THURSDAY, APRIL 3, 1919.

PRESERVATION OF TIMBER IN INDIA.

The Indian Forest Records. Vol. vi., part iv.: "A Further Note on the Antiseptic Treatment of Timber, recording Results obtained from Past Experiments." By R. S. Pearson. Pp. vi+ii+128+maps and plates. (Calcutta: Superintendent Government Printing, India, 1918.) Price 3 rupees, or 4*s.* 6*d.*

ALTHOUGH the main principles involved in the antiseptic treatment of timber as a means of protecting it against decay induced by fungi are invariable, their precise application is necessarily modified in detail with differences of climate and of the timbers treated. In India an additional factor intervenes in the necessity for the simultaneous protection of wood from attacks by insects, and from termites in particular.

Extremes of climate in India introduce difficulties in the antiseptic protection of timber that are lacking in cold-temperate regions. For instance, as Mr. Pearson notes, in hot, dry Indian districts the highly antiseptic lighter oils of raw creosote evaporate more rapidly than in cooler regions, so that ordinary creosote-oil would appear to be not so well suited for the preservation of railway sleepers in India as in England; accordingly Mr. Pearson, with the support of preliminary trials, rather favours the usage of heavier tar-oils. This relatively rapid loss of the more volatile tar-oils suggests that in India there should be deeper penetration, or possibly injection of larger quantities, of tar-oils when compared with current European practice; yet it is quite possible that the heavier oils remaining in the wood may be more toxic at the higher temperatures in India than in Europe, in which case ordinary creosote-oils might be well suited for use in India.

Depth and evenness of penetration of the antiseptic, and the amount of this injected, may thus acquire increased importance in India. But these details in the impregnation of timber, when pneumatic pressure is employed, are determined not only by the nature and water-contents of the wood, but also by the temperatures at which the process is carried out, by the intensity, duration, and rate of application of the pneumatic pressure, and even by the gas-pressures prevailing in the injection vessel before the admission or after the expulsion of the antiseptic. Only the fringe of this branch of the subject as regards Indian woods has been touched. The modern experiments we owe to Mr. Pearson, who conducted trials under varying conditions on the penetration of green oil mixed with "earth oil" ("liquid fuel") into some dipterocarp and several other timbers. In an earlier paper Mr. Pearson described his experiments on the absorption of antiseptic solutions by a number of Indian timbers treated in hot or cold baths ("open tanks").

Quite apart from any weakening of the antiseptic by evaporation of its components, depth of penetration is of special importance where the climate is hot and dry for prolonged periods and the treated wood is used out of doors—for instance, in the form of railway sleepers. In such places during drought the wood is particularly prone to develop splits, which not only cause mechanical weakness, but also provide points of entry for destructive fungi or insects. Mr. Pearson directs particular attention to this danger of splitting, and to the consequent necessity for seasoning wood to such a degree of dryness as will correspond with the atmospheric humidity. He suggests the possible use of artificial seasoning (kiln-drying) when a considerable degree of dryness has to be attained. In this connection several difficulties call for investigation. It will probably be found that in very dry parts of India the wood is in moisture-equilibrium with the air when it contains as little as 6, or even less, per cent. of water; but under artificial seasoning to such a degree of dryness wood is apt to become brittle. Again, the question arises as to the course to be pursued when the climate includes sharply marked alternating hot dry and wet seasons. Both these difficult cases may perhaps be met more or less efficiently by using a sufficiently deep injection of solutions (say of tar-oils) that obstruct the interchange of moisture between wood and atmosphere, and consequently decrease warping and splitting.

When the climate is permanently or periodically humid, soluble salt solutions, such as zinc chloride, will be washed out of exposed wood even more rapidly than in this country; accordingly, Mr. Pearson tentatively concludes that such preservative salts are unsuitable for use in sleepers in wet Indian climates. It appears possible that the use of zinc chloride to preserve railway sleepers in hot, dry climates may likewise be unsatisfactory; for the dry sleepers, exposed to the direct rays of the sun, will be raised to temperatures that may be sufficiently high to cause the zinc chloride to exercise its directly destructive action on the wood.

It is clear that, in general, but particularly in extreme Indian climates, in selecting an antiseptic solution as a preservative of timber, it is impossible to rely merely upon the fungicidal or insecticidal efficiency of the fresh solution. Only prolonged trials can solve the problems as to the depth of penetration and the amount of solution that yield most satisfactory economic results. The antiseptic most commonly used in England for railway sleepers and paving blocks, "creosote-oil," is costly in India, where its antiseptic durability is also dubious. Accordingly, Mr. Pearson's experiments include trials with solutions ranging from various tar-oils and their derivatives to rock-oils, salt solutions (including zinc chloride and sodium fluoride), and mixtures of these, also a saccharine solution containing arsenic in solution.

To determine all the unknown factors that will form the bases of the technically and commercially most satisfactory methods of preserving various

Indian timbers for divers uses would require years of work conducted by a number of investigators. Mr. Pearson's is pioneer work rather aiming to arrive at some practical conclusions within a time corresponding with the urgency of India's needs. But it would appear eminently desirable to accelerate and extend Mr. Pearson's work by the employment of a staff of investigating experts, in view not only of the results that he has already obtained, but also of the possibility that in India it may often be commercially more profitable to cultivate rapidly growing timber trees the wood of which is perishable and of low quality, but capable of being cheaply preserved by antiseptic treatment, than to grow trees of slower growth the timber of which is superior in quality and in durability. PERCY GROOM.

PROF. RIGHI'S RESEARCHES.

I Fenomeni Elettro-Atomici sotto l'Azione del Magnetismo. By Prof. A. Righi. Pp. xvi+435. (Bologna: Nicola Zanichelli, n.d.) Price 17.50 lire.

IN this volume Prof. Righi gives a summary of his researches on the effect of a magnetic field on the electric discharge. These researches have been mainly concerned with three effects: the change in the potential required to start the discharge, the change in the appearance of the charge at low pressures, and the mechanical forces acting on bodies in the neighbourhood of the discharge. In all three branches of his study he has recorded a large number of interesting and suggestive facts, which deserve the close attention of all students of physics; if they have not received the attention they deserve, it is largely because Prof. Righi has tended to describe his work in terms of theories which others who have pursued parallel investigations have been unable to accept.

A review is not a suitable medium for scientific discussion, and any detailed criticism of Prof. Righi's views would be out of place. But perhaps it may be useful to record some questions which inevitably occur to a reader of the chapter which deals with the effect of the magnetic field on the discharge potential, for this matter has been discussed less thoroughly than the theory of "magnetic rays" on which Prof. Righi bases his interpretation of the second group of phenomena.

Prof. Righi found that a magnetic field, whether parallel or perpendicular to the electric field, may produce either an increase or a decrease in the discharge potential. He asserts that the "accepted theory," which attributes the effect of the magnetic field to a change in the path of the ions, is inadequate to account for such a difference in the sign of the effect. As a matter of fact, there is no accepted theory which predicts satisfactorily the discharge potential in terms of the paths of the ions, even when there is no magnetic field. Changes in the discharge potential due to added electric fields (such as are produced by bringing an insulated body near to one electrode of a tube at low pressure) are at present inexplicable except in the most vague and general way; so long as such changes remain unexplained, it is quite impossible to prove that the change in the paths of the ions produced by a magnetic field must affect the discharge potential in one sense rather than the other. Prof. Righi, on the other hand, asserts that a theory which considers only the path of the ions after they are separated must predict that a transverse magnetic field will produce an increase in the discharge potential. In order to explain the occurrence of a decrease in certain conditions, an additional hypothesis is required; that which he suggests is based on the action of the field on the atom before it is ionised; he suggests that the field increases the radius of the electronic orbit in the atom, and so decreases its stability.

The first question which arises naturally is how Prof. Righi arrives at a result so directly contrary to that on which Langevin's theory of diamagnetism is based; according to the new theory, all atoms ought to be paramagnetic. The second is why he assumes, without proof, that an increase in the radius of the orbit means decreased stability. The third is whether he has attempted to calculate numerically the change predicted by his theory in the orbit; if he will do so, he will find that the change in the orbit produced by such fields as are concerned here is much too small to be likely to lead to any important change in the energy of ionisation. The fourth is why he has not attempted to apply one of the usual methods for measuring the energy required for ionisation to test his theory—and so on.

To these questions no answers are given in the volume before us. The author seems to us generally to be apt to seize with too great readiness on any explanation which will account for facts immediately under his notice, without considering with due care how it may fit in with facts less immediately obvious, and too ready to be content with qualitative explanations when quantitative explanations are required; for the same features are to be found in his treatment of the other two effects which he has studied, though they are less noticeable in his work on the "magnetic rotations" of bodies near or immersed in the discharge. They are less noticeable because the explanations which he offers are less novel. The phenomena which he describes are, as he recognises, direct consequences of the fundamental laws of electromagnetism; the criticism here would be rather that he treats individually and with unnecessary detail facts which are all illustrations of a single recognised principle. In particular, the explanation which is offered of the Hall effect, on the analogy of the "magnetic rotations," appears to differ in no essential way from that expounded in many text-books.

Perhaps a criticism of this kind is unjust, for Prof. Righi explains that he is not writing for the expert, but for the reader who wants to bring his knowledge of physics up to date. He inserts an introductory chapter for the benefit of such a reader, giving a brief history of the whole development of electrical theory during the past century. It is always hard to lay down precisely the limits of the knowledge of the general reader; we confess that we should be surprised if anyone could be discovered who could find both something new in the first chapter and something comprehensible in the others; but on this matter the opinion of so practised a writer as Prof. Righi is not lightly to be disputed. However, we must insist that, in addressing the general reader, an author undertakes certain responsibilities. If he addresses an expert audience, he can do no harm to anyone but himself if he does not give as much weight and prominence to the views of those who differ from him as to his own; if he addresses those who are not experts, he has not the same liberty of choice in this matter. Judged on this principle, Prof. Righi's treatise will scarcely pass the test; we do not think he offers his readers a fair chance of deciding between him and his critics.

From the excellent quality of type and paper, we conclude that Italy is free from war-time restrictions, which affect our own publications so adversely. But, then, what excuse is to be offered for the absence of an index or any adequate summary of contents? N. R. C.

OUR BOOKSHELF.

Pharmacy, Theoretical and Practical, including Arithmetic of Pharmacy. By Prof. Edsel A. Ruddiman. Pp. vi+267. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 8*s*. 6*d*. net.

THE object of this little work is to present in as few words as possible essential facts which every pharmacist should know. The book is divided into three sections, viz. arithmetic of pharmacy, theoretical pharmacy, and practical pharmacy. The first treats of weights and measures, and contains a number of arithmetical calculations of a very elementary nature. Theoretical pharmacy is discussed in fifty-five pages, which, it must be admitted, would be a very meagre allowance if the subject were treated in any detail; that, however, is not the case, as it is intended that the book should be used in conjunction with the United States Pharmacopœia or the National Formulary. Practical pharmacy is dealt with in a similar manner; formulæ for the various preparations considered are not given, the author confining himself to notes on the precautions to be taken, the reactions that occur, and so on.

The work contains a good deal of information in a small compass, and it certainly comprises many essential facts that every pharmacist should know. It is not, and apparently is not intended to be, a work from which pharmacy should be studied, but is rather a summary of facts such as a student would take note of during a course of lectures and demonstrations in pharmacy. Elementary students and students revising their work before examination would undoubtedly find it useful.

Afforestation. By John Boyd. Pp. 39. (London: W. and R. Chambers, Ltd., 1918.) Price 1*s*. net.

IN this small brochure Mr. Boyd deals with the afforestation question as it now presents itself to this country. As he correctly remarks, if, after the troubles we have experienced during the past four years in providing the timber required for effectively waging the war, we have not learned our lesson we are not likely ever to do so. After briefly describing the extensive forests which existed in Scotland, now replaced by bare hill- and mountain-sides, the author points out the great dependence of the community upon the products of the forest, both in their everyday life and in industries. The great value of forestry to agriculture, and the manner in which the small holding can be placed on a sound footing by being associated with forestry, are dealt with in some detail. Mr. Boyd, with considerable practical experience of the trouble caused, speaks with authority on the game question in its application to forestry, and his remarks on rabbits, black game, red deer, and so forth are worthy of study. Some practical suggestions are made with reference to the ground to be taken up for planting, natural herbage forming a guide for the classification of areas. The author concludes with a few notes on various trees likely to be useful for afforesting waste lands.

A Manual of Elementary Zoology. By L. A. Borradaile. Second edition. Pp. xiv+616. (London: Henry Frowde, and Hodder and Stoughton, 1918.) Price 16*s*. net.

IN this new edition there are, besides smaller additions, three new chapters dealing respectively with protozoa as parasites of man, with nematodes, and with cold-blooded vertebrates. In the first of these chapters a short account is given of Entamœba, Balantidium, Trypanosoma, and Plasmodium, and of their modes of transmission. There would seem to be no sound reason for employing the name *Entamoeba dysenteriae* instead of the well-known *E. histolytica,* especially in a junior students' text-book. In the chapter on nematodes the author gives an account of Ascaris, a summary of the principal types of life-history met with in the group, and a short statement of the special characters of parasites. In the account of *Filaria bancrofti* it should have been stated that the larvæ taken up by mosquitoes finally reach the labium (proboscis), and not the salivary glands (as stated on p. 304). In the chapter on cold-blooded vertebrates the figure of the cranial nerves of the skate is not correct in certain particulars. The outer buccal nerve (part of the seventh cranial nerve) is labelled wrongly as the maxillary branch of the fifth nerve, and the real maxillary is not labelled. The direction of the internal mandibular nerve and the external mandibular are not well shown. But these are only small blemishes. The book is excellently illustrated and written with a broad outlook.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Colour of the Scales of Iridescent Insects in Transmitted Light.

CURIOUS as it may seem, the origin of the brilliant metallic and iridescent colours in birds and insects has never been satisfactorily explained, though it is generally supposed among naturalists and others that they are in some way produced by the interference of light at the surfaces of thin plates, as in the soap-bubble.

Nevertheless, various other explanations have been put forward, and Michelson, with the weight of his great authority, decides unequivocally that they are due to selective reflection at the surface of a very opaque film, as in the case of metals or dry films of aniline dyes. For this conclusion he relies upon the "rigorous optical test of the measurement of the phase-difference and amplitude ratios" when polarised light is reflected. This view has, however, by no means gone unchallenged by Lord Rayleigh, Mallock, and others.

Whatever the truth of the matter may finally prove to be, both those who uphold the theory of selective reflection, and those who uphold the theory of interference, emphasise the fact that the light transmitted through the structures must be complementary to the light which is reflected.

Thus Michelson says: "In the cases which could be investigated for this relation (unfortunately rather few) the transmitted light is complementary to that which is reflected"; and Mallock says: "In cases where the structure is transparent it transmits the complementary colour with nearly the same intensity as the colour reflected." Probably the theory of selective reflection would require the transmitted colours to be more vivid than a theory of "thin plates"; and, as Lord Rayleigh has said, the transmitted colour of the surface layer of beetles' wings (or *Emailschicht* of Biedermann which he obtained by maceration in HNO_3, etc.) "is not nearly so full as it would be if due to anything like an aniline dye."

In spite of what is said by Michelson and Mallock, there are a number of iridescent scales in Lepidoptera, *Hypolimnas bolina*, etc., which, though perfectly transparent, are absolutely colourless. There is the still more anomalous case of the two surface layers of scales of *Morpho achilles*, and other similar species. I should be greatly interested if any of your readers could offer a probable explanation. The appearance of these scales is as follows:—They are perfectly transparent, closely striated, very thin (probably not much more than $0{\cdot}5\mu$), and by reflected light they are a bright light blue, which is practically unaltered by the angle of the incident light. *In situ* they show faint diffraction colours due to their striation. But the point to which I wish to direct attention is that, when examined by transmitted light under the microscope, they still have a *blue* colour, which is, if anything, more saturated than that shown by reflected light. This colour, though not unlike the "optical blue" of the sea and other fine suspensions, cannot be due to a similar cause, since the light transmitted is not red. It is clearly visible with a Zeiss AA objective, but practically invisible with higher powers—DD, etc. Moreover, if the scales are examined with an AA objective, and the condenser racked down, the blue colour will gradually disappear as the condenser is raised until it becomes invisible with critical illumination. These scales have, as a matter of fact, been mentioned by Biedermann, but he entirely fails to notice their significance.

H. ONSLOW.

3 Selwyn Gardens, Cambridge, March 15.

Matter and Radiation.

THE theory that matter only radiates energy to matter, as suggested by Dr. Shapley and Prof. Soddy in their interesting letters (March 13 and 20), would certainly solve the great problem of solar energy, and is in many ways attractive. But is not the evidence against it very strong? Amongst various arguments that may be advanced against it, let us consider that of the difficulty of reconciling it with the existing surface temperature of the earth.

It is evident that there is an approximate balance between the radiation received by the earth from the sun and that lost, the latter being very slightly larger owing to the heat conducted outwards from the centre. The mean temperature of the earth is about what we would expect on the assumption that it is receiving heat at a known and measured rate from the sun and radiating it uniformly in all directions in accordance with Stefan's law. The fraction of the total solid angle which is subtended by matter is apparently almost infinitesimal, yet the quantity of heat radiated agrees with that deduced from experiments in which the radiating body is entirely surrounded with matter. If we assume that surrounding matter only influences the distribution, and not the total flux of radiation, we are led into all sorts of further difficulties. For example, a large part of the radiation from the dark side of Venus would have to be directed towards the earth, so that the radiation received from Venus should be comparable with that received by Venus from the sun.

Another way of turning the same argument is to consider an isolated solar system. No heat could escape, so it would resemble a system in a perfectly reflecting envelope. Equilibrium would then only be reached when all the members had attained the same temperature. The isolation of the actual solar system in space should certainly be sufficiently close to ensure that its members would attain a temperature approximating to that of the sun.

It is possible that this argument is not new, and that there may be some way of evading it, but, as it appears to be difficult to do so, I think it is worthy of consideration.

HORACE H. POOLE.

Physical Laboratory, Trinity College, Dublin, March 26.

National Fisheries.

IN NATURE of March 13 is published a paragraph on British fisheries in which the following passage occurs:—"To the trade, fish that is scarce and dear is easier to handle than, and at least as profitable as, fish that is cheap and plentiful. From the point of view of the consumer and of the State, cheap food, a large and prosperous fishing population, and, if possible, some revenue, ought to be the objects of reconstruction of the industries concerned."

The note suggests an antithesis which has no foundation in fact. The fishing industry—producers, research workers, and the "trade"—bases the claim for reconstruction, which this association has voiced, on the fact that it desires to supply the nation with cheap fish. But cheap fish can be supplied only when plentiful catches *and regular* catches are assured, and to ensure regularity—that is the real crux—without simplifying the existing fishery law and administration is hopeless. No one interested in the development of British fisheries believes in the economic fallacy contained in the first sentence I have quoted from your pages. To quote Mr. Secretary Cecil in 1563:—"The causes of the decay of fishing must be the lack of the use of fishing, which must be divided into ij partes, small eating of fisshe in ye Realme, and not selling of it abroad." Both these causes have operated during the war. It is our purpose to remove them both. As this is not always understood, I shall be glad if you will publish this declaration, which can be taken as "official" on behalf of every branch of the fishing marine, to which the nation owes its freedom in 1919, as it did in 1588. G. C. L. HOWELL.

National Sea Fisheries Protection Association,
Fishmongers' Hall, E.C.4, March 24.

I ENTIRELY agree with Capt. Howell, and think that the road to fishery reconstruction, in the national interest, is marked out by the lines of the propaganda of the National Sea Fisheries Protection Association. I am sorry if it should appear that anything in the views put forward in the *Times* correspondence and articles is misrepresented in the note in NATURE of March 13, but it seemed to me that Lord Dunraven's letter did suggest such an antithesis as that to which Capt. Howell refers—that fish which is scarce and dear might be more profitable and more easy to handle than fish which is cheap and abundant, and that while the former condition might possibly be preferred by the distributing trades, the latter condition is that which is favourable alike to the nation as a whole and to the consumers in particular. In order to make it impossible that the former condition might be established, Lord Dunraven seems to suggest some form of nationalisation of the fisheries; this would also, he hopes, create revenue. The National Sea Fisheries Protection Association, on the other hand, seeks to secure the same object by its advocacy of a strong Imperial administration—a sounder method, it seems to me, for better than State revenue would be a prolific fishery population retaining its individuality; and largely increased British exports would be preferable to Lord Dunraven's Colonial imports. The note was intended to be purely descriptive, and so my personal opinions were not expressed.

THE WRITER OF THE NOTE.

Coal in Thrace.

I AM much obliged to Prof. Louis for his interesting information (NATURE, March 20, p. 45).

I assumed the coal to be anthracite on account of the assertion that the use of the bellows extinguished it, while it encourages the combustion of bituminous coal by a fuller supply of oxygen. The high temperature needed for the burning of anthracite would not be attained, I fancied, owing to the cold blast.

The geographical description does not apply to Pontos.

There is another "wonder" cited by Antigonos that has a possible bearing on the coal district of Thrace. He quotes Eudoxos as saying: "It is related that in the Thracian Sea, at the mountain which is called Sacred, during certain times bitumen (*asphaltos* in the Greek) is borne on the surface."

The *Mare Thracicum* in Kiepert's atlas extends from Thrace north of the Hellespont to the coast of Thessaly. The "Sacred Mountain" is probably Mount Athos, which in vulgar speech is still called "Hagion Oros." EDMUND M'CLURE.

80 Eccleston Square, March 24.

THE MACHINERY OF GOVERNMENT.[1]

"A MAN without a purpose," said Carlyle, "is like a ship without a rudder." What is true of an individual is in this case true of a community: a people without a common purpose can make no permanent progress. It must stagnate and ultimately disintegrate. In the last resort a free people can only be held together by either of two means: custom or community of purpose. It is not difficult to see that anything—and not least the machinery of Government—which facilitates the coherence of free people, whether in a single State or in a world commonwealth, and their co-operation towards the fulfilment of a common purpose, makes for the welfare and advancement of mankind.

During the war many English customs have been broken down, but the consequent tendency towards disintegration has been more than counterbalanced by the increased sway of a common purpose. Higher efficiency and more rapid progress have consequently become apparent in multifarious departments of the national life, as, for example, the exhibition of British scientific products held in London last summer, and repeated this winter in Manchester, has shown in the case of scientific industry. But with the signing of the armistice community of purpose began to lose its hold, and disintegration threatens to set in. Labour leaders are warning the nation against it, and leading articles in the *Times* are echoing and emphasising their warnings.

How is this danger to be avoided? New habits and customs take time to form. Moreover, as we may perhaps learn from the Americans, bondage to custom causes many of the evils that result from other kinds of fetters. So the prosperity, progress, and even preservation of the State demand, above all, community of purpose. Perhaps spiritual ideals alone can supply it, and the essential emotional drive towards its realisation. But, whatever the purpose be, some central Government is needed to plan and to direct the advance towards it. This—and not merely to police the route—is the function of the Government of a State.

In the past, of course, this function is very far from having been fulfilled, whether by Ministers of the Crown, who determine policy, or by the permanent Civil Service Departments, which pursue it. When Mr. Gladstone entered Parliament in 1832 he thought his first concern would be with questions of the succession to certain unstable European thrones. A dozen years later, after a close connection at the Board of Trade with the leaders of British industry and commerce, he held a very different view. But it has taken a long time for these industrial statesmen, these leaders of British activity outside the House of Commons, to see in the Government and its principal Departments the natural centre and focus of their activities in the service of the State. The process is not yet complete; nor have some captains of

[1] Report of the Machinery of Government Committee. Ministry of Reconstruction. (Cd. 9230.) (H.M. Stationery Office.) Price 6*d*. net.

industry yet recognised that they are in business primarily to serve their fellow-men, and not for private profit. They have looked upon the Government Departments with distrust, avoided their co-operation for fear of their control, and thought of them as circumlocution offices bound, and anxious to bind, by red tape.

It can scarcely be denied that hitherto many Government Departments have not been so much concerned with pointing out the line of progress and making it the line of least resistance as with hedging it about with restrictions. The functions assigned to the different Departments of State have, in many cases, been so multifarious that it has been impossible for the permanent heads of these offices to know their job, or explain it to the Minister who is responsible for it to Parliament. So it happens from time to time that Ministers are made to display, across the floor of the House of Commons, an abyss of ignorance that would be comic were it not so fraught with dire consequences. Departments, being aware of this risk, have been afraid of exposing their ignorance. Deficient in knowledge, they have sought to evade rather than to remove difficulties. Thus has come to pass the hand-to-mouth existence of some Government Departments. They have aimed at sending a deputation away smiling, or at avoiding a question in the House, rather than at mastering their business and convincing the public of the wisdom of their policy. Moreover, their duties being too big, they have often simplified their problems by reducing them to writing, and have afterwards ignored the more complicated reality. They have been content to administer printed regulations, and almost to forget the thing itself. So it has even happened that a permanent Civil Servant, desirous of spending a few weeks away from Whitehall in intimate personal contact with the real thing, has been told by a superior officer that he was not concerned with the thing itself, but with the papers about the thing!

The impossibility of expert knowledge of so many different matters as some Departments have had to administer has tended to put expert scientific knowledge—and not of physical science alone—at a discount throughout the Civil Service. Not wanting knowledge, they have sought for ability, and have attracted many of the ablest students of Oxford and Cambridge into their service. Since the nature of the case has prevented these able young men from becoming expert, and so has, in a large measure, wasted their abilities, the increasing drain upon the universities' output of first-rate men was, just before the war, becoming a menace to the country. On the other hand, the very able men who formed the highest ranks of the Civil Service were ready to administer anything, ready to move (like Cabinet Ministers) from education to Admiralty, or from the Board of Trade to the India Office. Men of like ability have achieved magnificent success in India and the Colonies. But in Whitehall it would be possible to combine expert knowledge with ability, and so vastly to increase the efficiency of the machinery of Government.

To effect the necessary change, Lord Haldane's Committee proposes that the business of the various Departments of Government shall be distributed so far as possible according to the class of service with which they are concerned.

In accordance with this principle, the Government is to guide, and not merely to regulate, the progress of the community. To this end it is to have more, instead of very much less, relevant knowledge available than any individual or group of individuals. This knowledge is to be provided by a Department of (1) *Research and Information*, which will continuously acquire knowledge and prosecute research in order to furnish a proper basis for authority. The information required by the Royal Commissions of the future will be ready to their hand, instead of, as at present, having to be reassembled by each new Commission that may be appointed. Moreover, each other Department of State is, the Committee recommends, to have its own special department of inquiries to keep in touch with the central Research Department, and to supply to the heads of its own office and to the public the kind of information which Joan and Peter's guardian, in Mr. Wells's recent volume, sought in vain at Whitehall. Again, the heads of each Department are advised to set aside certain regular times for looking ahead and framing a policy of progress that might well be recommended to many heads of extra-Government concerns.

In order that citizens may be efficient workers for the common purpose (and that means, for the most part, efficient ministers to the needs of their fellows), they need education; healthy conditions of life (which mean adequate town planning, housing, medical service, health insurance, and the like); food, clothing, and other consumable goods (which mean adequate production, distribution, and transport); suitable regulation of conditions under which they work in the service of their fellows; and protection from the interference of hostile persons at home and abroad. With the provision of these further services the Committee proposes that the following Departments shall be respectively concerned:—(2) *Education*; (3) *Health*; (4) *Production*; (5) *Employment*; (6) *Justice*; (7) *National Defence*; (8) *Foreign and External Affairs*.

Since the Minister of Production cannot supervise privately controlled industry and commerce, and also direct competing services which the Government is providing on its own account, there must also be a Department of (9) *Supplies* to fulfil this latter function. And, finally, since the State must cut its coat according to its cloth, there must be a Department of (10) *Finance*.

The reorganisation of the Civil Service so as to form the ten Departments named in the Committee's report would bring the leaders of national life outside Government circles—the statesmen of industry and commerce—into closer touch with the Government to the advantage of both; just as educators throughout the country already co-operate with their friends at the Board of Education, whom, more and more, they look upon as colleagues who share their interests and spend themselves in the same service. Thus will every walk in life come to be regarded as a branch of public service. Just as the Board of Education is aided by the Teachers' Registration Council as an advisory body, so the joint standing industrial councils that are being established according to the Whitley Committee's report may, before long, become advisory bodies to the new Ministries of Employment, Production, and Supplies.

The reform of the machinery of Government proposed by the Committee would, moreover, render it possible for all the higher officers of the ten Departments to be experts in their respective professions. They would then be better able to work intelligently for a definite purpose than is possible for mere administrators of miscellaneous regulations. We have advisedly stated that *all* the higher staff of each of the new offices should be expert; for the Committee, taking the Board of Education as a model, in many respects, of what the new Departments should be, would apparently be content with expertness on the part of the inspectorate alone. We believe, on the contrary, that the top men inside the new Whitehall offices should be encouraged to spend part of their time outside the office, acquiring intimate personal knowledge of the activities with which their Department is concerned, and of the men who are chiefly responsible for these activities in the country. Insisting, however, as we do, that the Civil Servants of the reformed Departments shall possess expert knowledge, we are far from underestimating the extreme importance of continuing to select only the ablest men for work of the higher division. But we maintain that, unless within a few years of their appointment they show promise of becoming expert in the work of their particular Department, they should be retired from the Service. Able, detached, and serene has been the typical Civil Servant of the past. No less able must be the Civil Servant of the future. Strenuous intellectual discipline must continue to be regarded as a necessary preliminary to entering the higher division of the Civil Service. But, instead of being detached, he must make his work his hobby. He must know his job and love it. "Without passion," said Lord Haldane years ago to the students of Edinburgh University, "nothing great is, or ever has been, accomplished."

Lord Haldane's Committee recognises that a more expert Civil Service would require increased Parliamentary control if the danger of bureaucracy is to be avoided. It suggests that Parliament might retain the necessary control by appointing a series of standing committees, each concerned with the activities of one of the ten Departments. It should, however, be borne in mind that neither this nor any other means of Parliamentary control will be satisfactory unless the *personnel* of the House of Commons is equal to these new duties.[2] In this connection it is well worth considering whether at least half the members of the House of Commons, instead of only the university representatives, should not be elected on an occupational, instead of on a residential, franchise. As a rule, people engaged in the same branch of national service have in these days far more in common with one another, and would take far more interest in a member who represented them in Parliament than the miscellaneous folk whose only link is that they chance to reside in the same neighbourhood.

Lord Haldane's Committee has little to say upon the application of its principle to local government. Since the destruction of School Boards in 1902, most of the functions of local government have been performed by county, county borough, and borough councils, the concern of which is not with any particular group of services, but with particular groups of people. We are far from desiring the resuscitation of the old School Boards, or the establishment of small *ad hoc* bodies for the local control of other services. But we would point out that subdivision of local responsibility for every form of national service, according to borough boundaries, and sometimes according to narrower boundaries still, has an injurious effect upon the efficiency of some of these services quite comparable with that of the present subdivision of responsibility among the different offices in Whitehall. Particularly is this the case with education. The local organisation of education cannot be satisfactorily effected by an authority that is responsible for part only of one complete organism centred in the local university or—as in the case of Manchester and Liverpool—universities. Responsibility for the administration of education throughout such an area might well be entrusted to a department of each of some ten or twelve provincial governments that would be the supreme authorities for the manifold activities of the various minor local authorities in their respective areas. In short, it is as important to apply the principle of Lord Haldane's Committee to local government as to central government. But it will be possible to do so only by enlarging the areas for which the local governments are responsible.

It remains to add that the transition from war to peace, which renders the reorganisation of some of the machinery of Government inevitable, is the proper time for making the further changes recommended by Lord Haldane's Committee. Their need is urgent.

SIR E. C. STIRLING, C.M.G., F.R.S.

THE death on March 20, in South Australia, of Sir Edward Charles Stirling, professor of physiology at the University of Adelaide, and director of the South Australian Museum, deprives Adelaide of one of its best-known figures.

Sir Edward was the eldest son of the Hon.

[2] An article in the *Times* of January 21, corrected on January 24, has pointed out that the new House of Commons contains not one Fellow of the Royal Society who is not either a university member (Sir Joseph Larmor and Sir Watson Cheyne) or a Privy Councillor (Mr. Balfour).

Edward Stirling. He was born in 1848, and his early education was obtained at St. Peter's College, Adelaide. Later he went to Trinity College, Cambridge, where he took honours in natural science. He completed his medical education at St. George's Hospital, where he later occupied the positions of house surgeon, assistant surgeon, teacher of operative surgery, and lecturer in physiology. He became a F.R.C.S. in 1874. In 1877 he married the eldest daughter of the late Joseph Gilbert, of Pewsey Vale, and four years later returned to Australia. Sir Edward's activities in Adelaide, where he spent the remainder of his life, were manifold. For a time he practised surgery, and became a surgeon at the Adelaide Hospital and lecturer in surgery at the University. From 1883 to 1886 he was member for North Adelaide in the House of Assembly. In 1887 he presided over the Section of Surgery at the Second Intercolonial Medical Congress. In 1889 he was president of the South Australia branch of the British Medical Association, and in the following year held the presidency of the Royal Society of South Australia.

Most of Sir Edward's scientific work was published in the period 1888–1902, during which time he wrote several interesting articles for NATURE. His interests were many, and he made important contributions to science in zoology, palæontology, and anthropology. His best-known work was on the marsupial mole (*Notoryctes typhlops*) (1888), on the anatomy of the female organs of generation of the kangaroo (1889), and various important observations on remains found at Lake Callabonna, which were published between 1893 and 1902, and concerned Diprotodon, *Genyornis newtoni*, and *Phascolonus gigas*. In 1894 he accompanied as ethnologist the Horn Scientific Exploration Expedition to Central Australia. He was made a fellow of the Royal Society in 1893, created C.M.G. in the same year, and for his services to science received a gold medal from the Queen of Holland. He was knighted in 1917.

Among the numerous institutions in Adelaide with which Sir Edward was associated there are two that owe much to his energy and ability—the University, where he was lecturer, and afterwards professor, of physiology, and the South Australian Museum, of which he was for many years director. His death will be deeply felt by a wide circle of people who knew him as a vigorous and kindly personality and as a staunch and loyal friend.

C. H. K.

NOTES.

THE *Berliner Tageblatt* announces that Herr Hans Bredow, an engineer who was formerly a director of the Telefunken Co., has been appointed Director-General of the Imperial Postal Department, and at the same time it directs attention to the fact that this is, so far as it knows, the first occasion on which a position held in Germany, as a rule, by lawyers and bureaucrats has been filled by the appointment of an engineer. Whilst it is true that since the institution of the Reichspostamt, on January 1, 1880, as the Imperial Department responsible for posts and telegraphs no engineer has occupied the chief administrative position of Secretary of State (the former title of the permanent head of the Department), on the other hand it has to be borne in mind that technically trained men have, from the earliest days of telegraphy in Germany, held important administrative posts in the Telegraph Department. For instance, the members of the Commission for the Administration of the State Telegraphs, appointed in Prussia in March, 1849, to carry on the telegraph services, consisted of an artillery colonel as chairman, and of an engineer and a postal inspector. In later times many of the important administrative posts in the Reichspostamt have always been held by technically trained men. It can be said generally that on the continent of Europe there has at all times existed a greater appreciation of the technically trained man in the public services than is the case in this country. Many instances could be quoted of engineers holding, on the Continent, the chief administrative positions in the public Departments, such as railways, posts and telegraphs, etc., wherein the work is largely of a technical nature. The example of foreign countries could in this respect be followed with great advantage to the public services in this country.

THE rumours for some time current that Sir Robert Morant was to take the chief post at the new Ministry of Health have proved to be correct. Taking advantage of the approaching retirement of Sir Horace Monro, Permanent Secretary to the Local Government Board, Dr. Addison has appointed Sir Robert Morant an additional Secretary to that Board, and has designated him First Secretary of the Ministry of Health, when formed. Secretary to the Board of Education when the changes rendered necessary by the introduction of school medical inspection were made, and first chairman of the National Health Insurance Commission, Sir Robert Morant seems fated to be called upon to play a prominent part when organisation or reorganisation is needed. That he is well fitted for the task is certain. There are, however, other advantages than those arising from his own qualifications attending the appointment of Sir Robert Morant. Associated with him in his work he is to have Sir George Newman as Chief Medical Officer and Mr. John Anderson as Second Secretary. Both these gentlemen have worked with Sir Robert Morant before, Sir George Newman at the Board of Education, where he was Medical Officer, and Mr. Anderson at the Insurance Commission, where he acted as secretary. It was inevitable, no doubt, that the chairman and secretary of the National Health Insurance Commission and the Medical Officer of the Board of Education should be accommodated at the Ministry of Health, but it is fortunate for Dr. Addison that the holders of these positions should be such men as those named.

THE number of clinical themometers tested at the National Physical Laboratory since the introduction of the Clinical Thermometer Order of October last has this week reached the total of half a million. The equipment for carrying out this work at Teddington has been increased to such an extent that the number of instruments tested per week is considerably in excess of those dealt with in any year under the older conditions for the certification of clinical thermometers. At the present time it is found that the number of clinical thermometers which do not comply with the provisions of the Order amounts to about 4 per cent. of the total received. The proportion, however, varies greatly for the different makers; for one firm, the output of which is large, the average number of rejected instruments has exceeded 25 per cent. for some time past. Further, of the numerous stocks of clinical thermometers which have been received from chemists and stores throughout the country, the number of unsatisfactory instruments falls between 9 and 10 per cent. It is of interest to note that the French Government has recently issued a decree rendering compulsory the testing of all clinical thermometers sold in France. The limits of error adopted are in agreement with those in force in this country, but the French decree very considerably restricts the types of instruments which may be offered for sale.

AT a special general meeting of the Geological Society, held on March 26, the following resolution of council was carried by 55 votes against 12:—"That it is desirable to admit women as fellows of the society." In submitting the motion, Mr. G. W. Lamplugh, president of the society, said:—"It will be within the recollection of most of the fellows that the question of the admission of women to candidature for the fellowship of the society has been raised on more than one occasion in the past. It was considered in 1889 and 1901, and, again, more systematically in 1908–9, when a poll of the fellows was taken and three special general meetings were held, with inconclusive results. It is generally recognised that the course of events since these dates has materially changed the situation. Women have been welcomed to our meetings as visitors, and we have had many examples of their qualifications for fellowship in the excellent papers which they have from time to time contributed to the society. The value of these papers has been appreciated by all geologists, and has been repeatedly acknowledged by the council in its awards. Therefore, in the opinion of the council, it is no longer reasonable to maintain a sex-bar against qualified candidates for the fellowship of the society, and I am empowered by the council to submit the above-mentioned resolution for your consideration."

AT a meeting of the Royal Microscopical Society on March 19 Lt.-Col. Clibborn made a proposition that the society should at once take measures to design and specify the British standard microscope. He suggested that (1) the stand should be designed, not as a concrete whole, but so as to admit the successive additions of other standard parts; (2) all fittings, other than optical, should be standardised; (3) each part should be made of the material best suited to the strains and wear it has to undergo; and (4) the design should aim at simplicity, a balance of the moving body in all positions, perfect rigidity, uniformity of movement round the arc traversed by the moving body, and artistic finish. It should not require clamping. Attention was directed to aluminium-bronze and rubel-bronze as materials more suitable than brass to secure rigidity for the stand; also to die-casting as a means of producing castings in unlimited number, and requiring little or no machinery. The manufacture should be carried out by precision tools and precision grinding to limit gauges, so that all the parts of all instruments would be interchangeable. It is to be noted that in 1916 a committee of the British Science Guild drafted full specifications for six types of microscopes (see Journal of the British Science Guild, January and November, 1916). This does not appear to be referred to by Col. Clibborn.

THE trustees of the British Museum have decided that henceforth for the rest of his official career Mr. C. E. Fagan's title shall be Secretary of the Natural History Departments, British Museum.

WE regret to announce the death on March 29, at eighty-six years of age, of Dr. Henry Wilde, F.R.S., distinguished by his work in applied electricity and other branches of physics.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 8 and 9. On the opening day the Bessemer medal for 1919 will be presented to Prof. Cav. Federico Giolitti, of Turin.

THE Silvanus Thompson memorial lecture of the Röntgen Society will be delivered by Prof. W. M. Bayliss on Tuesday, May 6, at the Royal Society of Medicine. The subject will be "The Electrical Changes in Active Tissues."

ACCORDING to a paragraph in the *Times* Trade Supplement for March 29, the National Council of Scientific and Industrial Research in Canada has proposed, with the approval of the Dominion Government, to establish a Scientific Research Bureau on the lines of the Bureau of Standards at Washington.

AT the annual general meeting of the Chemical Society, held on March 27, Sir James J. Dobbie was elected as president in succession to Sir William J. Pope, Dr. H. J. H. Fenton and Prof. James Walker were elected as vice-presidents, and the new ordinary members of council are Prof. F. E. Francis, Mr. J. Addyman Gardner, Dr. C. A. Keane, and Sir Robert Robertson.

APPLICATIONS are invited by the Royal Society for the two Mackinnon research studentships which are awarded annually for research in (1) astronomy, chemistry, geology, mineralogy, and physics, and (2) anatomy, botany, palæontology, pathology, physiology, and zoology. The scholarships are each of the value of 150*l*. Applications must be received not later than June 1.

SUMMER time in Great Britain came into force on Sunday, March 30, and will continue until the night of September 28–29 next. In Canada a motion to institute summer time this year was defeated in the Dominion House of Commons on March 27, while the British Columbia Legislature has passed a Daylight Saving Bill, operative from March 29. Much confusion must result from these different decisions. The railways of Canada have put summer time into operation, and so have the chief cities and towns, but in rural districts the old standard will be maintained.

WE learn from *Science* that Mr. Secretary Lane has appointed a Commission of mining and metallurgical experts to visit Europe to observe and assist reconstruction methods in the devastated regions of France and Belgium. The members of the Commission are Dr. F. G. Cottrell, chief metallurgist of the U.S. Bureau of Mines (chairman); Mr. G. S. Rice, chief mining engineer of the Bureau; Prof. F. H. Probert, consulting engineer of the Bureau and professor of mining in the University of California; Mr. R. H. Cameron, consulting chemist of the Bureau, and Mr. H. S. Gale, of the U.S. Geological Survey.

IN accordance with the express wish of the late Dr. John Foulerton, his executrix and sole legatee has transferred to the Royal Society 20,000*l*. National War Stock, the interest upon which is to be employed by the president and council in making awards to students, especially younger students, of sufficient amount to enable them to devote themselves, under the supervision and control of the president and council, to original research in medicine, to the improvement of the treatment of disease and the relief of human suffering. All awards are to be subject to the conditions that members of both sexes are to be equally eligible, and that every candidate must show that he or she and his or her father and paternal grandfather are of British nationality; but, subject to these conditions, the awards may be made by the president and council in such manner and upon such terms and conditions as they may from time to time determine at their discretion.

BY the untimely death of M. Jacques Danne, announced in last week's NATURE, science loses one of its earliest workers in radio-activity. M. Danne was associated with Prof. Curie in researches upon the physical properties of radium emanation and the active deposit therefrom; they found the law of decay of the latter when a body is exposed for a long time to the emanation, and recognised that a complex series of events was here in operation. M. Danne was the director of the laboratories at Gif, which are a model of their kind. They consist of a number of small buildings designed to serve the purpose of radio-active research, and to provide the accurate measurements and chemical analyses required in the process of extraction of radium from the crude ore; this latter is carried out in a factory near by. The laboratories possess a library which contains copies of practically all the purely scientific work published upon radium and allied substances. M. Danne was the editor of *Le Radium*, the only journal of its kind dealing with all the aspects of the physical and chemical properties of the radio-active bodies. He was a man of extraordinary energy, and accomplished work of much value in radio-active fields.

A FURTHER paper on the etiology of influenza by the late Major Graeme Gibson, in association with Major Bowman and Capt. Connor (see NATURE, March 13, p. 31), is published in the *British Medical Journal* for March 22, p. 331. The experiments recorded consisted of (1) the inoculation of animals with sputum from cases of influenza, (2) the inoculation of animals with blood from cases of influenza, (3) passage of the virus from animal to animal, and (4) cultural experiments and inoculation of cultures into animals. Of five monkeys inoculated with sputum collected at an early stage of the disease and filtered through a filter-candle, four gave positive results and one was negative. Positive results were also obtained with some rabbits and guinea-pigs, but not with mice. Experiments with blood were not very successful. The pathological lesions in the experimental influenza in the animals closely resembled those seen in the lungs of man. A minute coccoid micro-organism was grown by Noguchi's cultural methods from (*a*) the kidney of infected animals, (*b*) the filtrates of lung-tissue, and (*c*) the filtered sputum from cases of influenza. In view of these findings, the authors conclude that the organism isolated is capable of passing through a filter-candle, and that it is, in all probability, the cause of influenza as seen to-day.

MARCH closed with very wintry conditions over the British Isles, frost and snow occurring generally. During the early hours of Saturday, March 29, the heaviest snowstorm of the winter was experienced. In Scotland railway traffic was delayed, and the fall of snow is said to have been the heaviest experienced for years over the Irish midlands and the west. The snowstorm was due to the passage of a subsidiary cyclonic disturbance up the English Channel. Very heavy snow fell in London from 2.30 to 7 on Saturday morning, the depth amounting to 9 in. in some of the metropolitan suburbs, and at some places in the South of England the depth exceeded a foot. Snow has often fallen later in the winter or spring, and in 1917 much snow fell both in March and April. At Greenwich the latter half of March was 7° colder than the first part of the month. The mean temperature for the whole of March was 40·9°, which is 1° below the average for seventy-five years to 1915. It is 2° colder than March, 1918, but 2·4° warmer than March, 1917. Frost was registered on the grass this year at Greenwich on twenty-four nights, and with only one exception after March 12. The total rainfall for the month measured 2·91 in. (to the evening of March 31), which is exactly double the sixty years' average. The duration of bright sunshine during the month was eighty-nine hours, and there were only six sunless days.

SOME disconcerting possibilities are indicated in some notes by Mr. A. Philpott on birds introduced into Southland, New Zealand, which appear in the *New Zealand Journal of Science and Technology* (vol. i., No. 6). According to the author, in this district the introduced birds are now "much more prominent than the native birds." Some of the latter, he assures us, are still plentiful enough, and will probably continue to hold their own. It is devoutly to be hoped that this surmise will prove to be correct. But the dispossessed species can never be replaced, and they were infinitely the more valuable. Among the introduced species Mr. Philpott makes special mention of the starling, which, we are informed, is a useful bird, but not nearly so plentiful as it used to be. As it seems to be changing its nesting habits, there is a grave danger that a reversal of its rate of increase will in the near future have to be recorded. The Australians have learnt, by bitter experience, the folly of introductions of this kind. There the starling has become a pest, defying all attempts to reduce its numbers.

ANATOMISTS and palæontologists will indeed be grateful for the studies in comparative myology and osteology which Messrs. W. K. Gregory and C. L. Camp have just published in the Bulletin of the American Museum of Natural History (vol. xxxviii., art. 15). Not only have the authors given a very exhaustive account of the muscles of the shoulder girdle and pelvis in a number of reptiles, birds, and mammals, and the homologies of these muscles; they have also essayed the difficult task of reconstructing the musculature of a number of primitive fossil reptiles. Only those who have some practical acquaintance with dissections of this kind can appreciate the immense amount of labour which they must have expended to produce results so striking. A large number of very beautiful diagrams add still further to the value of this work, of which they may be justly proud.

IN the report on the Agricultural Department, Grenada, 1917–18, an account is given of further experiments with a parasitic fungus, *Sporotrichum globuliferum*, on the cacao thrips (*Heliothrips rubrocinctus*). The trees were sprayed with a powdered mixture of flour and fungus-spores suspended in water in the proportion of from 20 to 60 grams of the powder to 3½ gallons of water. The observations are not yet complete, but the experiment has demonstrated (1) that the fungus was readily distributed amongst thrips in the field, (2) that under favourable conditions of atmospheric humidity the fungus caused the death of large numbers of both young and adult thrips on the inoculated trees, and (3) that the fungus spread by natural agencies to trees outside the inoculated area. It remains to be determined whether adequate control of thrips can be secured by the use of this fungus, and how far the activity of the fungus is limited by climatic conditions; there is also the question as to the economic production of inoculating material in quantity.

A SEVERE earthquake was felt over eastern Bengal and Assam, most of Burma, and in north-east India as far west as Lahore on July 8, 1918. Capt. Murray Stuart, who has investigated the earthquake on behalf of the Geological Survey of India, has published an interesting summary of his results (Records Geol. Surv. India, vol. xlix., 1918, pp. 173–89). Without preliminary warning, the earthquake occurred at about 3.50 p.m. (Indian standard time), at a time when most people were out of doors, so that the loss of life was exceedingly small. The epicentral area lies some hundred miles to the south-east of that of the great Assam earthquake of 1897, the centre of this area being in the Balisera Hills, about 3½ miles south of the railway at Srimangal. Nearly all brick buildings were destroyed in the area of greatest intensity, but no fault-scarps were formed, though there was much shifting and fissuring of the surface material and ejection of water and sand. Making use of Dutton's well-known method, Capt. Stuart estimates that the focus was at a depth of eight or nine miles.

IN an article on the progressive desiccation of Africa in the *South African Journal of Science* (vol. xv., No. 3) Mr. E. H. L. Schwarz discusses at length the various hydrographical systems of that continent. Certain engineering works are proposed which the author believes would have a beneficial effect on South Africa. One is a dam across the Cunene River below Kinga, in Angola, some 250 miles from the coast; the other is a dam across the Selinda River or the Chobe River a few miles above its confluence with the Zambesi. These weirs would restore to Lake Ngami its old area, fill up the Etosha pan, and inundate much of the Makarikari depression. This, Mr. Schwarz believes, would result in a greater general humidity which would have the effect of bringing rain to the Kalahari desert; otherwise he foresees desert conditions gradually spreading through South Africa. Possibly Mr. Schwarz takes an unduly pessimistic view of the future of the country, and all authorities do not agree with him in his contention that the agricultural conditions in the Karroo have changed for the worse within recent times. It is open to argument whether the creation of such an immense inland lake would have the desired effect in modifying the climate, even if the scheme were practicable, but the paper is valuable for the facts it contains and the important issues which it raises.

A QUANTITATIVE examination of the relation of rainfall to configuration in certain localities of the British Isles has been made by Mr. Carle Salter, and was the subject of a lecture to the Institution of Water Engineers. The paper is now published by the institution as a separate pamphlet. Rainfall may be classed as convectional, cyclonic, or orographical. The first two types are only slightly affected by configuration of the land, but an examination of a rainfall map of the British Isles shows that orographical rains predominate in the course of the year. In winter orographical rains are most frequent, and in summer their influence, while apparent, is not so well marked. Unfortunately, no records exist of the average amount of rain which falls annually over the sea in the neighbourhood of the British Isles. Records of this nature, if available, would give a measure of the amount of non-orographical rain which falls over the land generally. An examination of data from stations near sea-level shows that elevations of only a few feet affect the amount of rainfall. The rate of increase per 100 ft. of altitude varies within wide limits. It is lower on slopes parallel to the prevailing winds than on slopes at right angles. On fairly steep ridges close to the sea the maximum rainfall often occurs slightly on the leeward side of the crest. These and other cases Mr. Salter discusses at length with a wealth of illustration from the records of the British Rainfall Organisation. It is unnecessary to point out the great importance of researches of this nature in relation to problems of water-supply.

THE evidence of complete combustion of coal is to be sought in the flue-gases. According to the *Coal Age* for November 21 last, these gases, when the combustion of the coal is complete, consist in part of carbon dioxide, of which there should be not less than 16 per cent. When the flue-gases show by analysis less than that percentage, too much air has been allowed to pass through the furnace. Even if we admit one-third more air into the fire-box than is theoretically necessary for complete combustion, the escaping gases should contain from 20 to 22 per cent. of carbon dioxide. In practice every pound of coal burned requires for its complete combustion 200 cu. ft. of air. When burned under such conditions, a pound of coal should develop 13,000 B.Th.U.

IN a paper read to the Institution of Electrical Engineers on February 27 Drs. Barclay and Smith discussed the determination of the efficiency of the turbo-alternator. The American Institution of Electrical Engineers gives a conventional theoretical method of computing the losses, but it is known in certain cases to lead to very erroneous results. The authors have found out, by experiments carried out at Messrs. Vickers's works, that the alternator losses can be determined conveniently and accurately under actual load conditions by measuring the amount of heating undergone by the air used for ventilating the alternator to keep it cool. The method is practically the same as that described by Sir Richard Threlfall to the institution in 1903. The main improvements lie in the methods of measuring the quantity and temperature of the air. In the discussion we were surprised to hear that the "stray losses"—that is, the losses not taken into account in the usual conventional way of testing—sometimes amounted to 40 per cent. of the total losses. We should have thought that the cause of this must be fairly self-evident.

A COAL meter for boilers, made by the Lea Recorder Co., Ltd., of Manchester, is described in the *Engineer* for March 14. This meter is intended for boilers fitted with chain-grates. The amount of fuel passing under the fire-door depends upon the depth, *i.e.* the thickness of the fire, and the velocity of the fire-grate, and both these variables are taken into account by the mechanism of the meter, which somewhat resembles that of the well-known **V**-notch recorder for water measurement made by the same firm. Tests have been made at the works of Messrs. Browett and Lindley, and are said to be satisfactory. The makers give a guarantee of accuracy to within 5 per cent.

AN illustrated article in *Engineering* for February 28 gives an account of submarines built for the British Navy during the war by Messrs. Vickers. Fifty-four boats in all were built and commissioned in a period of fifty-one months; of these the details of the K type are specially interesting. These vessels have a submerged displacement of 2570 tons, and are 339 ft. long by 26 ft. 8 in. beam. The double-hull principle is embodied in a modified form. The speed is twenty-four knots on the surface, the power being obtained from twin sets of geared steam turbines, which develop a shaft horse-power of 10,500. Steam is obtained from two boilers of the Yarrow type, working at 235 lb. per sq. in. The turbine machinery is supplemented by an 800-brake-horse-power heavy oil engine of the Vickers submarine type, which is coupled to a dynamo of the open single-armature design. The turbines are reserved for higher speeds only, whilst the dynamo, in addition to charging batteries, supplies the main motors with power for cruising at economical speeds. For submerged work the motors develop a total horse-power of 700 per shaft, and give a speed of nine knots. The motors drive the shafts through helical gearing. The storage battery for the use of the motors is divided into three groups of 112 cells per group.

THE following works are in the press for publication by the *Carnegie Institution of Washington*:—"The Cactaceæ: Descriptions and Illustrations of Plants of the Cactus Family," N. L. Britton and J. N. Rose, 4 vols., vols. i. and ii.; "A Biochemic Basis for the Study of Problems of Taxonomy, Heredity, Evolution, etc., with Especial Reference to the Starches and the Tissues of Parent and Hybrid Stocks, and to the Starches and the Hemoglobins of Varieties, Species, and Genera," E. T. Reichert; "A Biometric Study of Basal Metabolism in Man," J. A. Harris and F. G. Benedict; "Distribution of Vegetation in the United States, as Related to Climatic Conditions," B. E. Livingston and F. Shreve; "The Ecological Relations of Roots," J. E. Weaver; and "The Carbohydrate Economy of Cacti," H. A. Spoehr. *Mr. Edward Arnold's* latest announcements include the concluding volume of "Principles of Electrical Engineering and their Application," Prof. G. Kapp; "Air Navigation: Notes and Examples," Capt. S. F. Card; "Tacheometer Tables," Prof. H. Louis; and a revised and enlarged edition of the translation, by Dr. G. W. O. Howe, of Dr. A. Thomälen's "Text-book of Electrical Engineering." *Messrs. Hodder and Stoughton* are publishing "Automobile Repairing made Easy," Capt. V. W. Pagé, and a new edition of the same author's "The Modern Gasoline Automobile: Its Design, Construction, and Operation." *Messrs. Crosby Lockwood and Son* promise "Aeroplane Construction," S. Camm; "Oils, Fats, and Waxes," Dr. G. Martin; "Streamline Kite Balloons," Capt. P. H. Sumner; "The Engineer's Year-Book for 1919"; and a revision, by H. H. P. Powles, of "Clark's Mechanical Engineer's Pocket-Book." *Messrs. Gauthier-Villars et Cie* (Paris) have in preparation part iii. of Prof. E. Rothé's "Cours de Physique," dealing with "Aérodynamique"; vol. iii. of "Œuvres d'Halphen" is in the press for appearance with the same publishers, and vol. iv. is in preparation.

OUR ASTRONOMICAL COLUMN.

COMET 1914*c* (NEUJMIN).—A definitive orbit of this comet is contained in Publication of the Stockholm Observatory, vol. x., No. 6. The comet was discovered on 1914 June 24 by M. Neujmin, of the Simeis Observatory, Crimea, and fifty-one observations on thirty-six nights between that date and December 22, the majority of which were made at Mount Hamilton and Vienna, have been used to determine its orbit. The points that specially call for remark are that the orbit is hyperbolic, the eccentricity being 1·00367 ± 0·000296, and that the perihelion distance is exceptionally large—3·747. In spite of the fact that the arc of the orbit comprehended in the investigation is only 33° or 34°, the author, Mr. John Svärdson, is satisfied that the hyperbolic character of the orbit is real. The large perihelion distance is equalled only by the comet of 1729, and there are other resemblances between the orbits of the two comets—a fact which had been previously noticed. The elements found by Mr. Svärdson are given below with those of the comet of 1729 for comparison.

	1914*c*	1729
T =	1914 July 30·158 Berlin M.T.	1729 June 13 27 Paris M.T.
ω =	14° 2′ 12·5″	9° 53′ 22″
☊ =	270° 18′ 26·7″	310° 38′ 0″
i =	71° 2′ 18·4″	77° 5′ 18″
q =	3·747131	4·043496
e =	1·003672	1·0050334

COMET 1915*a* (MELLISH).—Stockholm Publication No. 5 (vol. x.) contains a definitive orbit of this comet by Mr. Rosenbaum. The orbit seems to be hyperbolic, eccentricity 1·000235, but the author is not satisfied that this is real. It may be remembered that in the middle of May the comet was observed to have two nuclei visibly separated, and Mr. Rosenbaum suggests that it is necessary to treat the observations before and after the disruption as distinct orbits.

THE CEPHEID VARIABLES.—The characteristics of the variable stars of which δ Cephei is the type furnish a problem which is occupying many minds: (1) Their variation is regular and continuous, and the rise to maximum is usually more rapid than the fall to minimum; (2) they show variation of radial velocity with the period of the light changes; (3) their spectral class varies with the period, advancing towards M as the period is longer, and also with the light variation, the stars being redder at minimum than at maximum; and (4) the period of light variation has a marked correlation with the mean absolute magnitude of any star. It is found difficult to propound a hypothesis that will account for these and other characteristics. There is good reason for thinking that the Cepheids are not binary stars. It has been suggested that they are rotating bodies hotter and brighter on one side than on the other, but this fails to fit the facts, and a third hypothesis, known as the pulsation theory, which supposes that the Cepheids are gaseous bodies alternately expanding and contracting is now under discussion. The Monthly Notices of the R.A.S. for November and January contain a thermo-dynamical investigation of this theory by Prof. Eddington, who discusses successfully the initial difficulty that the dissipation of energy would not permit the action to continue, and concludes that the hypothesis leads to results in agreement with observation in respect of (1) the absolute value of the period, which can be determined theoretically with small uncertainty; (2) the correlation of spectral type with absolute magnitude; and (3) the asymmetric form of the velocity curve.

WAR WORK OF BRITISH CHEMISTS.

THE anniversary dinner of the Chemical Society was held at the Connaught Rooms on March 27, Sir William J. Pope presiding. In proposing the toast of the Chemical Society, Lord Moulton stated that our real enemy in the war was Germany—the nation that had devoted itself *par excellence* to chemistry. Germany did not declare war until her installations for the production of ammonia and of nitrates in vast quantities were complete. Emboldened by the enormous preparation made for the supply of munitions, by the advances made in artillery, and by the decision to use poisonous gases, Germany thought she had but to strike a heavy blow and world-supremacy was hers. Lord Moulton then contrasted Germany's state of preparedness in 1914 for the production of munitions with that of England. Chemists were justified in claiming that it was they who had had to resist Ger-

European war + science

many, and it was marvellous to think that, owing to their response, by the time the war was at its height England was Germany's equal, if not her superior, in chemical warfare. The nation must not again be cut off from the essential means of defence, for the possibilities of war must always be remembered. To the chemist the future prospects are limitless; the discovery of new substances, the shortening of processes, economy—all these lie in his hands. The Chemical Society is doing valuable work because it exists for the general advancement of chemical science. Lord Moulton then referred to the valuable services rendered to the country by Sir William Pope in the problems connected with explosives, in the production of poisonous gases, and in the realm of photography.

In replying, Sir William Pope stated that the society numbered some 3500 members, and though it was nearly eighty years of age, it was not the age of decrepitude. It was still prepared to produce new methods for stimulating scientific work and scientific effort. He referred to Lord Moulton as the greatest chemical manufacturer of this or any other day, and chemists feel honoured at having been made an essential part of the stupendous weapon for destruction in the forging of which Lord Moulton had played so large a part. All the resources of science had been utilised in the war without scrutiny of cost, and the result had been worth the expenditure. Unless the same resources are used in the struggle before us to develop and promote, not only applied, but pure science, then our country will fall behind. It lies with our leaders to determine to what extent science will exist in the coming great wave of intellectual and material progress throughout the world. The nation must be prepared to pour out treasure into our educational establishments for securing the potential young energy of the country and of directing it into scientific channels, and money must be poured into our universities and colleges to stimulate scientific research. Whether it be pure or applied knowledge, the dividend paid will be enormous. The great object we have in view is the increase of human knowledge, and this can be achieved only by the expenditure of large sums of money.

Prof. H. E. Armstrong, in proposing the toast of "Our French Colleagues," referred to previous exchanges of courtesies between French and English chemists, and whilst this was the first time that the French Chemical Society had been officially represented at our anniversary dinner, he hoped that it would become a regular practice in the future. In replying, Dr. C. Poulenc expressed the great pleasure felt by himself and his colleagues in being invited to take part in the first public function held by the Chemical Society since 1914, for they realised that such an invitation set yet another seal on the bond of sympathy existing between the two nations.

The president then proposed "His Majesty's Forces," to which Lt.-Gen. Sir W. T. Furse, Master of the Ordnance, made acknowledgment.

Sir James J. Dobbie, president-elect, in proposing the toast of "The Guests," referred to the pleasure the society felt in seeing such a representative gathering of guests, and though it might seem difficult to bring them all into one toast, owing to the interests they represent being so diverse, the chemist had been closely associated with them all during the period of the war. The Right Hon. Herbert A. L. Fisher, in responding for the Board of Education, referred to the place of science in national education. Though we had arrears to make up and wanted more money, more teachers, and more learners for science, in the main the battle had been won. He was of the opinion that unless the country was provided with a large and generous scheme of education, a number of talents which might be educated to a high pitch of accomplishment would be lost. Unless the community realises that science has its message, its value, that it ought to be encouraged, and that no money spent on science is wasted, science will never be in a satisfactory and wholesome condition. Sir Aston Webb replied for Art, and Sir J. J. Thomson for Science.

ENERGY TRANSMISSION.

TWO or three years ago a Rumanian engineer, Mr. Constantinesco, brought to this country a remarkable new method of transmitting energy. A pipe filled with water or a similar fluid is used. Vibrations of the nature of sound-waves are produced mechanically at one end of the pipe, and the energy of these is recovered at the other end as mechanical energy. As there is no general movement of translation of the mass of fluid, little is lost and the efficiency of transmission is high. The energy recovered can be applied to any mechanical operation. The method has been said to be an alternative to electrical transmission, and, in a sense, this is true. Certainly it will find a field in which it will compete with other modes of doing work at a distance.

Researches have been going on during the war, and many devices have been perfected. But it has been necessary to observe secrecy as to what has been done and what is contemplated. It is known that one important invention made possible by the Sonic system of transmission is the C.C. synchronising gear on aeroplanes, which arrests the action of a machine-gun while a propeller-blade is in the line of fire, so that 2000 bullets per minute can be discharged through a propeller revolving at 1000 to 2000 r.p.m.

From a statement in the *Times* of March 27 it appears that works have been established at West Drayton by the Government which will serve as a laboratory to enable Mr. Constantinesco to develop his inventions. These works were recently visited by Queen Mary, the Queen of Rumania, and a distinguished company, who followed with great attention a demonstration of the applications of the new system to various industrial purposes. Although little has so far been made public, it is known that Mr. Constantinesco has shown remarkable ingenuity and patience in devising means for applying the Sonic system to industrial operations, and he has accomplished enough to prove that his method is of the highest possible interest.

THE PROBLEM OF RADIO-ACTIVE LEAD.[1]

II.

IT appears, then, that 206, the value pertaining to uranium-lead, is a very reasonable value.

But, as has been repeatedly pointed out, ordinary lead, constituting the vast bulk of the lead in the world, has without doubt a much higher atomic weight, 207·2, not to be expected from either of the lines of reasoning just given. In order to test the uniformity of this circumstance, Baxter, with the help of one of his assistants, investigated ordinary lead from non-uraniferous ores from many parts of the world, and discovered that the constancy of its quantitative behaviour is as striking as that of copper or silver. His figures agreed very closely, within the limit of error of experimentation, with those obtained as a part of the present comparison of the two kinds

[1] Presidential Address to the American Association for the Advancement of Science, Baltimore, December, 1918, by Prof. Theodore W. Richards. Continued from p. 78.

of lead, so that there could be no question as to lack of identity of methods or precautions.

Before leaving the subject of the relative atomic weights of these two types of lead, it is not without interest to note the exact absolute weights of the atoms. If, as we have excellent reason for believing on the basis of the brilliant work of Prof. R. A. Millikan, a so-called gram-atom (the atomic weight in grams) contains 606·2 sextillion actual atoms, the weights of the atoms of the two kinds of lead must be respectively 342 and 340 septillionths of a gram. Their extreme smallness as regards bulk may perhaps best be inferred from the consideration that the smallest object visible as a point in the common microscope has a diameter probably about one thousand times as great as an atom of lead.[2]

Evidently, on the basis of the quantitative results just exhibited, we must admit that there is at least one real difference between radio-active lead and the common metal. Are there other differences?

A question as to the density of each substance, and therefore as to the bulk occupied by the respective atoms, at once arises. Since the atom of uranium-lead weighs less than the other, it must occupy less space, supposing that it has the same density; or else it must have less density, supposing that it should occupy the same space. The identity of the chemical behaviour of the two types of lead suggests the probability of the latter alternative, and this was, therefore, assumed by Soddy; but experimental proof was evidently desirable. Therefore an extended investigation of the density of the various kinds of lead was carried out likewise in the Gibbs Memorial Laboratory. As a matter of fact, the densities of the several specimens were found to be very nearly proportional to their atomic weights; that is to say, the bulk of the atom of radio-active lead is almost exactly the same as the bulk of the atom of ordinary lead, although the weights of these atoms are so markedly different.

Densities and Atomic Volumes.

	Atomic weight	Density	Atomic volume
Pure uranio-lead ...	206·08	11·273	18·281
Australian mixture ...	206·34	11·289	18·278
Pure common lead ...	207·19	11·337	18·277

A distinctive property of elementary substances, which has always been supposed to be concerned more or less definitely with the atomic weight, is the spectrum, depending upon the wave-lengths of light emitted by the vapour. But, surprisingly enough, the spectrum lines produced by these two sorts of lead, when heated to the high temperature of the electric arc, are so precisely alike, both as to their wave-lengths and their intensities, that no ordinary spectrum analysis shows any difference whatever. This has been proved by careful experiments at Harvard and elsewhere. A and B were from two different specimens of radio-active lead, C from ordinary lead, all very carefully purified. The range covered is about from 3000 to 2000 wave-length—far in the ultra-violet. Very recently Prof. W. D. Harkins, of Chicago, and two assistants have detected, with a very extended grating spectrum, an exceedingly minute shift (0·0001 per cent. of the wave-length—an amount far too small to be shown by the spectra exhibited) of one of the lines. The wonder is, not that there should be a difference, but rather that they should be so very nearly identical. Evidently the very considerable difference in the atomic weight produces only a barely perceptible effect on the wave-lengths of light emitted by the several isotopic forms of a given element, although a less difference in atomic weight between two different elements (for example, cobalt and nickel) is concomitant with utterly divergent spectra.

Another very interesting question, involving the relations of substance both to light and to weight (or rather density), is its refractive index. All the formulæ relating to molecular refraction involve the *density* of the substance concerned. In the case under consideration, do the differing weights of the atoms, and therefore the differing densities of the same compounds of the two kinds of lead, affect the refractive indices of the salts? Is the refractive index of a given salt of radio-lead identical with that of the same salt of ordinary lead? Evidence on this point would go far to decide whether density or atomic volume is the more important thing in determining refractive index. A very careful study carried out with the help of Dr. W. C. Schumb at Harvard has, within the past few months, shown that, as a matter of fact, the refractive index of ordinary lead nitrate is identical with that of the nitrate of uranium-lead within one part in nearly twenty thousand—a result which shows that density is a less important factor in determining refractive index than had been previously assumed.

Both these conclusions concerning light—that drawn from the spectra and that drawn from the refractive indices—have a yet more far-reaching interest, for they give us a further clue as regards the innermost nature of the atom. That part of the atom which determines its weight seems to have, at least in these cases, very little effect on that part of the atom which determines its behaviour towards light.

Immediately connected with the question of density of the solid salts is the question as to the densities of their saturated solutions, as well as to the extent of saturation. Fajans and Lembert had recently obtained results probably indicating that the molecular solubility of each kind of lead is the same, and that the densities of the solutions are different, the density of the radio-lead solution being less to an extent consistent with its smaller molecular weight. These results, however, left much to be desired in the way of accuracy, and needed verification. Therefore, a very careful investigation, begun at Harvard with the assistance of Schumb, before the appearance of Fajans's publication, furnished valuable knowledge on this point.

Solubility of Two Kinds of Lead Nitrate.[3]

	Common lead	Uranium-lead
Per cent. salt in saturated solution (25·00°)	37·342	37·280
Grams lead per 100 grams water	37·281	37·130
Molecular solubility per 1000 grams water	1·7993	1·7989

Here, again, differences in weight alone are manifest, and these are proportional to the differences in the atomic weights; the molecular behaviour is essentially identical in the two sorts. Hence a difference in density between the two solutions must exist, exactly consistent with the difference in the atomic weights.

The identity in solubility might also be inferred from the impossibility of separating the two kinds of lead from each other by fractional crystallisation. This was predicted by Soddy, and tested by him and by others. Various vain attempts have been made to separate the different kinds of lead from one another,

2 If the smallest object visible in a microscope could be enlarged to the width of this printed page, the atoms in it would appear about the size of the dots on the letters *i*, or the periods, in the type above.

3 The uranium-lead used in these determinations was a specimen from Australia having the atomic weight 206·41, not quite like the earlier sample, but not different in important degree.

but apparently when once they are mixed no chemical method can separate them, since the properties of the different kinds are so nearly alike. The latest attempt at the Gibbs Memorial Laboratory involved one thousand fractional crystallisations of the Australian lead nitrate, which is believed to contain both ordinary and uranium-radium lead. The extreme fraction of the crystals (representing the least soluble portion, if any difference in solubility might exist) gave within the limit of error the same atomic weight as the extreme fraction of the mother liquor (representing the most soluble portion), thus confirming the work of others in this direction.

When wires constructed of two different metals are joined, and the junction is heated, an electrical potential or electromotive force is produced at the junction. This property seemed, then, to be a highly interesting one to test in order to find out how great may be the similarity of the two kinds of lead. In fact, wires made of radio-active lead and ordinary lead tested in the Gibbs laboratory gave no measurable thermo-electric effect, the wires acting as if they were made of the same identical substance, although the atomic weights and densities were different. No other known case of this sort is known, so far as I am aware. The melting points of the two kinds of lead were likewise found, with the assistance of N. F. Hall, to be identical within the probable accuracy of the experiment.

Let us bring all these results together into one table, so that we may better grasp their combined significance.

Summed up in a few words, the situation appears to be this: At least two kinds of lead exist—one, the ordinary metal disseminated throughout the world, in non-uraniferous ores; another, a form of lead apparently produced by the decomposition of uranium, radium being one of the intermediate products. If we leave out of consideration the probably inessential difference in radio-activity, the two kinds are very closely, if not exactly, alike in every respect excepting atomic weight, density, and immediately related properties involving weight, such as solubility. Thorium-lead appears to be a third variety, with similar relations. Shall we call these substances different elements, or the same? The best answer is that proposed by Soddy, who invented a new name and called them "isotopes" of the same element.

Comparison of Properties of Different Kinds of Lead.[4]

	Common lead A	Mixture (Australian) B	Uranio-lead C	Percentage difference A–B	A–C
Atomic weight	207·19	206·34	206·08	0·42	0·54
Density	11·337	11·280	11·273	0·42	0·56
Atomic volume ...	18·277	18·278	18·281	0·01	0·02
Melting point (absolute)	600·53	600·59	—	0·01	—
Solubility (metal as nitrate)	37·281	37·130	—	0·41	—
Refractive index of nitrate	1·7815	1·7814	—	0·01	—
Thermo-electric effect	—	—	—	0·00	—
Spectrum wave-length	—	—	—	0·00	0·00

Since every new fact concerning the behaviour of the elements gives a new possible means of discovering something about their nature, and since these facts are of an especially significant kind, the anomaly is of more than passing interest, and may be said to constitute one of the most interesting and puzzling situations now presented to the chemist who looks for the deeper meanings of things.

[4] For the sake of better comparison, the values given are all those found at Harvard, since they all involved nearly the same material. The results of experiments elsewhere, so far as they cover the same ground, are essentially identical.

Many new queries arise in one's mind from a study of the data. Among them is a question as to the nature of ordinary lead, which possesses a less reasonable atomic weight than the radio-active variety. Why should this state of things exist?

Ordinary lead may be either a pure substance or else a mixture of uranium-lead with lead of yet higher atomic weight, perhaps 208. The latter substance might be formed, as Soddy points out, if thorium (over 232) lost six atoms of helium, and he and Hönigschmid have found quantitative evidence of its existence in thorium minerals.

After reviewing all the data, Prof. F. W. Clarke has brought forward an interesting and reasonable hypothesis explaining the difference between the several kinds of lead. He points out that, whereas we have every reason to believe that uranium- and thorium-lead are the results of disintegration of heavier atoms, ordinary lead may be imagined to be the product of a far earlier synthesis or evolution from smaller atoms. The hypothesis might be supported by the analogy of the synthesis and decomposition of organic substances, which by no means always follow similar paths; it seems to be consistent with most, if not all, of the facts now known.

On the other hand, may not the uniformity of ordinary lead and its difference from either of the radio-active leads be almost equally capable of interpretation in quite a different fashion? Whenever, in the inconceivably distant past, the element lead was evolved, it is scarcely to be supposed that uranium-lead and thorium-lead could have been entirely absent. The conditions must have been chaotic and favourable to mixture. When the two or more forms were mixed, none of the processes of Nature would separate them. Therefore they must appear æons afterwards in an equably mixed state on earth, constituting our ordinary lead. There may have been more than two forms of lead; but two forms, one possessing an atomic weight 206, and the other an atomic weight above 208, would account for all the facts. The identity in nature of all the common lead on earth might indicate merely that at one time all the matter now constituting the earth was liquid or gaseous in violent agitation, so that all the kinds of lead were thoroughly commingled before solidification. This explanation, if it could be confirmed, would furnish important evidence concerning the early history of planets. So far afield may a difference in weight amounting to two units in the twenty-fourth decimal place, between two kinds of atoms so small as to be far beyond the possible range of our most piercing means of actual observation, carry the inquiring investigator!

The true answers to these questions are not to be found by speculation such as that just detailed, however suggestive such speculation may be. They are to be found by careful observation. For example, the doubt as to the nature of ordinary lead can be decided only by discovering whether or not it may be separated into two constituents. Since weight (or mass) is the quality distinguishing between the several isotopes or kinds of lead, weight (or mass) must be made the basis of separation. Hence the only hope of separating isotopes of lead lies in the method of fractional diffusion, as has been already suggested by many other experimenters on this subject. Promising preliminary experiments preparatory to such an undertaking have already been begun at Harvard, and before long more light may be obtained.

The idea that other elementary substances also may be mixtures of two or more isotopes has been advanced by several chemists. Especially if ordinary lead should really be found to be thus complicated, many, if not all, other elements should be tested in the same way. The outcome, while not in the least affecting our table of atomic weights so far as practical purposes are concerned, might lead to highly interesting theoretical conclusions.

How can such remote scientific knowledge, even if it satisfies our ever-insistent intellectual curiosity, be of any practical use? Who can tell? It must be admitted that the relationship is apparently slight as regards any immediate application, but one can never know how soon any new knowledge concerning the nature of things may bear unexpected fruit. Faraday had no conception of the electric locomotive or the power plants of Niagara when he performed those crucial experiments with magnets and wires that laid the basis for the dynamo. Nearly fifty years elapsed before his experiments on electric induction in moving wires bore fruit in a practical electric lighting system; and yet more years before the trolley-car, depending equally upon the principles discovered by Faraday, became an everyday occurrence. At the time of discovery, even if the wide bearing and extraordinary usefulness of his experiments could have been foreseen by him, they were certainly hidden from the world at large.

The laws of Nature cannot be intelligently applied until they are understood, and in order to understand them many experiments bearing upon the fundamental nature of things must be made in order that all may be combined in a far-reaching generalisation impossible without the detailed knowledge upon which it rests. When mankind discovers the fundamental laws underlying any set of phenomena, these phenomena come in much larger measure than before his control, and are applicable for his service. Until we understand the laws, all depends upon chance. Hence, merely from the practical point of view, concerning the material progress of humanity, the exact understanding of the laws of Nature is one of the most important of all the problems presented to man; and the unknown laws underlying the nature of the elements are obviously among the most fundamental of these laws of Nature.

Such gain in knowledge brings with it augmented responsibilities. Science gives human beings vastly increased power. This power has immeasurably beneficent possibilities, but it may be used for ill as well as for good. Science has recently been blamed by superficial critics, but she is not at fault if her great potentialities are sometimes perverted to serve malignant ends. Is not such atrocious perversion due rather to the fact that the ethical enlightenment of a part of the human race has not kept pace with the progress of science? May mankind be generous and high-minded enough to use the bountiful resources of Nature, not for evil, but for good, in the days to come!

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BRISTOL.—In the university courses for training engineers in the United States and Germany a certain amount of business training is given, with the result that in these countries there are many more engineers directing and administering engineering concerns than is the case in Great Britain. At the suggestion of the Dean of the faculty of engineering of the University, Dr. Wertheimer, the Senate has now decided that in future the curriculum for the B.Sc. degree shall include attendance at a course dealing with book-keeping, methods of administering and organising works, elements of commercial law, depreciation, estimating, costing, and the writing of specifications.

CAMBRIDGE.—Major H. McCombie, lecturer in chemistry in Birmingham University, has been elected to a fellowship at King's College.

LEEDS.—The council of the University has accepted with regret the resignation of Dr. C. Lovatt Evans, professor of experimental physiology and experimental pharmacology, who is leaving the Leeds Medical School at the end of June next in order to undertake research work in the Department of Pharmacology and Biochemistry of the Medical Research Committee.

LONDON.—Capt. J. R. Partington has been appointed as from April 1, 1919, to the newly established University chair of chemistry tenable at East London College. In 1910 Capt. Partington was elected Beyer research fellow of the University of Manchester, and in 1911 he was awarded an 1851 Exhibition scholarship. From 1911 to 1913 he studied under Profs. Nernst and Planck at Berlin. In 1913 he was appointed assistant lecturer and demonstrator in chemistry at Manchester, and, having served in the Army from 1914–16, he was recalled to take charge of research in the Ministry of Munitions Inventions Department. His principal publications are "Higher Mathematics for Chemical Students" and "A Text-book of Thermodynamics."

It can now be announced that the anonymous donor who in 1911 presented to the University the sum of 30,000*l.* for the erection of a school of architecture, a department of eugenics, and sculpture studios at the college is Sir Herbert H. Bartlett, Bart. The School of Architecture and the Department of Eugenics have been already completed, and the Sculpture Studios, towards the cost of which Sir Herbert Bartlett has presented an additional sum of 1000*l.*, will be put in hand immediately.

An offer by Mr. G. S. Baker of 500*l.* for the foundation at University College of a prize for the encouragement of botanical research to be named after his daughter, the late Dr. Sarah M. Baker, an old student and member of the staff of the college, has been accepted by the Senate with thanks.

Owing to ill-health, Prof. Vaughan Harley has resigned the chair of pathological chemistry, which he has held for twenty-three years.

The degree of D.Sc. in biochemistry has been conferred on Mr. E. C. Grey, an internal student, of the Lister Institute of Preventive Medicine, for a thesis entitled "The Enzymes of *B. coli communis.*"

MR. A. P. MCMULLEN, senior science master, Royal Naval College, Dartmouth, has been appointed Adviser on Education, Admiralty.

THE *Pharmazeutische Zeitung* reports the following changes in German botanical chairs:—Prof. Ludwig Jost, of Strasburg, succeeds at Heidelberg Prof. G. Klebs, who died last October in his sixty-first year, and Dr. W. Ruhland, of Halle, succeeds Prof. von Vöchting at Tübingen.

IT is announced in *Science* that the Carnegie Corporation of New York has voted a grant of 100,000*l.* to the Medical Department of Queen's University, Kingston, Ont. This grant is related to that in the will of Dr. James Douglas, New York, and is conditional on an additional 100,000*l.* being raised.

THE committee of the Summer School of Civics and Eugenics has arranged to hold its second school in August next, during the first two weeks. The centre selected for the meeting this year is Cambridge. The programme will fall into two portions, the first week being devoted to a preparatory course dealing with the scientific bases of educational and social work, and the lectures of the second week with special applications of civics and eugenics to the work of the teacher and social worker respectively. All communications should be addressed to the Secretary, Summer School of Civics and Eugenics, 11 Lincoln's Inn Fields, London, W.C.2.

There are about to be submitted to the Senate of the University of London, in the interests of demobilised officers and men, of released war-workers and other persons, proposals for starting next session within the University a special two years' course of comprehensive study for intending journalists, and for instituting a University diploma in journalism to be awarded after examination to students taking the special course. The proposals have been drafted by a committee formed of leading members of the University of London under the chairmanship of Sir Sidney Lee, Dean of the faculty of arts, in conference with the chief officers of the Institute of Journalists and representatives of the Appointments Department of the Ministry of Labour and of the Board of Education. Persons interested in the matter are invited to communicate, by letter only, with Sir Sidney Lee at the University of London, South Kensington, S.W.7, and to place the words "Courses for Journalists" on the outside of the envelope.

SOCIETIES AND ACADEMIES.

London.

Royal Society, March 20.—Sir J. J. Thomson, president, in the chair.—Dr. C. **Chree**: Magnetic storms of March 7–8 and August 15–16, 1918, and their discussion. The storms were of the same general type as one which occurred on December 16–17, 1917, and was discussed in a previous paper; but, unlike the previous storm, they both had conspicuous S.C.'s ("sudden commencements"). The movements constituting the S.C. on August 15–16 were unusually large, and their oscillatory character was very prominent at Agincourt and Eskdalemuir. In both cases, as in the storm of December, 1917, disturbance was much larger at Eskdalemuir than at Kew, especially in the vertical force. The declination changes at the two places showed rather a close resemblance, but the variations in the other elements differed at times not merely in amplitude, but also in general character. The disturbance at Agincourt on March 7–8 was similar in intensity to that at Eskdalemuir, but conspicuously different in many details. There were some exceedingly large and rapid changes, especially of declination and horizontal force, at Agincourt, the range of the former element being about 2° 5′, as compared with 51′ at Kew.—L. C. **Martin**: The transparency of biotite to infra-red radiations. The paper describes a curious reversible variation with temperature in the infra-red transmission of biotite. Tables and curves showing the variation in transmission of biotite with wave-length at various temperatures are given, and certain possible explanations are examined. The general nature of the effect is a halving of the transmission for a rise in temperature of about 200° C.

March 27.—Sir J. J. Thomson, president, in the chair.—H. L. **Hawkins**: The morphology and evolution of the ambulacrum in the Echinoidea.—Dr. R. **McCarrison**: The genesis of œdema in beri-beri.

Physical Society, February 28.—Prof. C. H. Lees, president, in the chair.—P. R. **Coursey**: Simplified inductance calculations, with special reference to thick coils. The method of calculation advocated in the paper is based on an extension of Nagaoka's formula for single-layer coils, to include as well all ordinary forms of thick coils. Rosa's formula for thick coils is put into the same form as Nagaoka's, and its use enables a series of correction factors to be calculated for various coil thicknesses. By the aid of a single sheet of curves giving values of these correction factors the inductance of any form of coil likely to be met with in practice may be readily calculated, using only one simple standard formula for all cases.—Dr. R. **Dunstan**: Acoustic experiments in connection with whistles and flutes. Experiments were made with hollow spheres, cylinders, and cones with holes of various sizes and in various positions. Bernoulli's theorem, which gives the wave-length of the sound produced by a cylindrical pipe in terms of the length of the pipe and an end-correction depending on the diameter only, was shown to be inadequate for practical purposes, the pitch depending on many other factors, such as the wind-pressure, the size and shape of the blow-hole, etc. Cylindrical flutes appear to require an end-correction which—within certain limits—is equal to D^2/d, where D is the diameter of the pipe and d the mean diameter of the mouth-hole (which is often oval in shape). In the shortest flute experimented with, which was only ½ in. long, Bernoulli's theorem would give the wave-length as 2 in., whereas it was actually 14 in. The conclusions drawn from the experiments are that in blowing across a hole in a hollow body a force existed on an elastic substance. The result is a "*spring back*," which produces an aerial throb, puff, or pulsation. The frequency of the pulsation is determined by relations between the dimensions of the instrument, the size of the hole, the wind-pressure, etc. Any resulting sound has its wave-length determined by the frequency, and not *primarily* by the dimensions of the instrument, as in the usual text-book treatment.—G. **Brodsky**: A new polariser. In the course of experiments with polarisers built of piles of glass plates disadvantages due to bulkiness of the apparatus and loss of light had to be overcome. The idea occurred to the author to place the pile of plates between two prisms of the same glass in such a manner as to (*a*) reduce the length of the polariser by one-half; (*b*) utilise the full aperture of the pile; and (*c*) get rid of *all* reflected light. Results obtained with experimental prisms were so good that they could be considered a very fair substitute for Nicol prisms of corresponding size, and the very small amount of light escaping through crossed prisms (which could be reduced further by additional plates) is for most purposes negligible. There would be no difficulty in building such polarisers to any required size, as all the material consisted entirely of glass in unlimited quantities and at a reasonable price, and it was hoped that this invention (British patent No. 121,906) would be used for many purposes. Experiments with piles of glass plates showed a very large discrepancy between the calculated and observed angle for best extinction. Whatever the glass used, and whatever the quality of the surface, this discrepancy came consistently to some 10°, whereas thin microscope-cover plates were found to be useless. There seemed to be still an interesting field for investigation as to the conditions affecting the surface of glass plates used in polarisers.

Aristotelian Society, March 17.—Dr. G. E. Moore, president, in the chair.—A. E. **Heath**: The scope of the scientific method. Though the man of science makes a conscious effort to avoid anthropocentric bias in his treatment of any field, this does not mean that he is confined to non-human fields. Ethical neutrality of method does not imply limitation to an ethically neutral subject-matter. Consequently it is held that the scientific method can be applied to any domain of experience. This thesis is supported by:—(1) The claim that what is attempted is always the complete description, by both qualitative and quantitative formulæ, of an unanalysed field of "primary fact." This is accomplished by the setting up of appropriate conceptual constructions by the two processes of abstraction and of generalisation by analogy, the method being sterilised by constant reference back to primary fact. (2) It is then shown in detail that such synthetic ordering of a primary field is both possible and helpful in biology, political theory, history, and æsthetics, though in the more concrete fields only qualitative treatment is as yet possible. (3) Finally, it is contended that the business of philosophy is the analysis of the primary data accepted uncritically in each field. Its method is thus a "reverse scientific method." One is ready to increase hypothetical entities for the purposes of economical description, according to Mach's principle; the other limits entities to those left after radical analysis, according to Ockham's principle of parsimony. The two principles are not contradictory, but complementary.

Linnean Society, March 20.—Sir David Prain, president, in the chair.—F. **Lewis**: Notes on a visit to Kunadiyaparawitta Mountain, with a list of the plants obtained and their altitudinal distribution. This curious mountain is nearly due west of the sacred "Adam's Peak," and rises abruptly to an altitude of 5186 ft. above the sea, and is surrounded by forest. The summit is small in extent, surrounded by precipices, in the path of the south-west monsoon, which strikes on this isolated peak and by its force dwarfs the vegetation on it. The rainfall on the eastern base is about 230 in. per annum, and on the western side about 330 in. yearly. The flora appears to be largely endemic, animal life is practically absent, and wind transport of seeds of those plants which are on the summit seems unlikely. Forty-nine plants were collected on the mountain-top in one day's visit, and were determined at Peradeniya, and the names are appended to the paper; of the forty-nine, ten only are found outside Ceylon, the remainder being endemic.—Miss M. **Rathbone**: Specimens of plants preserved by submitting them to the action of formalin vapour. In plants preserved in this way, the microscopic characters of the tissues and the form of the flower and relationship of its parts are less altered than in dried specimens, whilst for travellers the specimens are lighter and more convenient to carry than plants preserved in spirit.—H. R. **Amos**: Wheat-breeding in Argentina. The paper deals with work done by Mr. W. O. Backhouse and the author in breeding wheats suitable for the country and its diverse climates, the northern portion being warmer than the southern, which is subject to occasional frost; consequently their requirements are not the same. Results were described of crossing "Barletta" and "Rieti," both commonly cultivated forms in the Argentine, with a Russian variety, others between a Chinese form and "Barletta," with the view of obtaining forms immune to rust and not liable to shell out the grain on harvesting.

Mineralogical Society, March 18.—Sir William P. Beale, Bt., president, in the chair.—L. J. **Spencer**: Curvature in crystals. The curvature of crystals is evidently of many different kinds, and due to as many different causes. Numerous examples, figured in the literature and illustrated by specimens in the British Museum collection of minerals, are grouped under the headings: Curved crystallites and feathery microlites, capillary habit, aggregations of crystals, interfacial oscillation, vicinal faces, bent crystals and plastic deformation, twisted crystals, and cylindrical (?) and spherical (?) crystals (a supposition leading to a *reductio ad absurdum*).—Lieut. A. B. **Edge**: Siliceous sinter from Lustleigh, Devon. The district round Lustleigh, near Bovey Tracey, is mined on a small scale for a very fine quality of micaceous hæmatite, which occurs there in well-defined lodes traversing the granite. At the Plumley Mine (now disused) on the walls of one of these lodes is found a peculiar banded material, somewhat resembling lithomarge or halloysite, which on analysis proved to be a siliceous sinter or opal, with an approximate percentage composition of silica 70, water 21, hæmatite 6, alumina, soda, and potash 3, and a low specific gravity 1·73. It is hard and compact, and shows a beautifully banded structure, the layers being tinted to varying degrees by limonite and finely divided flakes of micaceous hæmatite. The general appearance of the material and the presence of delicately overfolded ripples in the banding suggest that it was originally deposited on the walls of the lode in the form of a jelly, and solidified by loss of water. Such loss continues at a very slow rate when specimens are kept in a dry atmosphere, and after some years the surface becomes soft and powdery. The sinter is very fragile, breaking conchoidally even when most carefully handled; this may be caused by the shrinkage strains set up during solidification. The source of this hydrated silica is rather doubtful; it probably formed part of the aqueous injection which deposited the hæmatite, but may possibly have been leached from the granite during the formation of the lode.—A. F. **Hallimond**: An anorthic metasilicate from acid-steel furnace slags. A description of the slags will be communicated to the Iron and Steel Institute. The substance is a metasilicate of iron, manganese, calcium, and magnesium, and appears as flat, elongated crystals with the following characters:—Forms $b(010)$, $m(110)$, $M(1\bar{1}0)$, $p(1\bar{1}2)$, $l(10\bar{1})$, $n(3\bar{1}0)$, constants α 99° 37′, β 110° 57′, γ 82° 3′; $a:b:c=1{\cdot}156:1:0{\cdot}497$; perfect cleavages parallel to m and M, $mM=95°\ 9\frac{1}{2}'$; colour clear amber-yellow, not pleochroic; optical characters, $2V=65\frac{1}{2}°$; negative, $\beta=1{\cdot}701$; axial plane nearly normal to the cleavage zone; extinction on a, 5°; acute bisectrix nearly normal to a.—Dr. G. T. **Prior**: The meteorites Adare and Ensisheim. The percentage amount of nickeliferous iron, and the ratio of iron to nickel in it, were found to be respectively 18 and 13 in the case of Adare, and $3\frac{1}{2}$ and $3\frac{1}{2}$ in the case of Ensisheim, which results support the view that in chondritic meteorites the less the amount of nickeliferous iron, the richer it is in nickel.—Dr. G. F. Herbert **Smith**: A students' goniometer. This instrument, which was made by Messrs. J. H. Steward, Ltd., is of the type in which the direction of reference is given by the reflection of some distant object in a mirror, and in which the axis of the graduated circle is horizontal. A ball-and-socket joint provides the mirror with all the necessary adjustments in direction, and it is also movable vertically in the plane of the axis of the circle. The crystal-holder is provided with a simple and convenient form of adjustment, which enables a crystal to be measured, as regards one half, without removal from the wax. A pointer on a swinging arm facilitates the setting of the crystal in the axis of the circle.

Zoological Society, March 18.—Mr. A. Ezra in the chair.—H. R. A. **Mallock**: Some points in insect mechanics.—H. F. **Blaauw**: The breeding of *Oryx gazella* at Gooilust.

Institution of Mining and Metallurgy, March 20.—Mr. H. F. Marriott, president, in the chair.—Sir Thomas Kirke **Rose**: The volatilisation of gold. It is now well known that gold is volatile at temperatures not far above its melting point, both *in vacuo* and at atmospheric pressures, and researches have shown that the factors affecting volatilisation, apart from time, temperature, and amount of exposed surface, are (*a*) the composition of the bullion, (*b*) the composition of the gases in contact with the gold, and

(c) the movement of these gases over the surface of the metal. Nevertheless, the results of these researches do not agree, and in order to obtain further data the author instituted experiments described in this paper. He deals in detail with the apparatus employed and the methods adopted in pursuing his investigations, and gives the following conclusions as the result of his work:—(1) The true volatilisation of gold is so small as to be negligible at the temperatures of industrial melting furnaces, say 1000° to 1300° C. It is difficult to measure with accuracy the infinitesimal amounts volatilised at these temperatures. (2) It is probable that the nature of the atmosphere, provided that it is maintained unchanged, has no effect on volatilisation. Even in a strong draught the amount volatilised remains exceedingly small. (3) Certain gold alloys, when molten, take up oxygen from atmospheres containing it, and will afterwards spirt or effervesce in a reducing atmosphere until the oxygen has been removed. Similarly, hydrogen, and in a less degree carbon monoxide, are occluded by such molten alloys, and the metal then spirts in an oxidising atmosphere. In spirting, showers of globules of the alloys of all sizes are thrown up, and the smaller ones, especially those of less than 0·001 mm. in diameter, are carried away by any draught, however slight, and are difficult to recover. They can be collected by such a filter as cotton-wool. (4) The action is observable in all the alloys of gold with silver or copper. Even parted gold containing 1 part per 1000 of silver is affected, though to a far less degree than coinage alloys, gold-silver parting alloys, and similar materials. Fine silver and its alloys with copper also spirt freely. (5) It is this action which causes the unrecovered losses in melting such alloys in crucibles without a cover of slag.—W. S. **Curteis**: Cobar stope-measurement methods. This paper deals with the methods adopted in measuring the stopes of the Great Cobar Mine for the purpose of working out the pay-sheets of the miners fortnightly, in place of the former practice of paying in a final settlement when the ore was withdrawn from the stope. With this end in view two different methods were employed, according to the form and peculiarities of the stope outline, and the author sets out the two systems of calculation in great detail, accompanied by sketches in elucidation. It is found that the measurements required for this purpose are also capable of being utilised for other purposes, including the calculation of ore reserves.

PARIS.

Academy of Sciences, March 10.—M. Léon Guignard in the chair.—L. **Lecornu**: The flow of liquids. A discussion of a theorem published by Hugoniot in 1886.—M. **Hamy**: The study of the perturbations of the optical axis of a meridian telescope. An account of the method of determining the constants defined in a previous communication.—L. **Maquenne** and E. **Demoussy**: A very sensitive reaction for copper. Application to the analyses of ashes and arable earths. The reaction is based on a blue coloration developed by traces of copper salts by the action of a ferro-cyanide in presence of a trace of a zinc salt. Iron interferes, and details of its method of removal are given. The reaction can detect 1 milligram of copper in a litre of solution.—H. **Parenty**: A steam expansion controller, the reduced pressure increasing with the amount required by the main.—G. E. Hale was elected a foreign associate in succession to A. von Baeyer.—J. **Drach**: The integration, by quadratures, of the equation $d^2y/dx^2=F(x, y)$.—P. **Fatou**: Singular lines of analytical functions.—G. **Julia**: A general property of entire functions related to Picard's theorem.—A. **Buhl**: The exchange of the parameter and the argument. Analogies with the reduction of double integrals of the second species.—F. **Michaux**: Emissive theories and the Doppler-Fizeau principle. The fact that the Doppler formula is verified when the wave-length is measured by an interferometer is not in agreement with the theories of Tolman and Thomson-Stewart, but is in accord with either the theory of Ritz or that of Lorentz.—J. **Rey**: The physical properties of petrol vapour. For a petrol density of 0·8 at 0° C. the characteristic equation of the vapour is sensibly of the form $p(v+a)=RT$, where a is 0·024 and R 5·09. A formula is also deduced for the flow of superheated petrol vapour.—E. **Cornec**: The spectrographic study of the ashes of marine plants. A list is given of nineteen elements recognised by the spectroscope in the ashes of seaweed. Gold, bismuth, gallium, and germanium exist only in the state of spectroscopic trace. The elements not previously recognised in marine plants include antimony, germanium, glucinum, titanium, tungsten, and vanadium.—A. **Bigot**: The geology of the Col du Cotentin.—P. **Guérin**: *Urera humblotii* and its affinities.—H. **Coupin**: The absorbing power of the root-tip. Contrary to the view currently held, the tip of the root can absorb water in sufficient quantity to produce germination.—M. **Molliard**: Egg-albumin constitutes a complete food for *Isaria densa*.—G. **Rivière** and G. **Bailhache**: *Amygdalopersica formonti*.—J. **Chifflot**: The secretory canals of some Gesneraceæ, and in particular of those of *Monophyllaea horsfieldii*.—M. **Mirande**: The cytological formation of starch and of oil in Chara.—A. **Lécaillon**: The changes observed in the reproduction and development in Chinese polyvoltin silkworms when transported and raised in France.

BOOKS RECEIVED.

Pensions for Hospital Officers and Staffs. Report of a Sub-Committee of the Executive Committee of King Edward's Hospital Fund for London. Pp. v+273. (London: C. and E. Layton.) 7*s*. 6*d*. net.

Manual de Fabricantes de Azucar de Caña y Quimicos Azucareros. Por Dr. G. L. Spencer. Traducción autorizada de la 6ª edición Inglesa, por el Dr. G. A. Cuadrado. Pp. xvii+617. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 23*s*. net.

Analytic Geometry. By Prof. M. M. Roberts and Prof. J. T. Colpitts. Pp. x+245. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net

Practical Pyrometry. By E. S. Ferry, G. A. Shook, and J. R. Collins. Pp. vii+147. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. net.

Practical Physiological Chemistry. By Prof. P. B. Hawk. Sixth edition. Pp. xiv+661+vi plates. (London: J. and A. Churchill.) 21*s*. net.

Food Control Mismanagement: The Tragedy of Milk Production. By Prof. R. Wallace. Pp. 40. (Edinburgh: Oliver and Boyd.) 6*d*.

Democratic Ideals and Reality: A Study in the Politics of Reconstruction. By H. J. Mackinder. Pp. 272. (London: Constable and Co., Ltd.) 7*s*. 6*d*. net.

National Life from the Standpoint of Science. By Prof. K. Pearson. Third issue. Pp. 106. (London: Cambridge University Press.) 1*s*. 6*d*. net.

The Function of Science in the Modern State. By Prof. K. Pearson. Second edition. Pp. vii+97. (London: Cambridge University Press.) 2*s*. net.

Elementary Mensuration, Constructive Plane Geometry, and Numerical Trigonometry. By P. Goyen.

Pp. viii + 169. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, and Papers in Elementary Engineering for Naval Cadetships, July and November, 1918. Edited by R. M. Milne. Pp. 36. (London: Macmillan and Co., Ltd.) 1*s*. 3*d*.

Prothèse Fonctionnelle des Blessés de Guerre. Troubles Physiologiques et Appareillage. By Dr. Ducroquet. Pp. ii + 235. (Paris: Masson et Cie.) 5 francs.

Lectures on the Philosophy of Mathematics. By J. B. Shaw. Pp. vii + 206. (Chicago and London: The Open Court Publishing Co.) 6*s*. net.

The Human Machine and Industrial Efficiency. By Prof. F. S. Lee. Pp. vii + 119. (London: Longmans and Co.) 5*s*. net.

Animal Parasites and Human Disease. By Dr. A. E. Chandler. Pp. xiii + 570. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Notes, Problems, and Laboratory Exercises in Mechanics, Sound, Light, Thermo-Mechanics, and Hydraulics. By Prof. H. Dunwoody. Pp. v + 369. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13*s*. 6*d*. net.

The Development of Forest Law in America. By J. P. Kinney. Pp. xviii + 254 + xxi. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11*s*. 6*d*. net.

The Essentials of American Timber Law. By J. P. Kinney. Pp. xix + 279 + x. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13*s*. 6*d*. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 3.

ROYAL INSTITUTION, at 3.—Prof. A. Findlay: Colloidal Matter and its Properties.

ROYAL SOCIETY, at 4.30.—Dr. T. R. Merton and Prof. J. W. Nicholson: Note on the Intensity Decrement in the Balmer Series.—Prof. E. W. Brown: The Determination of the Secular Accelerations of the Moon's Longitude from Modern Observations.—Dr. W. Rosenhain and S. L. Archbutt: The Inter-crystalline Fracture of Metals under Prolonged Application of Stress.—Dr. J. R. Airey: Zonal Harmonics of High Order in Terms of Bessel Functions.

LINNEAN SOCIETY, at 5.—W. B. Brierley: An Albino Mutant of *Botrytis cinerea*.—Dr. J. D. F. Gilchrist: The Post-Puerulus Stage of *Jasus lalandii*.—Montagu Drummond: The Ecology of a Small Area in Palestine.

CHILD-STUDY SOCIETY, at 6.—Dr. E. Pritchard: Home *v*. Institutional Training of Young Children.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. A. G. T. Cusins: The Development of Army Wireless during the War.

CHEMICAL SOCIETY, at 8.

SATURDAY, APRIL 5.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

MONDAY, APRIL 7.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. H. E. Armstrong: Problems of Food and their Connection with our Economic Policy.

SOCIETY OF ENGINEERS, at 5.—Prof. J. Young: Modern Explosives.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Miss Czaplicka: Poland.

ARISTOTELIAN SOCIETY, at 8.—A. F. Shand: Value in Relation to Emotion.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—E. A. Alliott: Drying by Heat in Conjunction with Mechanical Agitation and Spreading.—Dr. P. E. Spielmann and F. Butler Jones: The Estimation of Carbon Disulphide. A Critical Examination of the various Methods usually Employed.—Dr. P. E. Spielmann and Dr. S. P. Schotz: The Estimation of Thiophene.—Dr. P. E. Spielmann and H. Wood: The Estimation of "Free Carbon" in Tar and Pitch.

TUESDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Prof. A. Keith: British Ethnology—The People of Scotland.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Lieut. E. W. P. Chinnery: Reactions of Certain New Guinea Primitive People to Government Control.

ZOOLOGICAL SOCIETY, at 5.30.—Dr. F. E. Beddard: Three Fœtal Sperm-Whales.—L. T. Hogben: The Progressive Reduction of the Jugal in the Mammalia.—G. A. Boulenger: Description of Two New Lizards and a New Frog from the Andes of Colombia.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—G. Hughes: The Electrical and Mechanical Equipment of the All-metal Cars of the Manchester-Bury Section, Lancashire and Yorkshire Railway.—F. E. Gobey: All-metal Passengar Cars for British Railways.

ILLUMINATING ENGINEERING SOCIETY, at 8.—J. B. Fagan: Light and Colour in Relation to Stage Production.

WEDNESDAY, APRIL 9.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—The Rt. Hon. the Earl of Durham, K.G.: Presidential Address.—Sir Philip Watts: Ships of the British Navy on August 4, 1914, and Some Matters of Interest in Connection with their Production.—Sir E. H. Tennyson d'Eyncourt: Naval Construction during the War.—S. V. Goodall: The Naval Construction Corps of the United States Navy.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. L. E. Hill: Housing and Infant Mortality.

GEOLOGICAL SOCIETY, at 5.30.—W. Whitaker: The Section at Worms Heath (Surrey), with Remarks on Tertiary Pebble-beds and on Clay-with-Flints.—G. MacDonald Davies: Petrological Examination of the Beds at Worms Heath.

ROYAL AERONAUTICAL SOCIETY, at 8.—Col. H. G. Lyons: The Supply of Meteorological Information for Aeronautical Purposes.

THURSDAY, APRIL 10.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A. E. Seaton: The Work of the British Marine Engineering Design and Construction Committee.—Signor S. Orlando: Italian Two Floodable Compartment Cargo Steamers Built during the War.—Sir E. H. Tennyson d'Eyncourt and T. Graham: Some Recent Developments towards a Simplification of Merchant Ship Construction.—At 3.—C. I. R. Campbell: Development of Airship Construction.—W. L. Scott: Concrete Shipbuilding in the United States of America.—At 7.30.—The Hon. Sir C. A. Parsons and Stanley S. Cook: Investigation into the Causes of Corrosion and Erosion of Propellers.—J. H. Gibson: The Michell Thrust Block.

ROYAL INSTITUTION, at 3.—Prof. A. Findlay: Colloidal Matter and its Properties.

INSTITUTION OF MINING AND METALLURGY, at 5.—Major H. Standish Ball: The Work of the Miner on the Western Front.

ROYAL HISTORICAL SOCIETY, at 5.—R. A. Gregory: Science in the History of Civilisation.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—R. J. Kaula: Notes on Surface Condensing Plants, with Special Reference to the Requirements of Large Power Stations.

OPTICAL SOCIETY, at 7.30.—J. W. French: The Unaided Eye.—T. Smith: The Spacing of Glass-working Tools.

FRIDAY, APRIL 11.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—W. H. Gard: Some Experiences with Electric Welding in Warships.—Dr. J. Montgomerie: Further Experiments on the Stress Determination in Flat Steel Plates.—A. T. Wall: The Tonnage of Modern Steamships.—At 3.—J. L. Kent: Model Experiments on the Effect of Beam on the Resistance of Mercantile Ship Forms.—J. Semple: Some Experiments on Full Cargo Ship Models.

ROYAL ASTRONOMICAL SOCIETY, at 5

ROYAL INSTITUTION, at 5.30.—Sir J. J. Thomson: Piezo-Electricity and its Applications.

SATURDAY, APRIL 12.

ROYAL INSTITUTION, at 3.—Sir J. J. Thomson: Spectrum Analysis and its Application to Atomic Structure.

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