action of this insidious enemy to crop production. The remedies employed are practically endless, varying from simply scraping away the efflorescence (by which with little labour one-third of the salt concentration may be removed at a time), through palliatives such as carting silt on to the ground in their annual cleaning out of the irrigation tanks, introducing a rotation with some salt-resistant crop, such as irrigated ragi (*Eleusine coracana*) or even growing babul (*Acacia arabica*) for a term of years, and thereby making a profit out of it, or digging in a green manuring crop, to flooding the land when it is possible to do so. Many of these remedies were tested by the writer, with varying results; and ultimately success was obtained by enlarging and using the well which had the sweetest water and using it in sufficient quantity to mitigate the evil effects of its brackishness, green soiling, and introducing a suitable rotation after it, with sorghum immediately before planting the sugar cane.

Irrigation extends throughout the length and breadth of India, and is not owing to any deficiency in the total annual rainfall, but rather to its unequal distribution over the year. This is characteristic of the Old World continental masses, as contrasted with the New, where the rain is more or less equally distributed. India (and many British African colonies) is in the region of periodic rains; there is usually a short period each year when heavy rains fall, this being followed by a longer period of little or no rain. The growth of crops during the rainy season is insufficient to provide food for the great mass of population, and the excess water has thus to be conserved as much as possible for growing additional crops during the rainless period also. This, of course, is more especially the case with crops requiring much water, such as rice, which is grown in six inches of flowing water throughout its growing period, and sugar cane which, in the peninsula at any rate, needs water at frequent intervals throughout the year. The large area under rice has already been referred to, and there are some three million acres of sugar cane grown in India. Alkali is rarely a matter of serious moment in the peninsula, either as regards rice or sugar cane, or the various other crops irrigated; and much the same applies to the great irrigated areas farther east.

The duty of water is known in a rough-and-ready way for most of the crops grown, that is, the small quantity needed at first, the great increases when the roots have developed and the leaves reach their maximum expanse, and the shutting off of water when ripening approaches. But there is a fine field open for scientific study in this matter; for example, along the lines adopted by the Howards, as to whether equally good crops of rice may not be obtained by using less water, and thus extending the area, which is badly needed: most of India is very like a desert when the dry spell has had sway for some time. Much of this irrigation is on undulating land, and full advantage is taken of this: the Indian cultivator, without the aid of instruments, has an uncanny knowledge of the problem of leading the water from field to field in the right direction. There are few of the great flat areas of the reclaimed deserts referred to by the author, and the gradients of rice are surprisingly steep in places.

Attention may be directed, in conclusion, to the work done in recent years in the Hawaiian Islands, where the crop is almost entirely sugar cane, and where the theory and practice of irrigation has been very fully worked out as regards this crop. In three of the four islands of the group where the sugar cane is grown, the great proportion of it is irrigated. There is a plentiful supply of rain brought by the trade winds and falling on the east sides of the islands, but the amount drops practically to desert conditions on the west. This is countered by collecting the surplus rain on the eastern side and carrying it by tunnels through the mountains and by aqueducts across the valleys from one side to the other, until actually more cane is grown on the western side than the eastern. Seepage is countered by lining the channels with reinforced concrete made in slabs on the spot. It was found that the grit in the water seriously abraded the sides of the canals, so a system of settling tanks has been instituted

with very satisfactory results. But the most remarkable fact is that irrigation has been found to pay, even where the rainfall is heavy enough to grow luxuriant crops of cane. This can only mean that the duty of water has been very carefully worked out.

Such, indeed, is the case. Every estate is mapped out with contour lines, and a whole series of canals, ditches, and so on, is drawn on these plans; and the amount of water given to each field or section is frequently measured, and recorded throughout the growth of the canes. Numerous curves are prepared, on which a great deal of information is presented. One of the most remarkable of these is the curve of *profitable* irrigation which can be applied for each month of the twenty-four during which the cane is in the ground. Few countries can follow Hawaii in the vast expense involved in its irrigation system, but many useful suggestions would doubtless be obtained from a careful study of the work done in this group of islands by all interested in the duty of water. The difficulty, mentioned by Dr. Keen, as experienced in cultivation because of the irrigation channels, lastly, is got over in various ways: by the obvious one, of using elongated plots as units; by movable pipes for the last distribution of water; and even by the use of overhead water sprinklers, also removable, in place of irrigation furrows. C. A. B.

The Future of the Smithsonian Institution, Washington.

MEN of science in Great Britain had regretfully known for some time, through correspondence with friends in the United States, and by sundry opportunities of personal intercourse and discussion, that all was not well with the Smithsonian Institution in respect of its future scope and activities—that, notwithstanding the achievements of the past eighty years (it received its charter in 1846), perplexing uncertainties had now arisen regarding the specific objects which the organisation should direct and control. The Smithsonian is, in fact, at the cross-roads of endeavour, largely due to the very magnitude and completeness of its early conceptions.

Aware, in fullest measure, of their onerous responsibilities, the Chancellor of the Institution, Chief Justice Taft, and his colleagues on the Board of Regents, decided to summon a conference of representative American citizens, professional and lay, "To advise with reference to the future policy and field of service of the Smithsonian Institution." This conference took place at Washington on Feb. 11 last. Only three days earlier the death had occurred of Dr. C. D. Walcott, who had been Secretary of the Institution since 1907. From the report of the proceedings, which is now available, it is evident that the problem set, in chief, the provision of adequate funds for maintenance and continued development, received sympathetic recognition. Among those present were such well-known men as Dr. W. W. Campbell, President of the University of California; Mr. Robert W. Bingham (Kentucky); Mr. Charles F. Brush (Ohio); Dr. Simon Flexner, Director of the Rockefeller Institute for Medical Research; Mr. Robert P. Lamont (Illinois); Dr. Merriam, president of the Carnegie Institution; Mr. Ogden L. Mills (New York); Dr. H. F. Osborn; Dr. S. W. Stratton, president of the Massachusetts Institute of Technology; Dr. George E. Vincent, president of the Rockefeller Foundation; Dr. W. H. Welch, of Johns Hopkins University; and Mr. Robert Winsor (Massachusetts).

The Smithsonian Institution is everywhere such an accepted factor in the world of science that few, perhaps, are immediately prepared to recall its initial testamentary story, or the genesis of the foundation which perpetuates the name Smithson.

James Smithson was an Englishman. In his earlier years he was known as James Lewis Macie, his mother being the widow of James Macie, a country gentleman, who had resided near Bath. Born in 1765, young Macie was in due course entered at Pembroke College, Oxford, as a gentleman commoner, graduating there in 1786. Chancellor Taft, in his opening address to the recent Conference, recalls, neglecting needless reticence, that Macie was the natural son of that Hugh Smithson who, from the baronetcy of the realm, became the first Duke of Northumberland. At Oxford, Macie showed a marked predilection for scientific studies, and, as Dr. R. T. Gunther has recently pointed out (NATURE, April 2, p. 492), opportunities for such pursuits actually existed at Oxford at the period of his entry. Finally, in digression, the bar sinister on Macie's escutcheon was met, after his father's death—the precise date is unknown—by a successful application to the Crown to assume the name of Smithson.

Our Royal Society elected Macie a fellow on April 19, 1787, when twenty-two years old, and on the subjoined certificate: "James Lewis Macie, Esq., M.A., late of Pembroke College, Oxford, and now of John Street, Golden Square, a gentleman well versed in various branches of Natural Philosophy, and particularly in Chymistry and Mineralogy, being desirous of becoming a Fellow of the Royal Society, we whose names are hereunto subscribed do, from our personal knowledge of his merit, judge him highly worthy of that honour and likely to become a very useful and valuable member—Richard Kirwan, C. F. Greville, C. Blagden, H. Cavendish, David Pitcairn."

The first scientific paper of the newly elected fellow was read on July 7, 1791, before the Royal Society, and in the name of Macie. It was published in the *Philosophical Transactions*. According to the late Dr. S. P. Langley, the name of Smithson is first certainly known to have been used by him in connexion with his second communication to the Royal Society, read on Nov. 18, 1802.

Smithson died on June 27, 1829, at Genoa. Three years earlier he had made a will whereby he bequeathed (in case of the death of a nephew without heirs) his entire estate "to the United States of America, to found, at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men."

The proposed gift was first publicly announced by President Jackson in a message to Congress in 1835. The amount of the fund devolving was £111,389. We see that the donor had relegated his *alma mater*, and had passed over an ancient scientific foundation. Born in France, brought to England and naturalised, and in later years living among foreigners, Smithson may have become so detached in thought and habit that old ties, old associations, were forgotten. Conjecture surrenders to fact. But the use made of the gift as the keystone of an arch of knowledge was altogether unprecedented in character and optimism.

Ten years of travail and debate preceded the launching of the Smithsonian. The problem was to define knowledge and determine how best to increase and diffuse it. What was to be inscribed on the arms of the direction post? Five successive Congresses discussed the question. Many diverse propositions were made. Towards the end of 1846 a charter passed into law.

The first secretary was Joseph Henry, professor of physics and of natural history at Princeton. To his vision, zeal, and resource was due the organisation and the planning of projects for the Smithsonian Institution. Henry was succeeded by Prof. Spencer F. Baird (1878), biologist; he in turn by Dr. Samuel Pierpont Langley (1887), physicist and astronomer; next by Dr. Charles D. Walcott (1907), geologist and palæontologist.

Activities of great public value arose through Henry's influence; for example, the Weather Service, the U.S. Fish Commission, the system of International Exchanges of Scientific Literature, and the Bureau of Ethnology. There followed, under later leadership, the National Zoological Park, an Astrophysical Observatory, and other notable enterprises, each fostering research and progress. For long they were financed from the income of the private Smithsonian endowment. Congress now apportions certain sums for their maintenance, because, Dr. C. G. Abbot remarks, "the public needs them." Most of them are, however, still under Smithsonian administration. With reference to Congressional appropriation, we gather from Senator Reed Smoot, who spoke at the Conference, the unwelcome information that "the handicap under which the Smithsonian Institution labours in its relations with Congress is that Congressmen know so little about it." The Institution co-operates through specimens, instruments, men, and advice, with scientific agencies throughout the world. It has promoted the scientific survey of North America, and has taken part in no fewer than 1500 expeditions in various regions. Researches by men not directly connected with the Institution are subsidised at intervals; these not Americans alone, but Englishmen, Frenchmen, Germans, and other nationals. The Smithsonian publishes new knowledge gained by its own and outside workers in the form of large memoirs and smaller original papers, which, with unique liberality, it distributes to 1500 libraries and learned bodies in every country of the world. Its reprints in the familiar Annual Report of informing articles of distinction are well known. This was a matter in which Dr. S. P. Langley took personal pride and interest. Here it may be recalled that during Secretary Henry's term of office, he addressed a letter to the British Association pointing out the advantage of publishing systematic lists of the titles of scientific papers. As a sequel the Royal Society began its well-known "Catalogue of Scientific Papers."

Some quotations from recorded speeches at the Conference will serve to convey the general views of at least a few of the representatives present. Characteristic throughout was the enthusiastic affection entertained for the Smithsonian. Dr. C. G. Abbot gave an able summary of accomplishment. "Considering," he said, "the immense benefit which the foundation has brought to our country, it would be ungrateful to transform the private memorial character of the Institution into a Government agency. The Smithsonian is not just another institution; it is not just another museum, not just another university." Dr. Flexner is of opinion that "the Smithsonian makes an appeal on the one hand strongly to Government and equally to private philanthropy; because the fruits of science, however garnered, are something of which the public as a whole, without distinction, enjoys the benefit." Again, Dr. W. W. Campbell: "Men of the type of university professors or investigators are in need of favourable environment; they are in need of tranquillity; they must be men without worries; there should be a continuing financial policy." Dr. Osborn, as regards scientific research: "I remember well when Secretary Langley was laughed at for diverting the funds of the Institution to experiments in flight. Who would suggest that they were not valuable to-day, when the world is covered with airplanes?" Also Dr. George E. Vincent: "I am sure that out of this Conference there will develop a plan by means of which private citizens and the Government of the United States will combine to make this great Institution still more influential in the future."

In Great Britain many friends will watch with deep interest the effort that is being made to re-awaken and intensify appreciation of the Smithsonian Institution. The Conference delegates stand high in public esteem in the United States; they are of the type capable of moving men to action where action is imperative. It may be hoped that a satisfactory response will ensue respecting the 'field of service' under discussion.

T. E. JAMES.

University College, London, 1827–1927.

THE centenary celebrations of University College, London, which were inaugurated by Their Majesties the King and Queen on Thursday, June 23, continued day by day until the end of the ensuing week. To-day, July 2, they are to come to a joyous conclusion with a dance in the Great Hall, a building recently acquired and reconstructed by the College and dedicated as a war and centenary memorial on June 24 by H.R.H. Prince Arthur of Connaught. The celebrations have been on a scale befitting their august patronage, and the programme of receptions, divine services, concerts, lectures, and demonstrations arranged for the delectation of the visitors, shows that the College was determined to rise to the height of this opportunity. Specially noteworthy have been the lectures, more than forty in number, including many by such well-known authorities as Sir Flinders Petrie, Profs. J. Norman Collie, M. J. M. Hill, A. V. Hill, and Daniel Jones, and Sir Frederic Kenyon. These, and numerous demonstrations and exhibitions of great interest, were freely open to the public.

The circumstances in which University College came into being are vividly recalled in the brilliant oration pronounced by the Provost, Sir Gregory Foster, on Mar. 25, 1926, before the Union Society of the College at a gathering organised by it to commemorate the names of founders and other illustrious members. The founders' names selected for mention on that occasion were Dr. George Birkbeck and Isaac Lyon Goldsmid. The former, who also founded, in 1823, the Birkbeck Institute, now enrolled as Birkbeck College among the Schools of the University, was engaged about that time in association with Henry Brougham, afterwards Lord Brougham, in a campaign for promoting the education of the people, a campaign which led to the foundation of the famous Mechanics' Institutions. Goldsmid was a leader in the efforts that were being made in favour of religious toleration. Both movements were important factors in producing an atmosphere favourable to the reception of a scheme for a metropolitan university.

Many other distinguished men had, for several years before the laying of the foundation-stone of University College in April 1827, been canvassing the merits of such a scheme. Among them were the poet Thomas Campbell, George Grote, Joseph Hume, the Marquess of Lansdowne, Zachary Macaulay, James Mill, the Duke of Norfolk, and William Tooke. Francis Place, the "radical tailor of Charing Cross," also interested himself in the matter. It was Thomas Campbell who first put the project on paper. Fired with enthusiasm for the idea incorporated in the constitution of the then newly founded University of Berlin of devotion exclusively to the interests of science and learning without bias towards any particular creed or school of thought, he wrote a letter to Lord Brougham, which was published in the *Times* of Feb. 9, 1825, advocating a "proposal for a metropolitan university . . . . for effectively and multifariously teaching, examining, exercising, and rewarding with honours in the liberal arts and sciences" youths of from fifteen or sixteen to twenty or more years of age whom their parents could not afford to send to Oxford or Cambridge. This letter, despite disparaging editorial comments, led directly to the foundation of the University College. The movement was borne forward on a wave of generous enthusiasm for the advancement of learning and revolt against the dominance of academic particularism, privilege, protection, and repression.

To the wisdom and foresight of the founders Lord Balfour paid a remarkable tribute in his speech at the dedication ceremony in the Great Hall on June 24 last. Their work stands out, he said, as being little short, if short at all, of the boldest genius. "How many were there . . . who saw the great part science was going to play in civilisation? Very few. But they foresaw it, and while foreseeing it . . . they did not ignore or minimise the humanities."

It is precisely this judicious appreciation of the place of science in university education, coupled with a fine record of achievements in the fields of scientific research, that constitutes the most cogent argument for our gratitude and further support. We are reminded that its chemical laboratory, opened in the College in 1828, was one of the earliest places in England where chemistry was systematically taught. In that department Sir William Ramsay, following a line of distinguished predecessors—Edward Turner, Thomas Graham, A. W. Williamson—did fundamental work on the gases argon, neon, and helium, and from it went forth many a young chemist trained by him and eager to follow in his footsteps. Biology, like chemistry, was almost unknown as a subject of university study until University College began teaching it, and systematic medical education based upon scientific principles, carried out in a hospital built for medical purposes, was equally a novelty. Prof. Sharpey introduced the teaching of histology as a branch of physiology, and two of his pupils, Sir Michael Foster and Sir John Burden Sanderson, carried his methods to Cambridge and Oxford. The department for "Engineering and the Application of Mechanical Means to the Arts," which figures in the first programme of studies, did not immediately materialise, but later on a chair of engineering was instituted which was held successively by Profs. Vignoles, Hodgkinson, Fleeming Jenkin, and Alexander Kennedy. Here, too, the College blazed a trail that has been followed by the other universities.

In short, the College is justified in claiming that it has played no small part in that progress of science to which is largely due the great transformation in the religious, the political, the social, and educational aspects of our national life which has taken place in the past hundred years. Nor should we forget that the College was a pioneer in

giving the advantages of higher education to women, in establishing a complete university school of fine art, and in introducing the teaching of librarianship and phonetics.

As the circles of its influence have widened and the fame of its teaching has spread, the College has attracted more and more students, including many from far distant lands. In the past twenty-five years this growth has been rapid—from 1098 to 3228. Though the fees have been raised the increase in the fee income is but a fraction of the increase of expenditure entailed, and the College must look for fresh sources of revenue. The Centenary Appeal asks for £520,000, including £235,000 for endowment of chairs, of which seventeen are at present without endowment, and seventeen others are inadequately endowed. Up to June 18 the appeal had brought subscriptions amounting to £117,440, including £43,000 contributed by past and present students, and a grant of £25,000 by the Rockefeller Foundation for endowment of the Department of Pharmacology, while on June 23, the first day of the celebrations, appeared an announcement in the *Times* of a further gift of £93,178 from the same Foundation, supplementary to the gift of 1921, for the Departments of Anatomy and Physiology.

Of good omen for the future of the College is the purchase by the University of London of eleven and a half acres of land in its immediate vicinity. This momentous transaction, made possible by a gift of £400,000 from the Rockefeller Foundation and a Government grant of £125,000, synchronises auspiciously with the centenary celebrations, and suggests vistas of further progress for the College not less glorious than that already achieved.

News and Views.

THERE would appear to be good ground for believing that another sensational archæological discovery has suffered the fate of many of its kind in the past and has failed to stand the test of examination by experts. The remarkable character of the finds at Glozel, in which objects of neolithic culture akin to the Ægean, inscriptions on clay tablets, and engravings of animals on pebbles were found in association, aroused no little scepticism at the time of their discovery; but Dr. Salomon Reinach was convinced of their authenticity and, relying upon their evidence, put forward the theory that a degenerate Magdalenian culture had lasted so late as 4000–3500 B.C., with the consequence that the Magdalenian must be placed so low as 5000 B.C. The resemblance of the script on the tablets to that alleged to have been found in a Portuguese dolmen in 1894 was immediately apparent. It has been stated that a confession of forgery has appeared in Belgium, but confirmation of this is not yet to hand. In the issue of *Antiquity* for June, Mr. Crawford gives in some detail the results of an examination of the objects themselves, and subjects the circumstances of the find to a critical scrutiny based upon a personal inspection of the ground. He is persuaded that the objects in question are forgeries. His case is convincing; all the more so in that his opinion coincides with that of the Abbé Breuil.

IN connexion with the centenary celebrations of University College, London, it will be remembered that George Grote, the distinguished historian and publicist, was in especial measure the early friend and counsellor of the College. He was holding office as president at the date of his death in 1871. It is worthy of recall that on July 7, 1863, eight years before Grote died, he communicated the following wishes: "I desire that after my decease my cranium shall be opened by the Professor of Anatomy in University College, London, or by some other competent anatomist. I desire that my brain shall be carefully weighed and examined, and that the weight thereof shall be communicated to Prof. Bain, together with any other peculiarities which may be found, especially whether the cerebellum is deficient as compared with the cerebrum." After the historian's decease, Prof. Sharpey, finding that Bain desired to be relieved from participation in the foregoing directions, entrusted the autopsy to Prof. John Marshall, who published a description of the brain (with photographic illustrations) in the *Journal of Anatomy and Physiology* (vol. 27, 1893). It would be of interest to learn in whose keeping the brain remains. It is not at University College.

THE Electricity (Supply) Act, 1926, has raised the hopes of consumers for getting a cheaper supply of electricity in the immediate future. The Act gives facilities for shutting down all uneconomical generating stations and erecting and enlarging modern works equipped with the best generating plant available. The immediate problems in connexion with transmission and distribution are the obtaining of way leaves and the most economic methods of erecting overhead lines. Once it is conceded that no landowner should have an absolute veto to prevent transmission lines passing over his property, it is highly desirable that the present method of obtaining way leaves should be simplified. It is true that the Post Office is in a specially favoured position and has almost absolute powers to prevent its telegraphs and telephones being interfered with either by leakage or induction from power-lines, but it has never used its powers unreasonably. Hitherto, electrical development in Great Britain has been based on coal conservation, but the heavy costs of the transmission lines makes it probable that 'capital' conservation is equally important. We think that by far the most promising method of reducing costs is to utilise to the utmost all the plant in the station. To have the great bulk of the machinery lying idle for most of the day is most uneconomical. Some method of storage must be used and each machine run to its full capacity. Periods of light load are a loss to every

undertaking. The most promising method of fully utilising the plant in winter time is to have some low grade thermal storage system in consumer's houses for hot water and room heating. Several systems for this purpose are being tried, and electrical engineers would do well to encourage them. Once they become general, considerable reductions in the price of electricity will be possible.

IT is highly desirable that nothing be done to detract from the beauty either of a town or of a countryside. Yet just as it is necessary for an individual to consider ways and means, so it is necessary for us to encourage industry even at the expense of detracting from the beauty of the land in which we live. Railways, telegraph poles, coal-pits with their mountains of shale, and brick-fields, for example, have come to be regarded as necessary evils. Recently, in the *Morning Post*, the Countess Bathurst expressed apprehension lest the Electricity Bill lead to the disfigurement of beautiful parts of Great Britain by overhead electric mains. She says this has already happened in Switzerland and Italy. The average visitor to the continent rarely complains of the unsightliness of the lattice towers supporting overhead wires or even of the open-air transformer substations. A few grumble when they see a row of lattice poles going over the shoulder of a mountain peak, but the inhabitants have got accustomed to it, and, as a rule, regard it with pride. The Countess Bathurst suggests that the mains which form the 'grid' of the Government scheme for Great Britain should be placed underground. But if this were done, the transmission pressure would have to be greatly reduced and the era of cheap electricity would be in the distant future. It is quite possible that when we know more about the causes which make high-pressure electricity break down insulating materials, electrical engineers may be able to construct cables to withstand the 135,000 volts which is the standard pressure that will be used. Seeing that many countries are competing for the world's markets, it would be foolish to handicap even temporarily our industries merely for æsthetic considerations. The authorites responsible, however, should bear in mind that 'safety' is not the only consideration, and that the colours of the lattice poles and auxiliary devices should harmonise with their surroundings.

A FLIGHT across the Beaufort Sea is now being planned by Mr. G. H. Wilkins. According to Science Service of Washington, he proposes shortly to leave Point Barrow, Alaska, and set a course for about lat. 84° N., long. 100° W., which should take him over the position of Peary's reported Crocker Land. Thence he proposes to cross Ellesmere Island to Etah in Greenland. If the aeroplane is forced to descend on the way, the party hope to be able to return on foot, living on seals during the march. Even if all goes well, Mr. Wilkins points out that there may be considerable delay in his return owing to the poor communications with Etah and Ellesmere Island. Science Service also records a flight made by Mr. Wilkins and Mr. B. Eielson from Point Barrow on Mar. 29 of this year. On that occasion, with fuel for 1400 miles in calm weather, they proposed to fly 600 miles north-west, then 200 miles south, and then back to Point Barrow, thus investigating the southern borders of the Beaufort Sea. Engine trouble caused a forced descent about 550 miles north-west of Point Barrow. A sounding of ' about three miles ' indicated that he was north of the continental shelf. The exact position is not given. The flight was resumed, but a second forced landing soon had to be made. Eventually, by drifting with the ice and sledging, they returned to Point Barrow. Mr. Wilkins maintains that, contrary to the belief expressed by Capt. Amundsen and others, there are plenty of good landing places on polar pack.

RECENT acquisitions of the British Museum (Natural History) include the following: The Zoological Department has received a pair of elephant tusks of almost record size, presented by the Government of Kenya Colony. These tusks, which weigh 168 lb. and 166 lb. and are 9 ft. 2½ in. and 9 ft. 2¼ in. long respectively, were at the British Empire Exhibition, Wembley. The Department is sharing with the Museum d'Histoire Naturelle, Paris, the specimens collected in French Indo-China by M. J. Delacour and Mr. Willoughby P. Lowe. The British Museum consignment includes the rare carnivore Chrotogale. The most important purchase recently sanctioned by the Trustees is a large fossil amphibian obtained by Dr. B. Dunstan from hard sandstone of Triassic age near Sydney, N.S.W. The specimen, which is about 9 ft. long, is in the form of hollow moulds left after the decay of the bones. It will be possible to take plaster casts from these and to mount them as a skeleton, complete except for a few toe-bones. The specimen is one of the roofed-skull labyrinthodonts and belongs to the group Stereospondyla. Although fragments of fossils of this group have been known for more than a century, there is only one other specimen in which even a portion of the skeleton is associated with the skull, and that is at Stuttgart. During the last century the chalk-pits of Charlton, Northfleet, Lewes, and similar localities in Kent and Sussex, yielded some fossil starfishes, sea-urchins, and remains of fishes in an exceptional state of preservation. The late Mr. James Fox made a notable collection of such objects, and the Museum has now been able to obtain such specimens as it required. The Trustees have authorised the purchase for the Department of Botany of the late Mr. F. W. Payne's collection of 8000 microscope slides of diatoms. The slides are of special interest and value, because only one species is represented on each. The diatoms are mounted whole and also with the frustules separated, and arranged in different ways so that a complete examination can be made.

THE discussion initiated by the Illuminating Engineering Society at the Stationers' Hall on June 14, on the lighting of printing works, served a useful purpose in helping to make known the results

of the valuable investigation conducted by the committee working under the Department for Scientific and Industrial Research. Investigations tracing the influence of conditions on industrial output and efficiency require great care and patience, and the co-operation of the industries concerned is essential in order that conclusions may be willingly accepted. In this case the impartial nature of the Committee and the scientific standing of its members entitle its findings to respect, and the sympathetic co-operation of the Joint Industrial Council for the Printing Trades, the secretaries of which joined in the discussion, has been most valuable. The chief conclusion so far arrived at—that an illumination of the order of 20 foot-candles is necessary for full efficiency in typesetting by hand—is sufficiently striking. Probably few composing-rooms receive such a high illumination at present, and a considerable advance may now be anticipated. The conclusion is probably broadly applicable to other forms of fine work, and the lecturer, Mr. Weston, showed that it is economically justified. Numerous points in regard to the best form of lighting in composing-rooms (*e.g.* whether direct or indirect, general or local, etc.) are still under discussion. From the proceedings at the meeting, it would appear that a combination of moderate general lighting with high local illumination provides the best solution, and this may apply to other exacting forms of work where high illuminations are required.

MUCH sooner than was expected, some brief accounts of the great Kansu earthquake of May 23 (May 22, Greenwich time) have been received (*Times*, June 21, 22, and 24), but it seems clear that they come from the outlying zones of damage, not from the central region. At Langchow, the capital of the province, two pagodas were destroyed. The cities of Kanchow and Suhchow were only slightly damaged. So far as is yet known, the city of Liangchowfu, in the northern part of the province, seems to have suffered most. There was an early shock at 4 A.M. (local time), followed at 5.30 A.M. by the principal shock that lasted two minutes and ruined half the city. In this district the telegraph lines were thrown down and many lives were lost.

THE famous Oxfordshire stone circle known as the Rollright Stones, with the outlying cromlech, "The Whispering Knights," has been on the market as part of the estate of Little Rollright Manor. Considered by many archæologists to be older than Stonehenge, no ancient 'temple' is more deserving of the protection of the State, not only within the circuit of the unclimbable iron fence that closely surrounds it, but also by the preservation of a sufficient tract of open land all round, that the locality may not be spoiled by the erection, as at Stonehenge, of distracting and unworthy buildings in the close vicinity of the monument. In "The Cult of the Circle Builders," Mr. E. M. Nelson adopted a unit of length equal to 0·95 of the English foot as the unit employed by the builders of the Circle at Denber's Pasture in Yorkshire and elsewhere. The diameter of the Rollright stones is exactly 100 of such feet, and the lay-out of the outlying associated stones appears also to be based on certain proportions, which according to Mr. Nelson were represented by the numbers 3, 7, and an ancient value of π. In any case there is no other monument of the science of the British Bronze Age now extant in the midland or eastern counties than the Rollright circle.

THE Rothamsted Experimental Station, Harpenden, will have an instructive exhibit at the Royal Agricultural Society's Show which opens at Newport (Mon.) on July 5. The central portion of the exhibit illustrates the development of types of experiment at Rothamsted from 1843 to the present time, and it shows by means of a precision scale that results now obtained in a single year may be a hundred times as valuable as an experiment carried out twenty years ago. Effects of treatment of different plots for grass, mangolds, potatoes, and swedes are shown by actual turves and plants, and the specimens bring out the fact that balance between the different dressings applied to various crops is of essential importance. On the biological side, control work is illustrated, such as parasites of earwigs to combat the earwig pest in New Zealand, and investigations to keep down blackberry, gorse, ragwort, and other injurious plants by means of insects. Results of recent work of the Bacteriological Department of Rothamsted in connexion with the cultivation of lucerne are also included in the exhibit of the Station.

BIOLOGY lecturers at agricultural colleges and institutes, as well as teachers in rural schools where the curriculum includes elementary economic biology or nature study, will find that a new series of 'relief plaques' or tablets, lately put on the market, offers an effective aid in the work of giving instruction concerning insect pests and fungoid diseases of farm crops. Most of the tablets measure 12 in. by 10 in. though some are larger. Against a black background there is modelled a raised or relief representation of a crop plant of the farm suffering from a fungoid disease or attacked by some well-known insect pest—the whole being shown in natural colours. Frequently two, or even more, diseases of the same plant are represented on a single plaque. The models are well executed, and they should be more effective for class demonstration than ordinary pictorial representations of the various pests. Accompanying every plaque is a description of the pest the activities of which are indicated, and of recognised methods of control, written by a member of the staff of the Royal Agricultural College, Cirencester. The tablets have been prepared in Germany by the Deutsche Hochbild-Gesellschaft of Munich, and are reported to have been adopted at a number of agricultural educational institutions in continental countries. We understand that an English company is being formed to take up the business of the manufacture and sale of these, and other similar series of educational relief plaques, in Great Britian.

UNDER the Births and Deaths Registration Act, 1926, which came into force on July 1, the registration of still-births by the Registrars of Births and Deaths becomes obligatory. It has long been felt that the vital statistics of Great Britain have been deficient by non-registration of still-births. The Ministry of Health has issued leaflets (Circulars Nos. 802 and 802a), addressed to supervising authorities under the Midwives Acts and authorities carrying out maternity and child welfare schemes respectively, detailing the procedure under, and the principal provisions of, the new Act.

IN his recently published presidential address to the Quekett Microscopical Club, Sir David Prain recalled the establishment in his first medical school in 1878 of laboratory classes in botany, zoology, and physiology, so that, with the class on histology, there were in two years of study four courses involving to a greater or less degree microscopic work. "We were assured on the authority of four earnest teachers that it was our duty to be able to use the microscope. . . . No hint, however, was ever given us that to work with the microscope may be a source of pleasure. Little wonder that to some microscopic work appeared a disagreeable necessity; that to many it remained a matter of course; and that to only a few was vouchsafed the privilege of penetrating the secret of the Quekett Club." It is still unfortunately the case that few students either in biology or in medicine have penetrated this secret, but perhaps the hint that pleasure may be found in work with the microscope is as rarely given as in 1878.

THE president and council of the Royal Society have recommended Mr. Stanley Baldwin for election into the Society under the special statute which permits the election of persons who, in their opinion, either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society.

THE Government of India has invited the Far Eastern Association of Tropical Medicine to hold its seventh Congress in India in 1927, and the Congress will open at Calcutta on Dec. 5. The president is Major-General T. H. Symons, Director-General of the Indian Medical Service, and the general organising secretary, Lieut.-Col. J. Cunningham, I.M.S., from whom all information may be obtained at the Pasteur Institute of India, Kasauli, Punjab.

WE understand from A.S.L.I.B. (the Association of Special Libraries and Information Bureaux), 38 Bloomsbury Square, London, W.C.1, that the "Directory of Sources of Specialised Information," which the Association is preparing under the editorship of Mr. G. F. Barwick, is approaching completion. Mr. Barwick would like especially to include some more collections in the possession of private individuals.

AT the Royal Statistical Society's annual general meeting held on June 21, it was reported that the number of fellows on the roll is now 1056, and shows a small increase over last year. In the course of the proceedings a proposal was made that the existing letters, F.S.S., denoting fellowship of the Society, should be changed so as to include an indication of the status of the Society as a Royal Society. The alteration was opposed on behalf of the Council, and after some discussion the motion was withdrawn. Viscount D'Abernon was elected president for a second year, and the other officers of the Society were also re-elected.

THE Royal Photographic Society of Great Britain will hold its seventy-second annual exhibition in September and October of this year. This is the most representative exhibition of photographic work in the world, and comprises the recent achievements of photography, both pure and applied. It is desired to make the Scientific and Technical Section as representative as possible, and with this end in view exhibits are invited, which may comprise apparatus, models, prints, diagrams, transparencies, or any other form of record illustrating the applications of the photographic method to biology, botany, mineralogy, microscopy, geography, geology, spectroscopy, photometry, engineering, colorimetry, textiles, etc. Exhibits should be sent before Aug. 13, addressed to the Royal Photographic Society, 35 Russell Square, W.C.1. All communications should be addressed to the honorary secretary of the Scientific and Technical Group, Olaf Bloch, 35, Russell Square, W.C.1.

THE issue of the *Scientific American* for May contains an account of the survey of a portion of Alaska by means of three all-metal aeroplanes of amphibian type with 7 officers and 40 men from the United States Naval Air Station at San Diego. More than 40,000 square miles of rugged unexplored country was surveyed, a fourth of the survey being completed in a fortnight. A lake nine miles long and four wide was discovered at an altitude of 1500 feet, and will be used to furnish 100,000 electrical horse-power. Extensive forests of spruce, pine, and hemlock were also found, and a paper mill is to be established in the neighbourhood.

THE Report of the Museum at Valletta, Malta, for 1925–26, records the exploration of many archæological sites; the handle of a neolithic clay vase representing a ram's head is called by Prof. Zammit "the most important find of the year." The material illustrating local natural history, transferred from the University Museum in 1924, has now for the most part been placed provisionally on exhibition, and a summary catalogue of the constituent collections, as well as of recent accessions, is contributed to the report by Mr. Despott and should prove useful.

THE Section of Geodesy of the Geodetic and Geophysical Union has recently published No. 9 of the *Bulletin Géodésique*, in advance of the still unpublished Nos. 7, 8. Its contents are partly in English, partly in French. Besides a useful bibliography of recent publications, and an international

chronicle of geophysical organisation and work in various countries, it contains four articles of general interest. The first is a reprint of Dutton's address at Washington in 1889 on the contractional and isostatic hypotheses in physical geology. Two other articles deal with new geodetic measurements in Poland and France, while the last article describes a portable automatic tide gauge produced by the U.S. Coast and Geodetic Survey.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Research chemists and a research physicist at the Building Research Station, Garston, Watford—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 11). A lecturer in the zoology department of King's College, London—The Secretary, King's College, Strand, W.C.2 (July 12). A secretary and treasurer of the Rowett Research Institute—The Secretary, Rowett Research Institute, Bucksburn, Aberdeen (July 12). A bacteriologist in connexion with the Dairying Research Division of the Ministry of Agriculture for Northern Ireland—The Secretary, Ministry of Agriculture for Northern Ireland, Wellington Place, Belfast (July 15). An assistant lecturer in geology in the University of Manchester—The Registrar, University, Manchester (July 16). An evening lecturer in philosophy and logic at Birkbeck College—The Secretary, Birkbeck College, Fetter Lane, E.C.4 (July 16). An assistant in the department of economics of the South-Eastern Agricultural College, Wye, Kent—The Principal, South-Eastern Agricultural College, Wye, Kent. A half-time demonstrator and half-time research assistant familiar with X-ray apparatus and its use in crystallography, and a research assistant familiar with the chemistry and physics of photosynthesis, in the department of physics of the University of Toronto —Prof. J. C. McLennan, Athenæum Club, Pall Mall, S.W.1.

Our Astronomical Column.

COMET PONS-WINNECKE.—Recent observations, both visual and photographic, indicate a very definite central condensation, 10″ in diameter or less, permitting accurate measures to be made. According to usual views of comets, this indicates a well-defined meteoric cluster, not exceeding 250 miles in diameter. It is rather a puzzle how they have maintained this compact regular formation through at least 108 years, in view of repeated large perturbations by Jupiter. It suggests that some force other than gravitation may help to keep the constituents together.

The comet was seen with the naked eye on several occasions by those who knew exactly where to look for it ; it could be seen in the telescope before the close of twilight. Since its distance is only about a quarter of that of Eros in 1931, it should be possible to derive a good value of the solar parallax, provided that nearly simultaneous observations are available from the southern hemisphere. The distance on the night of June 26-27 was about 3,600,000 miles. According to a bulletin dated June 4, issued by Science Service of Washington, there is only one case known of a nearer approach of a comet to the earth. That is the comet 1770 I, known as Lexell's, which passed within 1,400,000 miles of the earth on July 1, 1770. Its coma then appeared $2\frac{1}{3}°$ in diameter (Chambers, "Story of the Comets," p. 87).

The motion of comet Pons-Winnecke was so rapid that on a photograph with the Greenwich Astrographic taken about 1^h on June 23, with 3 minutes exposure, it appeared as a narrow faint trail more than a millimetre long.

THE GREAT PERSEID SHOWER OF METEORS.—Mr. W. F. Denning writes : "This important stream commences at the end of June or beginning of July. It is desirable to ascertain the dates when the first and last members of the display are visible. From a discussion of thousands of recorded paths, between about June 21 and Sept. 10, I think that the limiting dates are June 25 and Sept. 5, a period of 72 days. But in consequence of the many feeble contemporary systems in play with radiants in the same region of the heavens, it is difficult to decide with absolute safety on the exact period over which true Perseids continue to fall. It would be a good plan to arrange simultaneous watches by a number of trustworthy observers. Meteors doubly observed yield radiants which are not affected with the same doubts as an object seen by one observer only. A meteor may be directed from the radiant of the Perseids and yet belong to another centre, whereas multiple records of the same object must give the correct radiant if the data are accurately recorded.

"The return of the Perseids this year takes place amid bright moonlight. The meteors, however, are often so bright and abundant on Aug. 11 and 12 that they well repay watching even when the moon is present."

THE SPECTROHELIOSCOPE.—An article by Lee McCrae in the *Scientific American* for March gives an illustrated description of Prof. Hale's spectrohelioscope, which accomplishes visually the same work that the spectroheliograph does photographically (see also NATURE, July 3, 1926, Supp. p. 1). It is not essentially new ; the earliest spectroscopic observations of the solar prominences were made visually, and the method of the oscillating slit, which is the main feature of Prof. Hale's instrument, was tried in those days. But long experience has so greatly improved all the accessories that the method is now much more effective.

The article points out the many advantages of the visual over the photographic method ; the photograph can only catch a particular aspect, whereas the visual method, like a cinema film, shows the progress of events. Its action is more rapid than the photograph ; further, it can pick out the regions of the sun where interesting developments are in progress, and follow them through their different stages.

Another advantage is that eruptions occur which change the wave-length of the line owing to Doppler effect. A record of these would be lost on the photograph, but can be obtained visually, since there is a device for altering the position of the slit. Knowledge has already been gained in this way regarding the nature of the whirling motion that occurs round sunspots. It is hoped to establish more accurately the relation between solar eruptions and magnetic storms on the earth.

Prof. Hale is trying to produce a simpler and cheaper form of the instrument, and hopes that it may lead to a more general and continuous watch on the sun for detecting outbursts.

Research Items.

CELTS FROM KNOLE PARK, SEVENOAKS.—Mr. J. P. T. Burchell contributes to *Man* for June a further note on the unorthodox association of polished celts and stemmed and barbed arrowheads from Knole Park. The celts, which have thin butts and pointed oval section, according to the Scandinavian chronology should belong to the pre-Dolmen period, but in England they have been found, as at Bexley Heath, in association with celts having a thin butt and square sides, and must be considered as having survived well into the Dolmen period. The celt with thick butt characteristic of the second Dolmen period in Scandinavia was not adopted in England. At Seamer Moor, Yorkshire, celts with thin butt and pointed oval section were found with expanding edges and incurved sides, together with kite-shaped arrowheads. In the passage graves of Scandinavia occur narrow-bladed diggers, shaft-hole axes with expanding cutting edges and incurved sides, together with hollow-based arrowheads. It is suggested that some of the artefacts of the passage-grave period in Scandinavia and Britain are copies in flint of existing metal types of more southern lands. The last period of Britain, the third phase of the Dolmen cult, is definitely of the Bronze Age, though the use of the metal is still deferred in Scandinavia. The Knole Park settlement, with its stemmed and barbed arrowheads typical of the æneolithic period, cannot be much earlier than the times of the round barrows. The celts indicate that the settlement was occupied by descendants of the pre-Dolmen period and that they were under the influence of an alien race.

VERTICAL DISTRIBUTION OF MARINE MACROPLANKTON.—In a fifth paper on this subject (*Jour. Marine Biol. Assoc.*, vol. 14, No. 3, 1927, pp. 557-608) dealing with the catches of a stramin ring-trawl, Mr. F. S. Russell gives particulars regarding the animals other than young fish, which have already been dealt with. The hauls were made at serial depths during the daylight at intervals between April and August 1926 and give a valuable series of records for many important plankton species. In general, Mr. Russell finds that most species have an optimum level in the water in which they live in the daytime, though this may vary according to weather and other conditions in ways not yet fully understood.

PHILIPPINE HYDROIDS.—The late Prof. C. C. Nutting reports (*U.S. Nat. Mus. Bull.* 100, 1927) on the hydroids collected by the U.S. Fisheries steamer *Albatross* in the Philippine region. Hydroids were taken at 58 of the 575 dredging stations reported for that cruise, which does not indicate an extraordinarily rich hydroid fauna. The collection represents 10 families, 27 genera, and 54 species, and affords many new records of species not hitherto found in the Philippine region. Prof. Nutting remarks on the relative scarcity of gymnoblastic forms, there being but three species belonging to this group, and one of these, the giant tubularid *Branchiocerianthus imperator*, was dredged outside the Philippine area in Japanese waters. Twenty-six species, almost one-half of the total, belong to the family Plumularidæ. The author adds some remarks on the recent multiplication of names and the breaking up of old genera by Stechow, which tend in his opinion to confuse the situation, and he expresses his own preference for a conservative course in nomenclature.

HYBRIDISATION AND VARIABILITY.—'New Lights on Evolution' is the title of an address by Prof. E. C. Jeffrey (*Science*, May 13, p. 458), the burden of which is an exposition of his well-known view that polymorphic genera of plants and animals are all hybrids. While formerly holding that hybrids were of no significance for evolution, he now appears to have adopted Lotsy's view that natural hybridisation is the only cause of variability. With all the ardour of a convert, he even maintains that *Drosophila melanogaster* is of hybrid origin, notwithstanding the abundant contrary evidence. The widespread occurrence of hybridism in flowering plants is recognised by many, but probably few would venture to see in it the sole effective cause of variation. Similarly, the author believes previous crossing to be the cause of parthenogenesis, but he omits to consider *Artemia salina* and its tetraploid parthenogenetic variety in this connexion.

TANAODON: A NEW PELECYPOD GENUS.—A most remarkable pelecypod from the Middle Devonian of China has just been described by Mr. Edwin Kirk (*Proc. U.S. Nat. Mus.*, vol. 70, art. 12). Externally it somewhat resembles Megalodon, and the author places it in the Megalodontidæ. The hinge, however, is strikingly different from that of any hitherto-known bivalve. The teeth form a series of elongate ridges disposed fan-wise, radiating from the umbo, and it is difficult to distribute them satisfactorily into cardinal and lateral. The author considers that eight may be reckoned as cardinal and three (or more) as posterior lateral. His figure shows thirteen of these ridges in all. Another interesting feature of the shell is the very prominent external umbono-postero-ventral ridge, which at its point of origin at the umbones is raised into a sharp keel but becomes less and less prominent as it passes outwards. It reminds one of the similar keel in Hemicardium.

GRAVITY SURVEY OF KWANTO.—The recent issue (No. 2) of vol. 4 of the *Japanese Journal of Astronomy and Geophysics* is wholly devoted to a report of a gravity survey, using an Eötvos variometer, of the Kwanto district, which suffered a great earthquake on Sept. 1, 1923. The district has since been investigated along many lines of geophysical research: land and hydrographic surveys have shown that the vertical displacements of the bottom of the Bay of Sagami, resulting from the earthquake, are more than a hundred times those of the land. In the present gravity survey, by N. Kumagai, 76 points were occupied, and the observations are carefully discussed and corrected for various sources of error, though further corrections are to be embodied in a later report. Unfortunately, few gravity observations dating from before the earthquake are available for the district, so that the observations of the present survey cannot be used to infer changes of density distribution resulting from the earthquake.

POSITIVE THERMIONS.—The May number of the *Journal of the Franklin Institute* contains an account by Dr. C. H. Kunsman of the 'iron catalyst' source of positive ions of the alkali and alkaline earth metals. Its great advantage is that the mixture from which the ions are produced can be mounted on a filament and used in a high vacuum. The source is, moreover, steady and not readily exhausted, whereas most of the older methods of producing positive ions either required the presence of gas or gave an emission which fell off rapidly with time. Dr. Kunsman has been able to show that the temperature variation of both the positive ion current and the electron current from a given specimen is in accord with the Richardson

equation, and that the energy needed to remove a positive ion from the surface is consistently less than that required by an electron. It seems probable that metal diffuses to the surface in much the same way as thorium does in the heat treatment of a thoriated filament. The ions have been analysed at Princeton by means of the mass spectrograph and have been shown to be singly charged atoms, and they have already been applied in the same laboratory to the study of the secondary emission of electrons when metal plates which have been thoroughly freed from gas are bombarded with positive ions.

THE BURNING OF CARBON DISULPHIDE.—It has been shown by A. G. White that the addition of small quantities of the vapours of ether, benzene, acetone, and acetaldehyde to mixtures of carbon disulphide and air causes a pronounced contraction in the range of flame propagation, especially at the lower limit. The results of further work on this subject are published in the *Journal of the Chemical Society* for April 1927. The present results are in general agreement with former work, and indicate that the added substance appears to act in three ways: (1) it alters the thermal constants of the mixture; (2) it alters the percentage of oxygen in the mixture; (3) it produces a specific catalytic effect. Of these, the catalytic effect is the most important and varies enormously from substance to substance. The order of efficacy of certain substances in preventing the propagation of flame at the limit in mixtures of carbon disulphide and air given by White differs from that found by Dixon.

DECOMPOSITION OF COAL.—Technical Paper No. 16 on fuel research (London: H.M. Stationery Office. 9*d*. net) records observations by J. G. King and R. E. Willgress, of the Fuel Research Station, on the "Primary Decomposition of Coal." The temperatures of initial decomposition of fuels were found to range from 180° C. for peat to 215°-245° C. for bituminous coals. For these coals the temperature of initial decomposition appeared to increase with decrease in carbon content, and to increase with increasing oxygen content. The evolution of moisture is a gradual process, but the first acceleration of moisture evolution coincides with the appearance of oil vapour. The temperatures observed are somewhat lower than those recorded by previous workers, and deserve consideration in connexion with all processes or researches involving heat treatment of coal in the region of 200°-300° C., in which the possibility of chemical change must never be overlooked.

DOPES AND DETONATIONS.—The second report on dopes and detonations (Aeronautical Research Committee: Reports and Memoranda, No. 1062 (E. 23). London: H.M. Stationery Office, 1927. 1*s*. 3*d*. net) has recently been published. The investigation which the report describes has included an experimental and theoretical study of low temperature oxidation of liquid fuels in air, in conjunction with engine experiments to determine the relationship between detonation and observed chemical action. The conclusion drawn from the experiments is that detonation in paraffin fuels and ether is due to the accumulation of peroxides in the nuclear drops during rapid compression. These drops ignite simultaneously when the detonation temperature of the peroxide is reached. The amount of peroxide formed would not in itself be sufficient to cause the detonation observed, but acts as a primer by simultaneous ignition of the nuclear drops. The metallic dopes act by reducing the peroxides as fast as they can be formed, and preventing their accumulation, thus delaying the ignition of the drops.

'HAVEG.'—In the *Chemiker-Zeitung* for May 11 there is an account of the use of 'Haveg,' an artificial resinous material like bakelite, for the manufacture of large pieces of chemical apparatus without the use of an iron-core or other reinforcement. Vessels can be constructed in one piece and without seams, up to 2·6 metres in diameter. The thickness of the walls varies from 10 mm. to 40 mm., and the vessels can withstand sudden alterations in temperature up to 130° C. Since the specific gravity lies between 1·6 and 1·8, the apparatus can be handled easily; moreover, breakages can be repaired inexpensively. During the hardening process the resin shrinks considerably, so that some difficulty is experienced during manufacture, if it is desired to combine it with metal. This difficulty has been overcome by constructing the inner vessel of perforated sheet metal, the perforations of which become filled with the resin, which when hard forms knobs or studs serving to bind the outer casing to the inner one.

RADIOLOGICAL APPARATUS.—The latest (1927) edition of Messrs. Newton and Wright's catalogue of apparatus for radiology describes in a brief but quite adequate way the various types of apparatus they make for radio-diagnostic, radio-therapeutic and X-ray research purposes. The closed circuit transformer has been developed for many years by this firm, and they are now able to build these machines for 250 kilovolts rectified three-phase output, giving practically continuous high-tension current without the introduction of condensers. Considerable prominence is given among the illustrations to the types of 'Metalix' tubes which are now available for medical and other purposes. This tube is, we understand, becoming largely used in medical work, its handiness of form being a great feature in its favour.

ELECTRODE STEAM GENERATORS.—The importance of having a uniform load on an electric power-station is well known to electrical engineers. If there is a large demand for a short period every day, the station must have sufficient plant to carry over the peak load, and this means that a number of machines are lying idle during nearly all the day, and so the overhead costs are large compared with the revenue. Engineers do their utmost, therefore, to secure a level load. For example, they often supply energy at a much cheaper rate during the night when the demand is small. To take advantage of this, electrode boilers are sometimes used which store the electrical energy delivered during the cheap period of supply as heat, either by heating water or converting it into steam. In the Bulletin for March of the Oerlikon Co. of Zurich, there is a description of electrode steam generators for electric pressures varying between 3000 volts and 8000 volts. One of the hospitals in Basle obtains steam and hot water for the kitchen and the laundry in this way. Two similar boilers each for 1000 kilowatt, 6000 volts, have been ordered for an installation in Great Britain. In Switzerland, where sometimes only a limited amount of electric power obtained from waterfalls is available, it is a boon to use these devices and so eliminate chimneys and smoke and avoid the necessity of coal storage room. The cost of maintenance of these electrode steam generators is very small. The equipment works as a star connected plant, with the boiler itself acting as the neutral point. It is therefore safe to have in a building. Tests on a high-tension boiler for 1200 kilowatts and 6400 volts have shown that the efficiency of the boiler can be as high as 98 per cent. We think that these electrode steam generators can in many cases be advantageously used.

The Influence of Water in Physical Change.

PROF. H. E. ARMSTRONG has long insisted on the view that chemical action is a species of reversed electrolysis and that an electrolyte, generally water in terrestrial systems, is a *sine qua non* for chemical action. Whether we should regard modifications in the 'molecular' weights of a liquid, alteration in the 'constants' of the Van der Waal's equation of state for a vapour or gas, change in the surface tension or vapour pressure of a liquid, all due to association or dissociation, as caused by the operation of physical or chemical change, might be debated by the purist.

At least three different types of union can readily be recognised; such as the cluster of polar molecules round charged ions, the association of molecules which are either dipolar or possess poles of a higher order, and thirdly, the definite electrovalent bond in which one or more electrons have been definitely transferred from the orbit of one atom to another; chemical union is certainly not restricted to the third class. In the second there appear to be all graduations in strength of union between polar molecules with increasing mutual distortion of the valence electron orbits and consequent alteration in the electric moments of the molecules. The enormous chemical reactivity of charged ions as well as the influence of water on chemical reactions indicates that water may function not only as an electrolyte but also in virtue of the fact that it consists of molecules of high electric moment; the latter may promote, as observed by Sir J. J. Thomson, the formation of clusters or addition compounds in reaction, and also render more polar, and in consequence more reactive, the molecules clustered in the primary addition compound.

Similar conclusions as to the necessity of stages in compound formation may be drawn from a consideration of the phenomenon of adsorption as well as the energies of 'catalysed' and non-catalysed reactions. It is clear that such compound formation included in the term 'association' is not necessarily an electrolytic process as generally understood, for in at any rate simple systems it is no more than the clustering of polar molecules around an ion, and, in somewhat more complicated cases, the effect of mutual attraction of molecules possessing definite electric moments being either dipolar or polar of a higher order. Such considerations involve inclusion of both mutual and interaction of ions and of polar molecules each possessing finite electric moments, as well as of reactions involving two electrodes and an electrolyte, in our system of chemical reaction mechanism.

The delivery and publication of the presidential address to the Chemical Society on Mar. 24, by Prof. H. B. Baker, represents this further stage in the experimental development of the idea associated with the action of water in chemical change ("Experiments on Molecular Association," *Jour. Chem. Soc.* (April), 949; 1927). Since the president was one of the first to investigate experimentally the functions of water in chemical change in gas reactions, so it is only to be anticipated that he would be the first to investigate its functions in physico-chemical changes involved in molecular association.

Prof. Baker has shown that all the liquids which he has examined may be regarded as analogous to an associable gas such as nitrogen dioxide, association increasing with decrease in temperature. The position of equilibrium in liquids is thus influenced by alteration in temperature, and the rate of attainment of the new equilibrium is greatly affected by the presence of catalysts, of which water is one of the most important. The necessity for some type of catalyst is clear when the thermal energies involved are considered. Thus the mean thermal energy at 0° C. of a molecule is some 0·035 volt, the process of disintegration of a binary complex of two hydrogen molecules requires only some 0·01 volt, but for vaporisation of liquids such as liquid bromine, benzene, or water, energies equivalent to 0·3 to 0·5 volt are required. Hydrogen complexes evidently would be rapidly broken up by thermal agitation alone at ordinary temperatures, but the destruction of complexes in these liquids, although possible by thermal agitation, will evidently proceed at a slow rate in the absence of a catalyst necessarily polar in character.

The existence of such complexes in solution and the gradual transformation of one type into another has been amply demonstrated by Prof. Baker in numerous experiments which have been considerably extended in this address. He has shown, *inter alia*, by vapour pressure and surface tension measurements, that the rate of attainment of equilibrium is affected not only by water but also by solid catalysts such as charcoal, platinum black, and thoria. If these catalysts were actually as dry as the liquids employed, we note again further evidence in the process of adsorption for the operation of forces causing reaction in the absence of water.

ERIC K. RIDEAL.

Archæology in Greece.[1]

IF this issue of the "Annual of the British School at Athens" belies its name by covering two yearly sessions, it is nevertheless true to its pre-War tradition both in the interest of its contents and the dignity of its appearance. First in importance must be placed the report of the excavations of two seasons, 1924 and 1925, at Sparta. In both years the main work was concentrated on the site of the theatre, where considerable portions of the stage and orchestra have been cleared and trials made in the *cavea*. This section of the work is described by the Director of the School, Mr. A. M. Woodward: the most interesting part of his description is that which deals with the *scenae frons* and the difficult problems connected with it. He shows that the *cavea* is a Roman construction, probably of Augustan age, doubtless on the site of an earlier and much smaller theatre. The evidence for the date of the stage-buildings is less clear, for remains of several periods exist, the earliest of which may possibly be earlier than Augustus. The inscriptions from this site, fully published here by Mr. Woodward, are both long and important, for the marble facing-blocks of the east *parodos*-wall of the theatre at its west end literally formed a single inscribed monument.

The other portion of the site attacked was the Acropolis, more particularly the area between the Hieron of Athena Chalkioikos and the retaining wall of the *cavea* of the theatre. Here a mixed deposit of various dates was cleared which yielded some of the best finds made during the excavations. The most important are the remains of a marble statue, slightly larger than life size, of a bearded warrior wearing a helmet with cheek-pieces decorated each with a ram's head. The arms are lost, but otherwise the statue is complete to the waist. The section in which Mr. Woodward dates this statue to about 480–470 B.C. and seeks to demonstrate that the subject is no other

[1] "The Annual of the British School at Athens," No. 26; Sessions 1923–24, 1924–25. Pp. viii+392+22 plates. (London: Macmillan and Co., Ltd.; n.d.) 63*s*. net.

than the hero of Thermopylæ, is among the most interesting in the volume.

Messrs. Casson and Heurtley write on the excavations which the British School has for several years past been conducting in the mounds of Macedonia. The former describes a burial mound at Chauchitsa with numerous interments of the iron age, beginning about 1150–1100 B.C., and the latter classifies and describes pottery picked up on mounds in western Macedonia and west Chalcidice.

It is a far cry from these prehistoric finds to the Finlay Library, some of the contents of which are described by William Miller in an article which is very attractive reading. The other contents of the volume well indicate how wide is the range of the School's activities and those of its students, past and present. Mr. Lawrence writes on Hellenistic sculpture from Rhodes, and Miss Lamb on stamped pithos fragments in the collection of the School, mostly from Melos. Mr. Tillyard discusses the difficult problem of the signature or *Martyria* in the Byzantine modes and its relation to the cadence; Mr. Seltman deals with the early cult of Eros in Athens and its representation in art, and Mr. Tod makes an invaluable contribution to Laconian epigraphy by giving a list (with references) of inscriptions omitted from the Corpus, or published since its appearance, and by supplementing its bibliographies.

University and Educational Intelligence.

BIRMINGHAM.—The degree of D.Sc. in chemistry has been awarded to the following: John Alfred Valentine Butler, for numerous papers on "Studies in Heterogenous Equilibria"; and Harold Archibald Scarborough, for papers on "Saponification and Properties of Mixed Solvents."

LONDON.—Sir William Beveridge has been re-elected vice-chancellor for the year 1927–28.

The title of emeritus professor of anatomy in the University has been conferred on Prof. Edward Barclay-Smith as from the end of the session 1926–27, when he retires from the University chair of anatomy tenable at King's College.

The following doctorates have been conferred: D.Sc. in Chemistry on Mr. F. H. McDowall (University College), for a thesis entitled "Constituents of *Myoporum lætum* Forst (The 'Ngaio')"; Mr. I. R. McHaffie (University College), for a thesis entitled "The Effect of the Presence of an Indifferent Gas on the Concentration and Activity of a Vapour in Equilibrium with a condensed Phase or System of Condensed Phases"; Mr. S. O. Rawling (University College), for a thesis entitled "The Sensitivity of Photographic Emulsions"; and Mr. F. Tattersfield (Rothamsted Experimental Station), for a thesis entitled "The Relationship between the Chemical Constitution of Organic Compounds and their Toxicity to Insects"; D.Sc. in Geology on Mr. S. W. Wooldridge (King's College), for a thesis entitled "Contributions to the Study of the Structure, Stratigraphy, and Geo-morphology of the London Basin"; D.Sc. (Engineering), on Mr. Bernard Hague (Imperial College—City and Guilds College), for a thesis entitled "Studies in the Theory of the Magnetic Field in Dynamo-Electric Machinery"; D.Sc. in Physics on Mr. J. W. T. Walsh, for a thesis entitled "The Theory of Luminescence in Radioactive Luminous Compound," and other papers.

A University postgraduate travelling studentship has been awarded to Dr. R. Purcell (Imperial College Science and Technology—Royal College of Science), who proposes to carry on chemical research at the University of Amsterdam under Prof. A. Smits, and to visit German universities.

The purchase for the sum of £525,000 of the Bloomsbury site by the University from the Duke of Bedford has been completed. The site, including roads, comprises about 11½ acres, bounded by Montague Place, Malet Street, Gordon Square, Woburn Square, Upper Montague Street, and Russell Square. £400,000 has been provided by the donation from the Rockefeller Foundation and £125,000 is derived from a Special Government Grant in respect of improved accommodation for the University.

DURING the celebrations at Louvain on June 28 and 29 to commemorate the five hundredth anniversary of the foundation of the University, the honorary degree of D.Sc. was conferred on Prof. E. G. Coker, professor of civil and mechanical engineering, University of London, University College.

A VACATION course for open-air work in geography, regional survey, geology, botany, and sketching will be held in Snowdonia on Aug. 19–Sept. 2. The centre will be Llanberis, and excursions to selected parts of Snowdonia will provide training in all branches of open-air work. Further particulars may be obtained by sending a stamped addressed envelope to Mr. Valentine Davis, Cheshire County Training College, Crewe.

THE Royal Commissioners for the Exhibition of 1851 have made the following appointments to Senior Studentships for 1927, the recommending bodies being indicated in brackets after the names: Mr. R. C. Blackie (University of Liverpool), for research in geology; Miss P. A. Hicks (University College of South Wales and Monmouthshire), for research in botany; Mr. R. Hill, for research in bio-chemistry, Mr. D. C. Rose, for research in physics, and Mr. L. H. Thomas, for research in theoretical physics (University of Cambridge); Dr. E. J. Williams (University College of Swansea and the Victoria University of Manchester), for research in physics.

POST-WAR depreciation in the value of available funds has been keenly felt by those responsible for important libraries. The initial cost of books has largely increased, and the cost of binding has been more than doubled. Such expenditure, essential if the institution is to be up-to-date, presents therefore a difficult problem; and in a library such as that of University College, London (which ranks in point of size third among the libraries of London and fifth among the university libraries of the Empire), the problem takes on a very serious aspect. Already the University Grants Committee has indicated the inadequacy of present library provision (see also NATURE, May 21, p. 733). So insufficient are the available funds at University College that a capital fund of £24,000 is being sought. Without it the usefulness of the library will be seriously impaired, not only by lack of means for purchase and binding, but also because of the difficulty of printing subject catalogues and other aids which are almost indispensable to the scholar. It is to be noted, too, that £7000 was recently expended on structural alterations to the Science Library, which is also absorbing part of a special grant of £10,000 for its completion. While the libraries are arranged primarily to meet the needs of staff and students, it should not be forgotten that they are available for all genuine students who make application, and that members of the British Association and of the Geologists' Association, whose libraries form part of the Science Library, have the right to use that Library. All interested are invited to co-operate in providing the required sum of £24,000.

Calendar of Discovery and Invention.

July 3, 1769.—Arkwright's famous patent for spinning by rollers was taken out on July 3, 1769, a few months after Watt's still more famous patent on the separate condenser for steam engines. A barber by trade, Arkwright became interested in the cotton-spinning problem in 1766 when thirty-five years of age, and his first machine was exhibited in the old Grammar School at Preston two years later. His machine of 1769 is preserved in the Science Museum, South Kensington. There are four rollers in pairs, the top rollers being covered with leather, while the lower rollers are fluted, the several pairs being weighted to ensure contact. His roller drawing principle exists to-day.

July 4, 1840.—The first steam vessel to carry the mails between England and America, and the first vessel of the famous Cunard Steamship Company, the s.s. *Britannia*, sailed from Liverpool on her maiden voyage on July 4, 1840, and reached Boston in 14 days 8 hours. She was built of wood and driven by paddles, and could accommodate 115 passengers.

July 5, 1639.—The incident related of Galileo watching the lamps swinging in Pisa Cathedral dates back to 1582. Many years afterwards, on July 5, 1639, in a letter he suggested the use of a swinging pendulum for astronomical purposes, and about the same time an arrangement was devised and set out on a drawing, for driving a pendulum by weights.

July 6, 1787.—On July 14, 1787, John Wilkinson, the famous Shropshire ironmaster, wrote: "Yesterday week my iron boat was launched. It answers all my expectations and it has convinced the unbelievers who were 999 in 1000. It will be a nine days' wonder, and then be like Columbus's egg." This iron canal barge, the first of all iron boats, was followed by several others, but iron as a constructive material did not come into general use for half a century.

July 7, 1879.—Among the most important observatories of the Far East are those of Zikawei, near Shanghai, and Manila, founded by the Society of Jesus, which alone among the great religious orders has been famous for its scientific work. The Manila observatory was first situated at Ateneo, and then at Ermita, and was founded in 1865 by Father Faura, S.J., who after some years of meteorological work, on July 7, 1879, predicted that a typhoon would pass over North Luzon. The event justified his warning. This was the first time that the existence, duration, and course of a typhoon had been predicted in the Far East. Father Faura's subsequent work proved so valuable that the merchants subscribed for its continuance, and with the connexion of Manila and Hong Kong by submarine cable came the beginning of the system of weather forecasts which has proved such an immense boon to shipping in the China Seas.

July 8, 1814.—One of the visitors to Paris soon after the fall of Napoleon was Edward Stanley, Bishop of Norwich, who, writing to his wife on July 8, 1814, gave an interesting account of his visit to the Jardin des Plantes, where "everything is arranged in such order that it is almost impossible to see it without feeling a love of science; here the mineralogist, geologist, naturalist, and entomologist may each pursue his favourite studies unmolested. Here, as everywhere else, the utmost liberality is shown to all, but to Englishmen particularly, your country is your passport."

July 9, 1908.—Following up the methods of Sir James Dewar, Kamerlingh Onnes, of the University of Leyden, liquefied helium, the only remaining gas that had not been coerced into that state, on July 9, 1908. E. C. S.

Societies and Academies.

LONDON.

Royal Society, June 23.—J. C. **McLennan** and J. H. **McLeod**: On the wave-length of the green auroral line in the oxygen spectrum. In 1925, McLennan and Shrum found a line in the spectrum of highly purified oxygen of wave-length λ 5577·35±0·15, and provisionally identified it with the green auroral line. Reinvestigation with a Fabry-Perot interferometer now determines the wave-length of this line as 5577·341±0·004. Babcock's value for the wave-length of the auroral line being 5577·350±0·005, there would thus seem to be no doubt as to the identity of the lines. Apparently oxygen as well as nitrogen is present in those regions of the upper atmosphere whence the auroral light is transmitted.

A. **Caress** and E. K. **Rideal**: The combination of nitrogen and hydrogen activated by electrons. A study of the combination of nitrogen and hydrogen to form ammonia in a triode valve has been made. Hydrogen atoms formed by thermal dissociation at a hot tungsten emitter combine with nitrogen at platinum and nickel surfaces to form ammonia. Hydrogen atoms excited by collision with *ca.* 13-volt electrons react with molecular nitrogen in the gas phase to form ammonia. In the absence of hydrogen atoms (by using a mixed barium calcium oxide emitter) no ammonia is observed until a voltage of 17 volts is attained, and a further rise in rate of formation occurs at 23 volts. These two rises are attributed to the chemical reactivity of N_2^+ and N^+. Ammonia seems to be produced by interaction of N_2^+ and N^+ with hydrogen to form primarily excited hydrogen atoms. The electron-efficiency of ammonia-formation from nitrogen ions is at least one ammonia molecule produced for the passage of four electrons; in the case of excited hydrogen atoms the efficiency appears to be even higher.

J. F. **Lehmann** and J. H. **Osgood**: The total ionisation due to the absorption in air of slow cathode rays. Electrons ejected from a hot tungsten filament were accelerated to an anode, by a potential difference of 200 up to 1000 volts and a portion passed through a carbon capillary into an ionisation chamber. The electron current entering the chamber, and the positive ion current due to the absorption of these electrons, were measured alternately. Ratio of ionisation current to electron current gave average ionisation per electron. Using an electron beam of given initial energy, ionisation per electron is approximately proportional to pressure of absorbing air, provided this pressure was less than a certain 'critical pressure.' For greater pressures, ionisation per electron was constant. The magnitude of the critical pressure was determined by the initial energy of the electron beam. Ratio of ionisation current to electron current, at pressures greater than critical pressure, represents average total ionisation due to complete absorption of an electron. This is directly proportional to initial energy of electron, and the ratio, initial energy of electrons/average total ionisation per electron, gave average energy expenditure associated with the formation of a pair of ions. This average per ion pair was 45 electron-volts, whereas the ionisation potential of air is 17 volts.

J. F. **Lehmann**: The absorption of slow cathode rays in various gases. A homogeneous beam of electrons of definite initial energy was introduced into an ionisation chamber. For complete absorption of the electron beam the average ionisation per electron was directly proportional to the energy of the electrons, the constant of proportionality varying markedly

from gas to gas. The ratio, initial energy of electron/average ionisation per electron for complete absorption, determined the average energy expenditure associated with the formation of a pair of ions. This ranged from 31 electron-volts per ion pair in helium to 45 electron-volts per ion pair in air, nitrogen, and carbon dioxide. The efficiency of ionisation as defined by the ratio, ionisation potential/average energy expended per ion pair, was, in helium 0·78, argon 0·46, hydrogen 0·43, nitrogen 0·38, and carbon dioxide 0·32. Thus much of the initial energy of the electron was expended by processes other than separating the molecule into positive and negative ion.

W. T. **Astbury**: A simple radioactive method for the photographic measurements of the integrated intensity of X-ray spectra. A simple photometric arrangement is described in which the negative is replaced by a carbon print and the measurements are carried out by means of α-rays and an α-ray electroscope. This radioactivity photometer has been applied to the investigation of the intensity distribution in X-ray crystal photographs. As a preliminary test the apparatus was used to find the intensity ratio, Cu K_α/K_β. In X-ray photographs of the (muscovite) mica cleavage plane it was found that, 1st order : 2nd order : 3rd order = 66 : 31 : 100, and that the intensity ratio is 6·2. The apparatus can give a curve showing a relation between X-ray intensity and α-ray intensity which is very approximately linear through the origin.

O. W. **Richardson** and F. S. **Robertson**: The emission of soft X-rays by different elements. The photoelectric activity of soft X-rays generated by electron impact on 14 different elements is measured. The soft X-ray yield under given conditions of electron excitation is a periodic function of the atomic member of the anticathode element.

E. V. **Appleton** and J. **Ratcliffe**: On the nature of wireless signal variations (1). Two methods of measuring the angle of incidence of downcoming wireless waves, both involving photographic registration, are described. The first utilises the ordinary night-time signal variations and can be employed in connexion with any steady transmitting station. It only yields useful results if the natural signal variations are small. The second requires a controlled wave-length change at the transmitter, but may be used even when the natural signal variations are large. The mean values of the angle of incidence for the periods immediately following sunset and preceding sunrise show a close agreement, and lead to an effective height of 90-100 km. for the atmospheric deflecting layer. There is a diurnal variation in the height of the ionised layer : it is higher in the middle of the night than during the sunset and sunrise periods. Comparatively rapid fluctuations have been observed in the angle of incidence of downcoming waves. Such fluctuations are considered as being due to 'reflection' at different points on a layer the mean height of which is sensibly constant.

E. V. **Appleton** and J. **Ratcliffe**: On the nature of wireless signal variations (2). Experiments were carried out on the nature of the variations of downcoming wireless waves responsible for nocturnal signal variations. A receiving assembly which is a combination of a loop and vertical aerial eliminates the effects of the ground waves at the receiving station. Large variations in intensity of downcoming waves are found. For wave-lengths of about 400 m. and distances of about 80 miles, fading is chiefly due to changes in the intensity of the downcoming waves. Variations in the phase relation between ground and sky waves are a secondary cause of fading. Changes in the angle of incidence or polarisation of the downcoming wave are not responsible in any very marked degree for signal variations. The downcoming ray has electric vectors both in, and at right angles to, the plane of propagation ; similar intensity variations are found in both these vectors.

L. H. **Martin**: The efficiency of K-series emission by K-ionised atoms. The K-series fluorescent radiations have been excited in plates of iron, nickel, copper, and zinc by beams of exciting X-rays ($\lambda = 0{\cdot}6$ A.U. $\rightarrow K$ limits), and the efficiency of K emission determined by an ionisation method. The efficiency of K emission is also deduced for selenium, bromine, and iodine, from some early measurements by Barkla and Beatty. The following values have been found for the K-series quantum transformation coefficient, *i.e.* the number of quanta of K-series radiation emitted per K-ionised atom : Fe (26) 0·29, Ni (28) 0·34, Cu (29) 0·40, Zn (30) 0·46, Se (34) 0·68, Br (35) 0·68, I (53) 0·88. The low values for this coefficient are explained in the hypothesis that in some conditions as yet undetermined, the excited K radiation does not escape from the atom, but is 'internally absorbed' in the outer electron shells, giving rise to high-speed photo-electrons. It is found experimentally that the probability of K-series emission as opposed to its internal absorption is independent of the frequency of the exciting radiation. The K-quantum transformation coefficient is a function of atomic number, and such that it seems probable that similar laws, relating probability of absorption to atomic number and wave-length, hold in cases of 'normal' and 'internal' absorption.

Geological Society, May 25.—F. S. **Wallis**: The Old Red Sandstone of the Bristol district. Although the total thickness of these deposits is now estimated at 3000 feet, the faunal contents give evidence of the presence of beds of Upper Old Red Sandstone age only, and no apparent unconformity in the strata or mineralogical break has been detected. Every gradation of deposit between the following types can be found : Coarse- and fine-grained sandstones, conglomeratic sandstones, siltstones, quartzites, cornstones, pure limestones, and conglomerates. True marls and shales are absent. The material was derived from a pre-Cambrian massif consisting of gneisses, mica- and quartz-schists with abundant quartz augen and volcanic or intrusive rocks, together with a sedimentary series of arenaceous and calcareous (largely silicified) types. This source was situated north-west of Bristol, and its rocks were similar to those of the Mona Complex, and especially to the Gwna Beds of that formation. It is not, however, necessary to postulate that the material came from the Anglesey of the present day. The sediments were transported by a great river, which, flowing through a country affected by heavy seasonal or spasmodic rainfalls, finally reached the sea by a broad delta in the neighbourhood of the Bristol district. Lagoons also formed important physiographical features near the coast.

SHEFFIELD.

Society of Glass Technology, May 18.—G. W. **Morey** and N. L. **Bowen**: The decomposition of glass by water at high temperatures and pressures. The glasses were heated with water in steel bombs for about 20 hours. The bomb was then cooled and the product examined. For optical glasses the amount of attack was greatest with a light barium crown, and least with the very dense barium crowns, which were remarkably resistant. Of commercial glasses, Jena combustion tubing withstood the action of water best, whilst the failure of Pyrex glass was outstanding.

At lower temperatures Pyrex glass was exceedingly good, but at the higher temperatures of the experiments the boric oxide was completely extracted. The crystals obtained with Pyrex glass at 325° C. were unknown.—G. Gehlhoff and M. Thomas: The brittleness of opal glass. A dense opal glass containing much fluorine was used, the opacity being increased by the addition of zinc oxide. At a temperature of about 1040° C. discontinuous changes take place. At high temperatures the glass is clear; in cooling down, crystals of a uniform and small size of grain are precipitated. The glass kept below the devitrification temperature already contains (owing to its having stood longer) bigger crystals. On further cooling down, in conformity with the law of the yet undefined constitution diagram, small crystals are precipitated, whereas the existing big ones still grew. Thus opal glasses must necessarily be worked above the temperature where precipitation of crystals causes opacity: brittleness results if they are worked below that temperature.—Francis Redfern, jun.: The new British 15-arm automatic suction bottle machine. There are approximately 40 tons of moving parts mounted on the stationary element and the whole machine weighs about 60 tons. It will revolve up to speeds of between 6 and 7 revolutions a minute, and is electrically controlled. A week's production of merchantable reputed quart bottles is estimated at 2800 gross. The machine can be produced in three sizes, 6 units, 10 units, and 15 units.

PARIS.

Academy of Sciences, May 23.—A. Lacroix: The meteoric iron of the oasis of Tamentit in the Tociat. This meteorite has been removed to Paris. Its date of fall was about 1400, and it is of interest as being the oldest meteoric iron known. It is poor in nickel and belongs structurally to the ataxite group.—L. Lecornu: The equipartition of energy.—C. Sauvageau: The gametophyte of *Nereia filiformis*.—Charles Nicolle and Charles Anderson: The comparative study of some recurrent virus, pathogenic to man.—Gaston Julia: A class of polynomials.—G. Cerf: A property of invariance of the group of contact transformations and the transformations of certain partial differential equations of the second order with n independent variables.—Corps: A new explanation of the negative result of the Michelson-Morley experiment.—W. Arkadiew: Sounds due to the magnetisation of iron.—C. Gutton and Mme. J. Mihul: The permeability of iron at high frequencies. The experiments described lead to conclusions in agreement with those of Laville. For wave-lengths varying between 8 and 25 metres, no variations in the permeability of iron could be proved analogous to the variations of the dielectric constant in the neighbourhood of absorption bands.—P. Bovis: Absorption spectra and pleochroism of iodine and of herepathite. Solid iodine possesses a large absorption band with maximum density at wave-length 0·255 μ.—E. Darmois: The rotatory power of the tartaric ion. A study of the effects of the presence of neutral salts in the tartrate solutions on the rotatory power. In these solutions sodium tartrate undergoes varied modifications in rotatory power; both the magnitude and sign of [α] are changed. If it is assumed that these modifications are of a physical nature, it would appear to be very improbable that a single explanation can cover all the cases.—R. de Mallemann: The calculation of the rotatory power of a system of molecules or anisotropic atoms. Application to quartz.—Mlle. C. Chamié: The grouping of atoms of radioactive elements in mercury. In mercury the radioactive substances examined (radium, thorium, actinium, polonium) do not appear to dissociate into individual atoms, but are distributed into small groups of atoms, which show by their photographic effect the α-particles they emit.—P. Maurice Vèzes: The calculation of ionic equilibria.—Mlle. Germaine Cauquil: Viscosity and geometrical isomerism. Derivatives of cyclopentanol and cyclohexanol have been examined from the point of view of the viscosity of the *cis* and *trans* isomers and the latter have been found to possess higher viscosities than the former. Similar differences would appear to exist in the *cis* and *trans* dichlorethylenes but the increase is not so marked.—J. Cournot and E. Perot: Some special cementations of aluminium and of duralmin after a double electrolytic deposit. Researches made from the point of view of the protection of aluminium and light alloys from the corrosive action of sea water.—Mme. Ramart-Lucas and M. Fasal: Contribution to the study of the pyrrolidones. The 5-methyl-3.3-dialkylpyrrolidones, treated with sodium amide and alkyl halide, react in the lactam form and give *N*-alkyl derivatives.—J. Bougault: An example of ether-oxide of a ketone hydrate. Benzalphenylethylsuccinic and benzylphenylethylmaleic acids.—R. Cornubert: Study of the action of sodium amide on cyclohexanone.—F. Blondel: The geological nature of the south-east of Indo-China.—E. Bruet: The discovery of the upper Pliocene in the valley of Aujon.—Jean Piveteau: Some fossil fishes from the north of Madagascar. One of the specimens collected by Waterlot in the Ambibole region belongs to the genus Acentrophorus, previously only found in the upper Permian in England. A discussion of the Madagascar form shows it to approach the species *A. varians* and *A. glaphyrus*.—Em. Perrot and Raymond-Hamet: The Yagé, a plant used as a stimulant by the Indians of the Amazon region of the equator and of Colombia. The plant appears to be *Banisteria Caapi*, and the active principle is an alkaloid, telepathine. The poisonous dose for animals (pigeon, guinea-pig, dog) is 200 mgm. per kilogram, and its local anæsthetic action resembles that of cocaine.—Louis Léger: The nature and evolution of the 'spherules' described in Ichthyophonus, a parasite of the trout.—Huguenard and A. Magnan: An accelerograph permitting the direct measurement of the accelerations of a bird in flight.—M. and Mme. A. Chauchard: Quantitative researches on the excitability of the apparatus of taste in man.—Jean Roche and Mme. Eugénie Siegler-Soru: The respiration *in vitro* of the blood of various homeotherm animals.—Mlle. M. L. Verrier: The transitory cephalic organs of the fry of *Acara tetramerus*.—Jules Barrois: The medusoid stage of Velleles.—Stelys: The physiological origin of cancer. The geophysics of a pathogenic medium. Outline of a universal causality.

GENEVA.

Society of Physics and Natural History, April 21.—L. Duparc: The tectonic of the Tonkin coal basin. The strata of this basin, hitherto generally attributed to the Devonian, are Permo-Triassic. From this follow important modifications of the tectonic interpretations of this basin, the coal of which, sometimes in very thick seams, is of Triassic age.—W. H. Schopfer: The refractive index of the cysticeric fluid and its variations. This index is 1·3358 for the internal fluid and 1·3430 for the external fluid. This index gives interesting indications on the approximate content of the fluid in proteins.—G. Tiercy: The effective temperatures of the giant stars. Applying the formula of Saha corrected for the constant, the

author obtains for the stars of the spectral type M_0, K_5, G_5, F_5, A_5, B_5:

Giant stars: M_0 2200°, K_5 2900°, G_5 3800°, F_5 5600°, A_5 9200°.

Dwarf stars: M 4000°, K_5 4300°, G_5 6500°, F_5 8500°, A_5 11,500°, B_5 14,500°.

Official Publications Received.

BRITISH.

Department of Zoology, University College of Wales, Aberystwyth. Report on Marine and Fresh Water Investigations. (New Series 2, Years ending 30th June 1924, and 30th June 1925.) Pp. 76. (Aberystwyth. 5s.

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1926. Pp. 11. (Salisbury: Government Printer.)

Proceedings of the Society for Psychical Research. Part 102, Vol. 36, June. Pp. 437-513. (London: Francis Edwards.) 4s. 6d. net.

Hull Museum Publications. No. 124: Wilberforce House, its History and Collections. By T. Sheppard. New edition. Pp. 88+30 plates. 1s. No. 148: Record of Additions. Edited by T. Sheppard. Pp. 18+5 plates. No. 149: Yorkshire Silver Tokens, etc., in the Hull Museum. By T. Sheppard. Pp. 32. (Hull.)

The Journal of the Central Bureau for Animal Husbandry and Dairying in India. Vol. 1, Part 1, April. Pp. vi+59+5 plates. (Calcutta: Government of India Central Publication Branch.) 10 annas.

Aeronautical Research Committee: Reports and Memoranda. No. 1065 (Ae. 247): Preliminary Experiments on Two-Dimensional Flow round Bodies moving through a Stationary Fluid. By Prof. B. Melvill Jones, W. S. Farren and Flight-Lieut. C. E. W. Lockyer. (A.1.b. Photographic Work, etc. 11.—T. 2350.) Pp. 12+15 plates. (London: H.M. Stationery Office.) 1s. 6d. net.

Gypsy Lore Society Monographs. No. 4: The Position of Romani in Indo-Aryan. By Prof. R. L. Turner. Pp. 47. (London: Bernard Quaritch, Ltd.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 2, No. 14: The Igneous and Metamorphic History of Cromar, Deeside, Aberdeenshire. By Dr. H. H. Read. Pp. 317-353. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 4s. 6d.

British Museum (Natural History). Picture Postcards. Set C20: British Game Birds, Series No. 2. 5 cards in colour. 1s. (London: British Museum (Natural History).)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 38, Part 2, June 21st. Pp. 145-263. (London: Edward Stanford, Ltd.) 5s.

Diamond Jubilee of the Confederation of Canada: Sixty Years of Canadian Progress, 1867-1927. Pp. viii+168. (London: High Commissioner for Canada.) 10 cents.

FOREIGN.

Geofysiske Publikasjoner utgitt av det Norske Videnskaps-Akademii Oslo. Vol. 5, No. 2: Photogrammetrische Bestimmung der Höhe von irisierenden Wolken (Perlmutterwolken) am 30 Dezember 1926. Von Carl Störmer. Pp. 8+2 Tafeln. (Oslo: A. W. Brøggers Boktrykkeri A/S.) 1.50 kr.

Treasury Department: United States Coast Guard. Bulletin No. 15: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1926. Pp. v+127. (Washington, D.C.: Government Printing Office.)

Report on Norwegian Fishery and Marine Investigations. Vol. 3, No. 8: The Production of Plankton in the Coastal Waters off Bergen, March-April 1922. By H. H. Gran. Pp. 74. (Bergen: A. S. John Griegs Boktrykkeri.)

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 10: Educational Boards and Foundations, 1924-26. By Henry R. Evans. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Smithsonian Miscellaneous Collections. Vol. 78, No. 8: The Flora of Barro Colorado Island, Panama. By Paul G. Standley. (Publication 2914.) Pp. 32. (Washington, D.C.: Smithsonian Institution.)

Publikationer fra det Danske Meteorologiske Institut. Meddelelser, No. 7: Meteorological Problems. ii: The Energy of the Winds. By V. H. Ryd. Pp. v+96. (Kjøbenhavn: G. E. C. Gad.)

Stanford University Publications. University Series, Biological Sciences, Vol. 5, No. 1: Introduction to the Limnology of the Searsville Lake. By Dr. Flora Murray Scott. Pp. 83. (Stanford University, Calif.: Stanford University Press.) 1.50 dollars.

Contributions from the Dudley Herbarium of Stanford University. Vol. 1, No. 1: A Distributional Catalogue of the Lupines of Oregon. By Charles Piper Smith. Pp. 55. (Stanford University, Calif.: Stanford University Press.)

Bulletin of the Terrestrial Electric Observatory of Fernando Sanford, Palo Alto, California. Vol. 3: Summary of Observations on Earth Potential, Air-Potential Gradients, and Earth-Currents for the Year 1925. Pp. 24. (Palo Alto, Calif.)

Field Museum of Natural History. Anthropological Series, Vol. 17, No. 1: A Correlation of the Mayan and European Calendars. By J. Eric Thompson. (Publication 241.) Pp. 22. Zoological Series, Vol. 13: Catalogue of Birds of the Americas and the adjacent Islands in Field Museum of Natural History. Initiated by Charles B. Cory, continued by Charles E. Hellmayr. Part 5: Tyrranidae. (Publication 242.) Pp. vi+517. Anthropology, Memoirs, Vol. 2, No. 1: Archaeological Explorations in Peru. Part 1: Ancient Pottery from Trujillo. By Prof. A. L. Kroeber. (First Captain Marshall Field Archaeological Expedition to Peru.) Pp. 43+13 plates. (Chicago, Ill.)

Iowa Geological Survey. Vol. 31. Annual Reports, 1923 and 1924, with accompanying Papers. Pp. 400. (Des Moines, Iowa.)

United States Department of Agriculture. Department Bulletin No. 1487: A Study in Hyperparasitism, with particular reference to the Parasites of *Apanteles melanoscelus* (Ratzeburg). By C. F. W. Muesebeck and S. M. Dohanian. Pp. 36. (Washington, D.C.: Government Printing Office.) 10 cents.

CATALOGUES.

Constable Books, 1927. (Summer edition.) Pp. 24. (London: Constable and Co., Ltd.)

Important Works on Natural History and Science, published prior to 1800. (Catalogue 150.) Pp. 44. (London: Dulau and Co., Ltd.)

Fine and Applied Arts, First editions, Modern Presses. (No. 437.) Pp. 20. (Cambridge: Bowes and Bowes.)

Diary of Societies.

SATURDAY, JULY 2.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District Meeting) (at Town Hall, St. Anne's on Sea), at 10.30 A.M.

PHYSIOLOGICAL SOCIETY (in Physiological Laboratory, Oxford), at 4.—F. Buchanan: A Method for recording the Action-Current of a Single Spot of Skeletal Muscle without injuring any other Spot.—F. R. Fraser, J. B. S. Haldane, R. Hilton, and G. C. Linder: A Study of the Arterial Blood in Ammonium Chloride Acidosis.—Dr. E. D. Adrian and Rachel Matthews: The Interaction of Retinal Neurones.—Prof. J. Mellanby: The Digestion and Absorption of Fat.—Demonstrations:—Apparatus for investigating Radiant Heating and its Effects, by Prof. H. M. Vernon and M. D. Vernon.—Some Changes in the Tissues during Attempted Acclimatisation to Alterations in O_2-Pressure in the Air, by J. A. Campbell.—Method of studying Ciliated Epithelium of Trachea, by Dr. Leonard Hill.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Provincial Meeting at Royal Alexandra Hospital for Sick Children, Dyke Road, Brighton).

MONDAY, JULY 4.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Sir Joseph Larmor: The Grasp of Mind on Nature. The James Scott Prize will be presented to Sir Joseph Larmor.

ROYAL INSTITUTION, at 5.—General Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh).

TUESDAY, JULY 5.

ROYAL SOCIETY OF MEDICINE, at 5.—Annual General Meeting.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh).

WEDNESDAY, JULY 6.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh).

THURSDAY, JULY 7.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh).

FRIDAY, JULY 8.

SOCIETY OF CHEMICAL INDUSTRY (Annual General Meeting) (in Edinburgh).

SATURDAY, JULY 9.

BRITISH MYCOLOGICAL SOCIETY (Phytopathological Meeting) (at the Research Station, East Malling, Kent), at 11.30.—R. G. Hatton: General Account of the Station and its Activities.—At 12.—Demonstration of Reversion in Black Currants, by Mr. Hatton and Mr. Amos.—At 1.30.—Dr. H. Wormald: Brief Outline of the Pathological Problems under Investigation at East Malling.—1.45 to 3.45.—Tour of Egham Field and Great East Field, and Examination of Specimens, Cultures, etc., in the Laboratory. Features of pathological interest include examples of 'Die-back' in Plum Trees, various Raspberry Diseases, Walnut Bacteriosis, Spraying Experiments against Raspberry Anthracnose, and Apple Spraying Experiments, etc.—At 4.30.—General Discussion.

CONFERENCE.

JUNE 30 TO JULY 2.

NATIONAL ASSOCIATION FOR THE PREVENTION OF TUBERCULOSIS (at British Medical Association House, Tavistock Square, W.C.1).

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