THURSDAY, MARCH 13, 1919.

BIOLOGICAL PROBLEMS.

Medical Contributions to the Study of Evolution. By Prof. J. G. Adami. Pp. xviii+372. (London: Duckworth and Co., 1918.) Price 18*s*. net.

A BOOK attempting to throw light upon biological problems from a new point of view is always likely to be interesting, and we therefore welcome Prof. Adami's work. Undoubtedly much controversial matter is introduced, but a point of view that sometimes challenges what is too often taken for granted is, at any rate, stimulating. Although in his letter quoted in the appendix Sir Ray Lankester protests that certain experiments are well known to him, we venture to think that many of the facts brought forward are unfamiliar to biologists in general.

The book is divided into three parts, with two appendices. Parts i. and ii. will be the most interesting to the general biologist. The reprinted papers in the latter parts of the book, however, entail a great deal of repetition, while the style is somewhat cumbrous and involved. The preparation of the book in war-time may be the excuse for leaving many things as they were originally written, later work being often referred to in footnotes, but the actual matter could, with advantage, have been condensed into a much shorter book without loss of clearness. A less unwieldy book, too, might have been published at a lower price, for we cannot say that the amount asked errs on the side of cheapness.

The first part of the book consists of the Croonian Lectures for 1917 on "Adaptation and Disease." Starting with an introductory chapter upon variation and adaptation as the basis of evolution, we get two chapters upon variation and adaptation in the bacteria, followed by one upon the corresponding adaptations in higher animals to pathogenic agencies. The next chapter deals with the inheritance of acquired conditions in the higher mammals, quoting Carrière's work with tuberculin, and Stockdale's experiments upon the effects of alcohol vapour, to show that influences acting upon the parents may affect the offspring in the two succeeding generations. Kammerer's work upon *Salamandra maculosa* is also quoted. Chap. vi. deals with the physico-chemical basis of the subject, and the author brings forward a conception of the constitution of living matter based on the structure of the proteins. He recalls the fact that in organic compounds generally the mere position of a radical profoundly alters the properties of the compound, and shows that with a complex molecule such alterations may lead to a multiplicity of different new properties. From this he proceeds to the elaboration of a physico-chemical conception of growth. The final chapter is devoted to a recapitulation and review of the conclusions reached.

It is a pity that in such a work there is evinced a spirit of animosity to certain leading biologists. We may suspect the author of setting up a figment for demolition in ascribing to Bateson the belief that evolution occurs solely by the loss of factors. We think also that nothing of importance is gained by the republication of the controversy in Appendix ii., the tone of which reflects credit upon neither party.

There are a few misprints and inaccuracies requiring attention. On p. 18 Limulus is stated to be "no crab, but an Arthropod"; this should obviously be "Arachnid." The "intestinal amœbæ" of Musgrave and Clegg referred to upon p. 46 are almost certainly coprozoic forms and not true parasites; nevertheless, the adaptability to unusual forms of diet is interesting. The allusion upon p. 240 to Loeb's work on chemical fertilisation is out of date and should not have been left as it stands. In the first place, it has been shown conclusively that development is not initiated by mere changes in tonicity. Moreover, though active nuclear changes and cell division may be set up by artificial means, they do not always continue, but under certain conditions the process may cease when the four- or eight-celled stage has been reached, leaving the resting cells susceptible each of fertilisation by a spermatozoon.

The main value of the book consists in the insistence upon the physico-chemical constitution of living matter, and we welcome particularly the author's onslaught upon Weismann's cut-and-dried morphological conceptions of heredity. Nevertheless, it should be borne in mind that the work of Conklin and others shows the existence of structure even in the egg. It may be pointed out, however, that in chap. vii. we are somewhat inconsistently presented with some purely morphological diagrams illustrative of the side-chain theory. It is evident that a physico-chemical explanation of such a theory must depend upon unsatisfied or unsaturated linkages, which would be just as easy to represent and would convey a truer picture of the mechanism of protoplasmic reaction.

On the whole, the book may be commended to the attention of the general biologist.

GENETICS FOR THE BOTANIST.

Plant Genetics. By J. M. Coulter and M. C. Coulter. Pp. ix+214. (Chicago: University of Chicago Press; London: Cambridge University Press, 1918.) Price 1.50 dollars net.

THIS little book is one written by botanists for botanists. The authors state in their preface that it is designed especially for the undergraduate student in botany who wishes to obtain some knowledge of what is being done in genetics without desiring to specialise in the subject. They have attempted, so far as possible, to present an exposition of Mendelian, or neo-Mendelian, phenomena illustrated by examples from the vegetable world alone. As to the advisability of this there is likely to be some difference of opinion, for many hold, and with some justice, that one of the instructive features of genetics for the student lies in the numerous close parallels to be found between animals and plants in respect of heredity. A discovery in an animal may at any moment throw a flood of light upon puzzling phenomena in plants, and the converse is equally true. The genetics of plants and animals are so closely interwoven that an attempt to treat of one without the other necessarily leads to a sense of incompleteness. At the same time the unity of some of the fundamental phenomena of life in the vegetable and animal kingdoms—a most valuable lesson for the young student—is apt to be lost sight of. Even the authors have had to confess that the animal cannot be entirely excluded, for they had perforce to bring in Morgan's Drosophila and Castle's rats. Nevertheless, they have succeeded in illustrating most of the important phenomena from plants alone, and the work will be of service not only to the young botanist, but perhaps even more so to the zoologist, who is apt to be hazy with regard to the special features that plants exhibit.

We venture to hope that in the next edition the authors will enter rather more fully into the phenomena of the fertilisation of plants; for it is here that the zoologist so often encounters a stumbling-block. The chapter on endosperm inheritance is a distinct advance upon the usual text-book treatment; but we would suggest, for the sake of the zoologist, a more detailed account of the manner in which the egg is derived from the megaspore, and of the fate of the nuclei of the pollen-grain. Apogamy, too, might be treated more liberally, with reference made to the important researches of Ostenfeld and Rosenberg. Apart from its intrinsic value, the work of these observers has a peculiar interest in connection with Mendel's own work on Hieracium. On the whole, the authors have given a clear and lucid presentation of genetic phenomena in plants, and one that should prove useful to the class of student for whom it was designed. We hope it may fall into the hands of many students and teachers in this country, where the study of plant genetics is far less widespread than it should be. It is high time it became an integral part of the botanical course at every university, and the authors of this little book have certainly demonstrated that this can easily be done without unduly trespassing upon the field of the zoologist.

For the benefit of the English student, it should be stated that although the authors have naturally drawn upon American material in illustration of the various phenomena, it does not follow that these were necessarily discovered on the other side of the Atlantic. They state, for instance, that "the classic illustration of coupled characters was brought to light by Emerson during breeding experiments with corn." If there is a classic example here, it should surely be Bateson and Punnett's sweet peas, where the phenomena were first discovered, and the peculiarities of this type of inheritance first worked out. The authors confess to some inexactness in dealing with details, urging the excuse of pedagogical necessity. Still there are few statements definitely misleading. But the account of Mendel's peas on p. 37 looks as though the authors had fallen into the familiar trap that has snared so many an elementary student, forgetting that the seed characters used belong to a generation subsequent to that of the plant on which they are borne.

The book is of a handy, small size for a student's pocket, well printed, and illustrated by a number of simple diagrams.

NATURAL HISTORY IN THE NEW WORLD.

(1) *Far Away and Long Ago. A History of My Early Life.* By W. H. Hudson. Pp. xii+332. (London: J. M. Dent and Sons, Ltd., 1918.) Price 15*s.* net.

(2) *Jungle Peace.* By William Beebe. Pp. 297. (New York: Henry Holt and Co., 1918.)

(3) *The Ledge on Bald Face.* By Major C. G. D. Roberts. Pp. 255. (London: Ward, Lock, and Co., Ltd., 1918.) Price 5*s.* net.

(1) THERE is much of the old-time naturalist in "Far Away and Long Ago," by that G.O.M. of natural history, Mr. W. H. Hudson. It is a simple story, the recollections of his early life on the savannahs of the Argentine. We can imagine the *estancia*, with its poplars and willows, and with its flowery orchard lying isolated on the lonely downs. The whole was protected by a broad moat, and must have been a veritable oasis to woodland birds in what otherwise was to them an inhospitable land. Here Hudson made friends of birds, beasts, and trees, each one to him acquiring its own individuality: the cowbird parasitical like the cuckoo; the red willow, with its pair of tyrant birds, ever ready to attack the wandering hawk; green paroquets; peaches in blossom, loveliest of sights, and a proper bandstand for flocks of singers. The armadillo and the opossum were burrowers, the latter, with its children, giving hospitality to pit vipers, most malignant of snakes. Here and there, on the plains, were *viscacha* villages, immense badger-like earths of a large rodent now getting extinct. The house was an old one, a relic of the early Spanish settlers, tillers of the ground, later driven to the herdsman or *guacho* life. As to the fenman the fens are the most beautiful of all lands, so to Hudson his pampas colours of yellow to rust, the latter produced by giant thistles, are beyond compare, their serenity disturbed only by the occasional *pampero* (hurricane) from the Southern Ocean. He was clearly a lonely boy, and it is not difficult to see how he made friends with Nature.

Hudson brings us back to Rosas, whom he describes as the bloodiest, the most original-minded, and the greatest of the dictators of South America. Rosas was in origin a *guacho,* and he had the cruelty and sardonic humour of the class from which he sprang. He brought peace to the prairies, and in his time came many of the British settlers, who are now merging into a new race. The old settler neighbours are described with their establishments and estates, which are clearly best remembered for their rheas, feral pigs, or more frequently their birds and frog-infested lakes. Old as Hudson is, he still remains a boy, projecting himself into bird, beast, and plant. We imagine him as full of happiness and peace, and we trust he may continue so for many years. Try as we may, we cannot speak of him impersonally after we have read his book.

(2) "Jungle Peace" is altogether a contrast, the work of a modern, professional naturalist, with excellent descriptions and bright writing, but without the delightful unconsciousness of self belonging to the old-time author. Perhaps, in these days, scientific education has to some degree killed out the soul for Nature, and we may never see it again in its old form in the professional man of science, in whom the wonders of heredity have crushed out interest in simple habits and psychology. The book is the description of the establishment of a tropical research station in British Guiana, the wish being to study birds, beasts, and insects in their natural environment. The site chosen was an old house in the jungle near the mouth of the Essequibo, and the quite vivid descriptions show that it was well chosen and suitable for researches on the beasts of the little-known continent of South America. The jungle came right up to the doors of the house, and a trail was cut through it to form a collecting ground. The fauna was evidently of extraordinary richness.

(3) Our third work is in a different category still, the latest work of a popular author of the North-west, a land famed for its inimitable wilds and its few, but conspicuous, beasts. To quote R. W. Service,

Big mountains heaved to heaven, which the blinding sunsets blazon,
Black canyons where the rapids rip and roar.

Major Roberts is a man to follow, for he is never dull, and is true to Nature in man, bird, and beast.

OUR BOOKSHELF.

Man's Redemption of Man. By Sir William Osler. Third edition. Pp. 63. (London: Constable and Co., Ltd., 1918.) Price *7d.* net.

This "lay sermon" is a delightful piece of writing; good thoughts in good English; a little Magnificat for anæsthetics, antiseptics, preventive medicine, and other great results of the work of the medical sciences; the author has the secret of sympathy, and the art of making you think of what he is saying. The war has shown us further instances of the value of medical discoveries than we had in 1910; but that fact does not impair the wisdom and the pleasantness of the discourse. There is one passage in it which is exemplary; Sir William challenges the anti-vaccinationists with the old argument, which they cannot beat:—

"I would like to issue a Mount-Carmel-like challenge to any ten unvaccinated priests of Baal. I will take ten selected vaccinated persons, and help in the next severe epidemic, with ten selected unvaccinated persons (if available!). I should choose three Members of Parliament, three anti-vaccination doctors, if they could be found, and four anti-vaccination propagandists. And I will make this promise—neither to jeer nor to gibe when they catch the disease, but to look after them as brothers; and for the three or four who are certain to die I will try to arrange the funerals with all the pomp and ceremony of an anti-vaccination demonstration."

Galileo. By W. W. Bryant. ("Pioneers of Progress," Men of Science Series.) Pp. 64+portrait. (London: Society for Promoting Christian Knowledge, 1918.) Price *2s.* net.

Born in the same year as Shakespeare, Galileo Galilei shared with his contemporary that philosophic outlook, that felicity of diction, and that elegant style which have contributed to the fame of both. Prof. Playfair has said that in reading Galileo's "Dialogues" one feels oneself carried back to the period when the telescope was first directed to the heavens, and when the earth's motion, with its train of consequences, was proved for the first time. Mr. Bryant has given a careful account of the life of the great natural philosopher, whose first appointment was a professorship of mathematics with a salary of about five shillings a week. Galileo was, however, both a discoverer and an inventor, and started a workshop in his own house, in which he employed a staff of mechanics under his personal supervision to make his geometrical and military compass, his hydrostatic balance, his magnets and telescopes. He ground all his lenses himself until his sight failed. The story of his conflict with the Jesuits as to the Copernican doctrine, and of his examination before the Inquisition, is retold in an interesting but unbiassed manner. His sufferings hastened the triumph of the doctrines which he upheld, and have ensured his enduring fame. H. S. A.

Surface Tension and Surface Energy and their Influence on Chemical Phenomena. By Dr. R. S. Willows and E. Hatschek. Second edition. Pp. viii+115. (London: J. and A. Churchill, 1919.) Price *4s. 6d.* net.

The first edition of this useful volume was reviewed in the issue of Nature for July 8, 1915 (vol. xcv., p. 506), when the scope of the book was described. The present edition has been enlarged by the addition of a chapter on some important complex phenomena, and it also now includes, among other additions, Mr. Whittaker's work on the connection between surface energy and internal latent heat; a summary of recent theories on the structure and properties of metals, in which the surface energy of the intercrystalline layer plays an important part; Dr. A. Ferguson's equation connecting surface tension and absolute temperature, and paragraphs on adsorption.

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 Directorship of the Natural History Museum.

A RETROSPECT of fifteen to twenty years will show the effect in action of the proposed appointment of a Civil Servant to be director of the Natural History Museum.

The Science Museum adjacent had then been handed over to the direction of a Civil Service official, acting, apparently, on secret instructions that the collection of machinery and models initiated by Bennet Woodcroft was too great an expense for this country to maintain, although something less than one of our numerous Lord Chancellors; and a "ca' canny" policy was to be adopted until the director had qualified for the higher scale, when the museum was to be closed.

But the science collection was saved by a miracle from dispersal, and a competent man appointed to direct in the late Mr. Last. Too late, unfortunately, for him to secure such trophies as a broad-gauge express locomotive or the paddle-engines of the *Great Eastern*, to be had as a gift, and erected outside in the open if there were no funds to house them.

The historical collection was the envy of Germany, which would have bid for it, if the chance had come, to serve as the nucleus of the magnificent museum in imitation at Munich, on which no expense was spared to make it perfect and complete.

Prof. Klein was on a visit of inspection at the time to collect ideas for the projected Munich Museum, and I felt humiliated for England that he should glimpse our official mentality, and hear the low opinion held of the value of our own work, as I accompanied him round.

Quieta non movere is the motto of the old Government official. But the first act of Mr. Last's appointment was to set the collection of models at work by compressed air.

The collection grew out of the old Patent Museum, under the care of Bennet Woodcroft, encouraged by Cole, and housed in the Brompton "Boilers," Thackeray's name for the corrugated-iron sheds.

It is melancholy to reflect on the glorious chances lost by the niggardly policy lasting up to the war. The office of Master-General of the Ordnance had been re-established, entrusted with our military preparedness; and why not that of the Master-General of the Mechanicks, as Sir Samuel Morland was, for title of the director, chosen as an enthusiast, always on the look-out for additions?

But there has been no director of the Science Museum since Mr. Last. The Government official is suspicious of the competent man. G. GREENHILL.

1 Staple Inn, W.C.1, March 8.

Absorption of Gases by Charcoal.

OF late years much attention has been given to the remarkable power of charcoal to absorb gases of all kinds, and during the war extensive use has been made of this property in the construction of masks for removing noxious gases from the air inhaled by the wearer. As a matter of justice to the memory of a man whose interesting work in the chemistry of vegetable products is apt to be forgotten, I should like to remind readers of NATURE that the first practical application of charcoal for such purposes was made by Dr. John Stenhouse, lecturer in chemistry at St. Bartholomew's Hospital. In 1854 Stenhouse devised a charcoal respirator consisting of a perforated zinc case filled with granular wood charcoal, and adapted to fit over the mouth and nose. Respirators of this kind were in use by nurses and dressers in St. Bartholomew's, and, I believe, some other hospitals, down to the time when Lister's antiseptic system rendered such protection from the offensive emanations of sores unnecessary. When I worked in Stenhouse's private laboratory in 1862–63, he gave me one of these respirators, and I made use of it long afterwards with great advantage when experimenting on the gases from *aqua regia* and other irritating substances.

Stenhouse further succeeded in inducing the authorities of the City of London to make use of charcoal as a deodorant of the gases liable to escape from the gullies in the streets, in which application it was quite satisfactory so long as it was kept dry. The difficulty of excluding water and mud from the trays on which the charcoal was placed led, after a few years, to the abandonment of the system in the streets. The letter addressed by Stenhouse to the Lord Mayor in February, 1860, on the subject was reviewed in the *Chemical News* (vol. iii., p. 78). In the same journal (vol. xxv., p. 239) there is a letter from Stenhouse dated May, 1872, in which he refers to his respirators as then coming into use in chemical laboratories. WILLIAM A. TILDEN.

February 28.

The Profession of Chemistry.

THE admirable article under the above title in the issue of NATURE for February 27 will be welcomed by all who cherish the belief that active development of chemical study is vital to the welfare of the State, and modestly hope that public recognition of this fact, so long deferred, may be acknowledged before it is too late. I am convinced, however, that this recognition will not be accorded until the question of nomenclature, to which you refer, has been arranged satisfactorily.

Schools and universities are not the only seats of learning. The street is one; its influence is persistent and universal, for practically all sections of the community, excepting Outer Hebridesians and Scotch crofters, come, sooner or later, under the spell of its suggestion. Yet every day, from childhood to the grave, we are told by the street that a chemist is identical with a pharmacist, and principally occupied in dispensing medicine and in the sale of toilet requisites. Is it surprising that the public is still unaware of the basic fact that the principles of chemistry lie at the foundation of our great national industries and of all the forms which life itself assumes?

In the exercise of his craft the baker practises daily some curious operations in organic chemistry which are not even yet understood by organic chemists themselves. Supposing that some enterprising baker early in the nineteenth century had called himself a "chemist and baker," that the idea had been embraced by the whole body of bakers, and that the public, in purchasing jam-tarts or cake, had become accustomed to passing under the sign of the "Chemist and Baker," would it not be excusable if the much abused public hazily associated confectionery with argon, T.N.T., or British dyes?

The only remedy for the present situation is courteously to approach the Pharmaceutical Society and endeavour to establish a friendly arrangement, in conformity with which the members of that body, who are now variously denominated "chemist," "pharmacist," and "druggist," would content themselves with two of these names, leaving the first word for the definition of persons engaged more obviously in the extension of chemical knowledge or the application of chemical principles.

Pharmacy is an honourable occupation, and I cannot believe that the pharmacist would lose dignity or status by the change. Comparatively few pharmacists are chemists in the modern sense, and it is well known that in other great countries this confusion of titles does not prevail; in fact, this is one of the few points on which we are at variance with our Allies, whilst they are in complete harmony with the Hun.

M. O. FORSTER.

Savage Club, W.C.2, March 4.

Graphic Methods in Nautical Astronomy.

IN the issue of NATURE published on October 24 last (vol. cii., p. 155) there appeared an account of an ingenious chart devised by Mr. G. W. Littlehales, of the United States Hydrographic Department, for dealing rapidly with certain problems in nautical astronomy which involve the solution of a spherical triangle when the three sides, or the two sides and the included angle, are known. The article is entitled "A New Graphic Method in Nautical Astronomy," but it would appear that the idea has been familiar in France for more than five-and-twenty years. The possibility of constructing a chart like that made by Mr. G. W. Littlehales was demonstrated by Maurice d'Ocagne so long ago as 1891 in his work "Nomographie: les calculs usuels effectués au moyen des abaques," p. 84, and an abacus devised by him on these lines was described in W. Dyck's "Katalog mathematischer und mathematisch-physikalischer Modelle, Apparate und Instrumente," published in 1892, p. 163. A figure of the chart can be found in a paper by d'Ocagne which appeared in the *Journal de l'Ecole Polytechnique* (second series, 4th cahier, 1898, p. 224), and also in his "Traité de Nomographie," 1899, p. 328. In a modified form the chart was employed by E. Collignon in 1898 (see his "Note sur la détermination de l'heure du passage du soleil dans un plan vertical," *Journal de l'Ecole Polytechnique, loc. cit.*, pp. 123–35).

As drawn by Mr. Littlehales the chart occupies a square of 15-in. side. From 5° to 175° it is graduated to single degrees, and over a large part of the scale can be read by estimation to 6′. Although the printing of two copies obtained from Mr. Potter, agent for Admiralty charts, Minories, London (price 2*s*. 6*d*. each), is roughly executed, the chart is capable of doing good service in providing a rapid means of checking the results of calculation. The particular cases in the solution of spherical triangles it is designed to deal with, frequently occur in the reduction of crystal measurements, and the use of the chart can be confidently recommended to crystallographers.

A. HUTCHINSON.

The Mineralogical Laboratory, Cambridge, February 26.

Curious Markings on Chalk.

IN NATURE of March 6 there appeared a short notice of a piece of chalk said to be carved to represent a mammoth. This specimen was described and figured by Mr. Reid Moir in the February issue of *Man*, p. 17, pl. B. Examination of the figures there given shows that the object is nothing more than a somewhat imperfect natural cast of a chamber of the shell of an Ammonite. It is significant that in some parts of the country where such casts are not uncommon the quarrymen call them "pigs."

CHAS. W. ANDREWS.

British Museum (Natural History), March 8.

Globular Clusters, Cepheid Variables, and Radiation.

(1) THE determination of the past duration of solar radiation, and, consequently, the problem of the age of the inhabitable earth, imposes upon theories of radiation a difficulty the magnitude and fundamental importance of which appear to be too infrequently considered. The difference in the time-scales derived from the gravitational theory of solar energy and from geological and astronomical observation is not one of a few per cent. (or less) of the basic quantities involved, as is generally the case with the discrepancies that have led to conspicuous modifications of radiation theories; the discrepancy is rather a matter of a hundred to one, or even of a thousand or more to one. A more glaring disagreement could scarcely be imagined between a generally accepted and thoroughly workable theory on one hand, and, on the other, a mass of observation now too extensive and varied to be denied and some equally formidable physical laws.

Until recently the arguments for a long time-scale have been mostly geological and biological, and they have not been strongly insisted upon; imperfections in the geological records have been held to minimise the disagreement with the Helmholtz-Kelvin contraction theory of the sun. Similarly, the arguments for the short time-scale have not been too convincing, to some geologists at least, because of the promising possibility of finding new sources of energy or other escape from the physical theory. Hence on both sides of the question there has been a feeling of uncertainty relative to the validity and finality of opposing arguments, and on neither side has the discrepancy been strongly emphasised as a critical point for theories of radiation and the structure of matter.

(2) In recent volumes of NATURE the limited possibilities of the gravitational contraction of the sun in the problem of the age of the earth have been argued anew by Lindemann,[1] Jeans,[2] and Eddington.[3] The energy of contraction, as is well known, is essentially self-regulating for gaseous stars, and its evaluation is a clear and straightforward process. The available supplementary sources of energy seem incompetent; the heat of chemical combinations, an assumed increase in the specific heat, any definitely recognised atomic supply—all such as these appear quite insufficient to affect the problem. In fact, Jeans has shown by a calculation, remarkable both for its brevity and directness, that the total capacity of all electrical sources of energy (including the chemical and radio-active) must be comparatively small. He concludes: "It accordingly looks as though the Helmholtz contraction will provide much more energy than any other source, and we must apparently adjust our views to the time-scale set by the contraction theory."

Eddington[4] has pointed out important objections to the rather bizarre conception of obtaining great stores of energy through the gradual annihilation of matter, positive and negative electrons occasionally annulling each other.

Hence, unless we question, in some manner wholly new, the strict application of the gravitational theory, we may feel now more certain than ever that the sun could have radiated at the present rate for only a few million years.

(3) The main purpose of this note is to remark that recent developments in stellar astronomy make it unnecessary to rely on geological evidence alone for the proof of a vastly longer duration of solar radiation than the gravitational hypothesis admits. Thus the argument need no longer involve only the indefinite opposing of the tenets and conclusions of one science

1 Vol. xcv., pp. 203, 372 (1915). 2 Vol. xcix., p. 444 (1917).
3 Vol. xcix., p. 445 (1917).
4 *Loc. cit.* and Monthly Notices, vol. lxxvii., p. 611 (1917).

against those of another. Each of the lines of astrophysical evidence sketched below supports the existence of a long time-scale; taken altogether, I believe they may be considered (in agreement with geological results) as very strong evidence that the quantity of energy radiated by the sun has not changed appreciably during more than a thousand million years.[5]

(*a*) Studies of globular clusters and of faint stars now indicate a diameter of the known galactic system of scarcely less than a half-million light-years.[6] Average stellar velocities appear to be less than 10^{-4} times the velocity of light. Accordingly, a single oscillation-period of a star, or of a group of stars, in the galactic system is probably not less than 10^{10} years—nearly a thousand times longer than the interval during which the Helmholtz-Kelvin contraction, according to current interpretation, can sustain present solar radiation—and one oscillation-period cannot be taken to represent a very large part of the history of a star's evolution.[7] We have no evidence of clusters the stars of which are all at the beginning or end of their luminous careers; stars are not evolving from invisibility continuously and in great numbers in any part of the galactic system that we have studied. In other words, the introduction of a vastly greater linear scale into the sidereal system indicates the necessity for a corresponding increase in time.

(*b*) Compared with the most distant globular clusters known, the brighter ones are some 200,000 light-years nearer the earth, and, therefore, in our records their stars are 200,000 years older.[8] Such an interval of time would more than suffice, on the basis of recognised sources of energy, for the whole development (through luminous stages) of a giant star, according to calculations by Eddington.[9] There is, however, no evidence of differences of age for near and distant clusters, either in the numbers, colours, and distribution, or other properties of giant stars open to investigation. Indeed, the distribution and motion of globular clusters with respect to the galactic system, their isolation in space, and the evidence of states of internal equilibrium practically negative the possibility of short life for their hundreds of giant stars.

(*c*) The luminosity-period curve of Cepheid variation[10] uniquely relates the period of pulsation of a giant Cepheid variable to its absolute brightness, the individual deviations from the mean curve averaging less than the observational uncertainties. The shorter the period of a Cepheid, the less is its absolute brightness. But for any given star this brightness does not decrease during the giant stage, according to theoretical results of Eddington[11] and Jeans[12]; apparently, therefore, the total life of the variation of a Cepheid passes without appreciable shortening of period.[13] Since period $\propto$ density$^{-\frac{1}{2}}$ according to the hypothesis that some type of pulsation is the cause of Cepheid phenomena, the variability passes also without appreciable change in mean density, and therefore gravitational contraction in these giant stars makes no progress during the whole interval of time that Cepheid variation is effective. This interval of time, however, must be exceedingly long; no certain non-periodic diminution either in amplitude or period has ever been detected in a typical Cepheid. Disregarding both the period-luminosity curve and the mathematical theory of a gaseous giant star, we still have, as Eddington has also noticed,[14] an indication from individual Cepheids that the time-scale is long. A study of δ Cephei[15] for 125 years and of ζ Geminorum for 75 years shows no measurable change in period—no change, therefore, either in mean density or in volume, and the observations are precise enough to justify the conclusion that gravitational theory, as ordinarily interpreted, accounts for less than a thousandth of the energy that is radiated away.

To the three groups of argument outlined above may be added a number of quantitatively less definite results. The clearest are :—(*d*) Evidence similar to (*c*) from the study of the periods of eclipsing binaries, and (*e*) the tidal development of our planetary system.

None of these results goes farther numerically than to indicate lower limits to the time-scale. The evidence of contraction is essentially all negative, and the duration of stellar radiation may be anything greater than the lower limit. So far as we now know, it is just as probably a million as a hundred times the value provided by known sources of energy.

(4) It should be remarked that the geological evidence has become much stronger in recent years. The exhaustive summarisation by Barrell[16] of methods of measuring earth-age from the radio-activity of rhythms in sedimentation and erosion, salinity of the oceans, and biological evolution leaves little ground for a short time-scale in geological history. The oldest sedimentary rocks appear to be about 1,500,000,000 years old, and before their formation unknown ages elapsed. Independently of the extrapolated results from radio-activity in terrestrial rocks, Schuchert[17] derives from studies in historical geology an age of some 800,000,000 years for the earliest Archæozoic formations.

(5) In computing the total energy radiated by the sun, the custom naturally has been to multiply the amount measured for unit area at the earth's surface by the total superficial area of the sphere the centre of which is at the sun and the radius of which is the earth's mean distance. It may be well to point out, as a possible contribution to the solution of the great discrepancy discussed above, that, however natural the customary procedure may be, nevertheless this integration over the whole sphere involves an assumption that may be not only unnecessary, but possibly even unwarranted in the present state of our knowledge of the theories and phenomena of radiation; and if solar and stellar radiation is not uniformly propagated in all directions—if in any way it is facilitated by the presence of surrounding bodies—then the controversy between the short and long time-scales approaches a solution that does not violate the basic results of either line of reasoning.

If, following Sir J. J. Thomson,[18] we actually materialise the Faraday lines of electric force and adopt a corpuscular theory of radiation, already we may have good reason to question the assumed independence of radiation and direction. The ordinary undulatory theory, to be sure, requires a continuity in the electromagnetic field, but continuity is by no means a necessary postulate in the analysis of Maxwell's equations.

A special and limiting condition, along the line of the present suggestion, would require that the radiation from an isolated source should be wholly confined to the solid angles subtended by surrounding matter. Dr.

5 Cf. general discussion in Publ. Ast. Soc. Pac., vol. xxx., p. 283 (1918).
6 Mt. Wilson Contr., No. 157 (1918).
7 Cf. Charlier, *Observatory*, vol. xl., p. 390 (1917): Jeans, *ibid.*, p. 406. A much smaller stellar system was considered by Charlier and Jeans than is now under consideration.
8 Publ. Ast. Soc. Pac., vol. xxx., p. 54 (1918); Mt. Wilson Contr., No. 157, p. 14 (1918).
9 Monthly Notices, vol. lxxvii., pp. 610, 612 (1917).
10 Mt. Wilson Contr., No. 151, p. 16 (1917).
11 NATURE, vol. xcix., p. 308 (1917); Monthly Notices, vol. lxxvii., pp. 16, 506 (1916, 1917).
12 Monthly Notices, vol. lxxviii., p. 36 (1917).
13 Mt. Wilson Contr., No. 154, p. 6 (1917).
14 *Observatory*, vol. xli., p. 379 (1918).
15 Cf. analysis by Luizet, Annales de l'Université de Lyon, N.S., i. fascicule 33 (1912).
16 Bull. Geol. Soc. of Amer., vol. xxviii., pp. 745-904 (1917).
17 "The Evolution of the Earth and its Inhabitants" (New Haven, 1918), chap. ii.
18 "Electricity and Matter" (London 1904), and elsewhere.

Bateman's[19] corpuscular theory of the structure of the electromagnetic field is not out of harmony with this view, and, moreover, his hypothesis has the distinct advantage of accounting for wave-motion as a special case, thus apparently pointing to a method of avoiding those difficulties with interference and diffraction that usually affect corpuscular theories. If we accept the rather preferable "solid angle" hypothesis instead of a less restricted type of non-uniform radiation (such, for instance, as the "specked" wave-front[20]), it is not certain just what difficulties might arise in regard to the ultimate trend of planetary temperatures. But certainly the great majority of recorded sidereal phenomena would be unaffected, whether the "solid angle" interpretation is adopted or merely one which requires that radiation should be much restricted outside the solid angle.

In addition to the possibility of accounting immediately for the large discrepancy in the duration of solar and stellar radiation, there would be other decided advantages in a hypothesis of this kind.

First, we should no longer be confronted with the tragic and almost incomprehensible "waste" of stellar energy. On the ordinary continuity theory, all the sun's radiation, except the one-millionth of 1 per cent. that falls upon planets or known stars,[21] penetrates indefinitely far beyond the regions where now we observe material bodies; and we recognise no reasonable mechanism for its recovery or rematerialisation.

Secondly, we should not have to call upon some unknown source of energy to account for the simplest problems of stellar radiation; the otherwise happy accordances now existing between astronomical observation and gravitational theories of gaseous bodies would emerge from the shadow of this great doubt.

Thirdly, among others of less obvious connection, the following outstanding stellar phenomena might find partial or complete explanation:—(*a*) The remarkable decrease of redness with brightness for the giant stars in globular clusters[22]; (*b*) the relation of spectral type to brightness for both giant and dwarf visual binaries; and (*c*) the low density of the reddish companions in eclipsing variable star systems. In all these cases it would be a matter of the ratio of the angle occupied by neighbouring bodies to the total solid angle.

To summarise:—As commonly interpreted, the Helmholtz-Kelvin contraction, and other but less important known stores of energy, can have maintained solar radiation for less than twenty million years. On the other hand, it is equally definite that the sun has radiated at its present rate for much more than a thousand million years; in support of strong geological evidence of a long time-scale, various astrophysical results may now be adduced, mainly from observations and interpretations of star clusters and variables. The very pronounced disagreement might be explained either if sources of energy now unrecognised could be discovered in the sun and stars, or if the necessity of modification of the physical theories could be demonstrated. "The search for an additional store of energy is not at all encouraging,"[23] since gravitational, chemical, radio-active, or other electrical sources appear unavailing. If we assume that the radiation from isolated sources, such as sidereal bodies, is not uniformly propagated in all directions,[24] we may find the solution not only to the dilemma of the ages of stars, but perhaps also to other astrophysical phenomena; and, conversely, the removal of this serious discrepancy may be proposed as an argument for a corpuscular theory of radiation, in which the direction of other bodies from a radiant source is an important factor. HARLOW SHAPLEY.

Mount Wilson Solar Observatory, Pasadena, California, December 14, 1918.

[19] Proc. Nat. Acad. Sci., vol. iv., p. 140 (1918); the *Messenger of Mathematics*, N.S., vol. xlvii., p. 161 (1918); *Phil. Mag.*, vol. xxxiv., p. 405 (1917). The more extended statement of the theory will appear in the Proceedings of the London Mathematical Society.

[20] Sir J. J. Thomson, Proc. Cambr. Phil. Soc., vol. xiv., p. 419 (1907). Cf. Jeans, "Report on Radiation and the Quantum-Theory" (London, 1914), pp. 81, 85 ff.

[21] The angle subtended by the large nebulæ much exceeds that of stars and planets, but it is very unlikely that the nebulæ represent a continuous distribution of matter.

[22] Mt. Wilson Communications, Nos. 19 and 34 (1916), and elsewhere.

[23] Eddington, NATURE, vol. xcix., p. 445 (1917).

[24] [December 28.] Father Rodés has pointed out to me that Poincaré, in a discussion of the impossibility of regarding the sun as a cooling body entirely without power of renewing its heat ("Hypothèses Cosmogoniques," p. 192), refers to the "solid angle" hypothesis, rejecting it, however, for the reason (which in the present problem does not now appear sufficient) that "at the moment when energy leaves the sun it obviously cannot foretell whether or not it will encounter a planet." Poincaré did not consider the discrepancy very serious between geology and the contraction theory, apparently believing that radio-activity would be competent to make up whatever defic of energy might exist.

RESEARCH AND UNIVERSITY EDUCATION.

IN his opening presidential address this session to the Royal Society of Edinburgh on "The Endowment of Scientific and Industrial Research" (Proc. Roy. Soc. Edinburgh, 1919, vol. xxxix., No. 1), Dr. John Horne discusses the report of the Committee of the Privy Council for Scientific and Industrial Research for 1917–18, and the findings of Sir J. J. Thomson's committee on the position of natural science in the educational system of Great Britain, and then turns his attention nearer home to the results of the Carnegie Trust's research scheme in furnishing trained research workers. He alludes especially to the chemistry department of St. Andrews, which has secured more research scholars and fellows under this scheme than any other educational centre in Scotland. Its favourable position in this respect is ascribed to the smallness of the number of students, to specially commodious and well-equipped laboratories, to a private research endowment which secures complete freedom of action to the head of the department and has rendered it unnecessary for him ever to approach the University Court for help, to a special field of investigation—the chemistry of sugars—capable of providing unlimited subjects for the training not only of the organic, but also of the physical and bio-chemist, and, lastly, to the initiative of the professor in finding industrial positions for the trained workers—it is to be hoped, at a salary that interests the income-tax commissioner. In the larger Scottish universities the science departments struggle under the disadvantages of inadequate laboratories, crowded class-rooms, and overworked and underpaid staffs. One hears, in fact, of nothing now but the duplication of the notoriously large medical classes, and even of the double daily lectures being given by the same lecturer. The Carnegie Trustees are asked seriously to consider whether the funds provided for scientific study and investigation cannot be increased very largely.

It is interesting to find thus officially recognised a few of the more elementary conditions for the fostering of research. The conclusion that one of the main reasons for the success of the St. Andrews chemical research school is due to the *smallness* of the number of students should give at least a moment's pause to those who are urging on the movement for the expansion of the universities, and demanding that they should undertake more and more the routine instruction of the community. There is no surer way of killing research than to leave it, as it usually has been left, to take what is over in a rapidly growing democratic university, after every other need has first been canvassed. If we are, as is probable, to have greatly enlarged universities everywhere, and greatly increased Government grants for this purpose, in the name of common sense let some definite and inalienable part of these grants be put in the hands of persons who know what scientific research is.

The St. Andrews research school of chemistry is a brilliant exception just because this has been the case. A private individual, Prof. Purdie, the present professor's predecessor, founded it, built the laboratory, and provided the endowment out of his own private generosity, and left it in the hands of his successors. He knew what research was, and he has been able to effect more for research in Scotland than the million of Mr. Carnegie, in the hands of his trustees. So little did the latter understand the needs of scientific research, or how to promote it before the war, that they spent on their whole research scheme less than one-half *what they saved* out of the revenue of the fund given them primarily for this purpose.

F. S.

PROF. E. C. PICKERING, For.Mem.R.S.

BY the death of Prof. Edward Charles Pickering, astronomy has lost a great leader, whose stimulating influence and remarkable gifts for organisation have contributed in an extraordinary degree to the advancement of our knowledge of the stellar universe. Born at Boston in 1846, Pickering was educated at the Boston Latin School and at the Lawrence Scientific School, Harvard. At the early age of twenty-one he was appointed Thayer professor of physics at the Massachusetts Institute of Technology, where he is said to have established the first physical laboratory in the United States. In 1876 he succeeded Winlock as professor of practical astronomy and director of the Astronomical Observatory of Harvard College, and continued in this position to the time of his death, which occurred on February 3.

Pickering's work in astronomy has been especially remarkable for the numerous enterprises of great magnitude which he initiated, and for the energetic manner in which he carried his schemes to successful completion. Thanks to the generous encouragement given to scientific workers in America, the resources of the Harvard Observatory were in some measure commensurate with Pickering's great conceptions. Beginning with the erection of the 15-in. refractor in 1847, by public subscription, the resources of the observatory have since been so augmented by subscriptions, gifts, and bequests that the annual income from invested funds during recent years has provided for the employment of a staff of no fewer than forty persons. Through the Boyden bequest, in 1887, Pickering was charged with the establishment of an observatory at a high elevation, under favourable climatic conditions; and with admirable foresight as to the needs of modern astronomy, he seized the opportunity of locating the new observatory south of the equator. The station selected was at Arequipa, in Peru, at an elevation of 6080 ft., and all important researches undertaken at Harvard College have since been made to include stars in all parts of the sky, from the North to the South Pole. Another important benefaction, which largely influenced the activity of Pickering, was the Henry Draper memorial, by which Mrs. Draper made liberal provision for the continuation of the researches on the spectra and other physical properties of the stars which had been carried on by her husband, and interrupted by his death.

While precise measurements of position have not been neglected, the policy of the Harvard Observatory, from the beginning, has been the development of the physical side of astronomy, and it was doubtless very congenial to Pickering to find himself in a position to devote his energies mainly to photometry, photography, and spectroscopy. His earliest work at the observatory was the reduction of Argelander's observations of variable stars, calling for extensive photometric measurements of the brightness of the stars which had been utilised for purposes of comparison. Photometric work in general later became a leading feature of his programme of observations. For these investigations he devised the meridian photometer, with which, under favourable conditions, stars could be observed at the rate of one a minute, with an average deviation not generally exceeding one-tenth of a magnitude.

Under Pickering's guidance, and largely through his own untiring personal observations, a photometric survey of the entire heavens, involving observations to the number of more than two millions, has been made and published. The "Revised Harvard Photometry," forming vol. l. of the Annals of the observatory, and giving the magnitudes and spectra of 9110 stars, mainly of magnitude 6·50 and brighter, has thus become an indispensable source of reference in many departments of astronomical research. A later volume of the Annals (vol. liv.) extends the observations to 36,682 stars fainter than magnitude 6·50. This again has been supplemented by numerous publications on photographic photometry, including the results of investigations undertaken for the establishment of a standard scale of photographic magnitudes. These extensive researches are the chief basis of modern standard magnitudes, and have been of immense value to observers of variable stars, as well as to those occupied with stellar statistics.

The great advantages of photographic methods of observation were early realised by Pickering, and, besides utilising photography in many of his larger undertakings, he showed great ingenuity in devising new applications for special purposes. One of his well-known devices was an instrument for automatically charting the brighter stars on every fine evening; and among numerous other arrangements was one for recording the rapid changes in brightness of short-period variables by intermittent exposures at short intervals.

The number of photographs of the heavens now accumulated in the Harvard "library of photographs" must be approaching two hundred thousand. All stars of the 11th magnitude, and many fainter ones, are shown over and over again on these plates, and the collection provides the only history that exists of the stellar universe. When any new object is discovered, as in the case of the planet Eros, or the recent Nova Aquilæ, its past history for many years has almost invariably been revealed by the Harvard plates, and a vast amount of valuable material doubtless still remains to be extracted.

In forming his plans for the spectroscopic work of the Henry Draper memorial, Pickering again took a large view of his opportunities. The photography of the spectra of stars with a slit spectroscope, one by one, though essential for the precise determination of radial velocities, is of necessity a slow process, and the objective-prism, whereby hundreds of spectra may often be obtained in a single exposure, made a strong appeal to him. The scale of the spectra yielded by this "wholesale" method is usually small, but it suffices for purposes of general classification, and thousands of stars were soon included in the spectroscopic survey. The first "Draper Catalogue," forming vol. xxvii. of the Harvard Annals, includes 10,351 stars north of -25°, classified on an alphabetical system, which, with some modifications, has become generally adopted by astronomers throughout the world. This work has since been continued at Harvard and at Arequipa, and a new Draper catalogue giving the spectra of nearly a quarter of a million stars is now in course of publication.

Many notable discoveries have been made in connection with the work of the Draper memorial. One of the earliest was that of the periodical duplication of the lines in the spectra of β Aurigæ and ζ Ursæ Majoris, proving these stars to be binaries, which, however, are far beyond the limits of resolving power of the largest telescopes. Mention should also be made of the discovery of the presence of bright hydrogen lines as a characteristic feature of variable stars of Secchi's third type, leading to the detection of a large number of variables of this class; and also of the interesting series of lines in the spectrum of ζ Puppis, which have since become of considerable importance in connection with theories of spectra.

Pickering was not alone a zealous worker himself; he was ever ready to aid the work of other institutions and individuals by advance copies of data which might be of use to them, by the loan of photographs, or in numberless other ways. Besides the voluminous publications of the observatory, he maintained a valuable service of bulletins and telegrams for the distribution of information respecting discoveries, made at Harvard or elsewhere, which required immediate announcement.

The value of Pickering's contributions to science was universally recognised. He was a foreign member of the Royal Society, of the Institute of France, and of most of the other important learned societies of Europe. The gold medal of the Royal Astronomical Society was awarded to him in 1886 for his photometric researches, and again in 1901 for his researches on variable stars and his work in astronomical photography. He was president of the Astronomical Society of America, and received the Bruce, Draper, and Rumford medals. Honours were also bestowed upon him by his own and other universities.

LT.-COL. W. WATSON, C.M.G., F.R.S.

BRITISH science is the poorer as the result of the war by many a distinguished name. Few have deserved more highly of their country, or done more useful work in defending our men against the scientific savagery of poison-gas shells, than Lt.-Col. William Watson as director of the Central Laboratory, B.E.F., from its establishment in June, 1915, soon after the first gas-attack, to the conclusion of 1918. The hazardous and exacting nature of this work, in the course of which Watson was frequently "gassed," no doubt largely contributed to his death, which took place, after two months in hospital, on March 3, at the comparatively early age of fifty. The full record of the manifold activities of the Central Laboratory under his direction will doubtless appear in its appropriate place when further details are available. We must be content here with a summary of his career as a scientific investigator.

Watson received his training, in the accurate and delicate physical manipulation which distinguished all his work, at the Royal College of Science under Sir Arthur Rücker and Prof. Boys, and took his B.Sc. degree in 1890, securing first place on the list of honours in physics. He obtained an immediate appointment as demonstrator in the college, and afterwards succeeded to the assistant professorship in 1897. He was elected a fellow of the Royal Society in 1901, and became in due course one of the professors of physics at the Imperial College of Science and Technology.

Watson's first scientific work was as assistant in the great magnetic survey of the British Isles instituted by Rücker and Thorpe, 1890–95, in which he did the lion's share of the observational work, and appears in the record as the most accurate of the observers. He also had the advantage of assisting Prof. Boys in his delicate experiments with the radio-micrometer, in timing the periodicity of the electric discharge, and in photographing the flight of bullets. In the meantime he was occupied, in conjunction with the late J. W. Rodger, on an elaborate investigation of the magnetic rotation of the plane of polarisation in liquids (Phil. Trans., 1895, pp. 621–54), which has not yet been surpassed. A research of a similar character by an original method, on the determination of the earth's magnetic field (Phil. Trans., 1902, pp. 431–62), threw great light on some of the sources of error in absolute magnetic measurements.

While engaged in these researches, and taking his full share of the teaching work, Watson yet found time to write his well-known "Text-book of Physics," which has become deservedly popular, and has made his name familiar to an ever-increasing circle of students. As a teacher his clearness of exposition and his skill in devising experimental illustrations made his lectures very attractive to the serious student.

A large part was taken by Watson in the design and equipment of the new laboratory (now part of the Imperial College) to which the physics department of the Royal College was transferred in 1905. He next became interested in the application of physical methods to the scientific study of the petrol motor, and devised many ingenious instruments of research, including a new type of optical indicator, which has proved invaluable for accurate work on high-speed engines. The laboratory which he designed and equipped for these experiments has since been taken over and extended by the Air Ministry, and proved very useful during the war for the solution of urgent problems in connection with aero-engines. Many of his results were of fundamental importance, and will be found in most standard treatises on the subject.

Watson assisted Sir W. de W. Abney for many years in his researches on colour vision, and made useful contributions of his own to the theory and methods of measurement, a characteristic example of which will be found in his paper on luminosity curves (Proc. R.S., 88 A, p. 404, 1913). In a later paper Sir W. Abney indicates that they were busily engaged on work of great promise in this direction when Watson was "commandeered as scientific adviser at the front." The work which he accomplished in this capacity was doubtless of the greatest national importance, but, in the interests of pure science, one cannot help regretting that so active and many-sided an investigator should have been cut off in his prime by the relentless exigencies of war.

NOTES.

AFTER two years' interval, owing to war conditions, the British Association for the Advancement of Science will resume its series of annual meetings this year at Bournemouth from September 9 to 13, under the presidency of the Hon. Sir Charles Parsons.

SIR GEORGE NEWMAN, K.C.B., Chief Medical Officer, Local Government Board, has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

AT the quarterly Court of the governors of the London Hospital, held on March 5, Lord Knutsford made the important announcement that it is proposed to fill up two vacancies on the honorary visiting staff by the appointment of two whole-time adequately paid officers in charge of the beds. Under the new arrangement there would be a director, three clinical assistants, and laboratory and clerical assistants. These members of the staff will give their whole time to curing disease, to researches on the causation of disease, and to the education of the medical students, and they will be of precisely equal rank with the other members of the honorary staff. It will be remembered that this kind of arrangement was suggested in the report of the Haldane University Commission, and has been commended by Sir George Newman in his "Notes on Medical Education."

THE ravages of the larvæ of ox warble-flies are well known to farmers, butchers, hide-dealers, and tanners. The flesh of bullocks and the milk yield of cows suffer through the presence of these parasites, and the piercing of the hides greatly reduces the value of the latter. Furthermore, the annoyance caused by the flies during a hot July or August prevents cattle from thriving so well as they otherwise would do. So far little or no good results have been achieved from the application of various dips and smears which are intended to prevent oviposition by the flies. The only measure that can be advocated with any confidence is the systematic destruction of the larvæ in the backs of the cattle. This method has the obvious disadvantage that the parasite is destroyed only after it has wrought its injuries. Impressed by the damage caused by the fly, the War Office called a conference last July of Government Departments, men of science, traders, and others familiar with the pest to discuss measures for its extermination. A scientific sub-committee, presided over by Sir Stewart Stockman, will supervise experimental researches. A Government grant has been sanctioned, and the experiments are designed to furnish information on methods of preventing egg-laying of the fly, and on the effects of drugs in destroying the larvæ in the body of the host before they commence to penetrate the hide.

THE predominant character of the weather over the British Isles since the commencement of the year has been rainy and dull. The rainfall in January exceeded the average over the whole kingdom except in Scotland N., where there was a deficiency of about 2 in. At Bournemouth the rainfall was 252 per cent. of the normal, at Arundel 236 per cent., and in London, at Camden Square, 176 per cent. At Kew Observatory the excess of rain was 1·77 in., at Southampton 2·24 in., and at Falmouth 2·86 in. February rainfall was in excess of the average in the south and east of England, and deficient elsewhere. At Greenwich the excess of rain was 0·75 in., at Cambridge 1·85 in., at Southampton 2·32 in., and at Falmouth 2·80 in. In the first ten days of March rains were generally heavy; at Greenwich, in the three days ending March 5, the rainfall measured 1·49 in., which is 0·03 in. more than the sixty years' average for the whole month. The aggregate duration of bright sunshine since the commencement of the year has been deficient in all districts of the British Isles except in Ireland and in Scotland N.; in the south-east district of England the deficiency amounts to 0·6h. daily for the first nine weeks, or in all 38h. At Kew Observatory the sunshine in February was little more than one-half of the average, and at Cambridge it was less than one-half of the normal.

DR. S. F. HARMER, keeper of the Department of Zoology, Natural History Museum, has sent us a letter in which he points out that the remarks upon the directorship of the museum published in our issue of March 6 may be read as an undeserved reflection upon the value of the scientific services rendered to the museum by the assistant secretary, Mr. C. E. Fagan. For ourselves, we gladly accept Dr. Harmer's testimony of high appreciation of Mr. Fagan's services to science during the long period he has held office. We are, however, concerned solely with the principle, common in Government Departments, of appointing lay officials to direct scientific institutions. It is of the utmost importance at the present time not to concede this principle even when personal considerations may all be in favour of the appointment proposed. Dr. Harmer says that Mr. Fagan's work "has been essentially scientific, and that his services in rendering the national museum a scientific institution have been exceptionally great." These are, of course, claims to consideration, and no doubt the Trustees will give full attention to them. Our point is that, whatever candidates are forthcoming, scientific knowledge and experience should determine the appointment, and not purely administrative ability.

THE Department of Scientific and Industrial Research has just issued two revised Circulars, Research Association 1 and 3, the first giving an outline of the Government scheme for industrial research, the second the conditions as to the payment to research associations by the committee of council. As will be remembered, the Government has placed a fund of a million sterling at the disposal of the Research Department to enable it to encourage the industries to undertake research. This new fund is being expended on a co-operative basis in the form of liberal contributions by the Department towards the income raised by voluntary associations of manufacturers established for the purpose of research, and the joint fund for each industry is under the sole control of the councils or boards of the respective research associations so formed, subject to the conditions outlined in the second Circular referred to above. The results obtained from research will be available for the benefit of the contributing firms, but no firms outside the organisation will have any such rights. The associations are to be companies limited by guarantee of a nominal sum and working without profit, *i.e.* without division of profits among the members in the form of dividends. Moreover, the subscriptions of the contributing firms will not be subject to income or excess profits taxes, and the income of the association will similarly be free from income tax. The Government grant will be given for a period of years to be agreed upon, not exceeding five, except in special cases. The general practice, we believe, is to grant pound for pound raised by subscriptions within certain minimum and maximum limits, specified in each case, for the stipulated period, although, where the special circumstances of the industry may need it, this ratio may be increased. There is, moreover, provision for a possible increase of the grant where the association raises additional sums, and for reduction where it fails to reach the specified minimum.

THE *Times* of March 1, 3, and 4 contained long articles dealing with the necessity for the unification of the administration and the further development of the fishing industry. Two rather different points of view were taken by the writers; a special correspondent stated what may be regarded as the expressed opinions of the fishing industries—that is, the great trawling companies, the wholesale and retail traders, and the conservation industries; while Lord Dunraven stated the views of the Sub-Committee on Fisheries of the Empire Resources Development Committee. On one hand, the trade interests press for a great simplification in the existing machinery of central and local regulation and administration, consolidation of the law with regard to fishing, and the formation of a strong and adequate Imperial Ministry with the development of the industry as its single task. This would be directed to securing the means of speedy and economical transport and distribution of the fish landed, processes which are at present inadequate and wasteful. It would be closely and integrally linked up with—would actually include—the means of scientific, statistical, and industrial research carried out in the closest possible association with the industry itself and the machinery of administration. It would see that the present neglect of the inshore fisheries—shell-fish in particular—should cease, and it would greatly develop the fresh-water fisheries, particularly those for salmon and eels. On the other hand, Lord Dunraven emphasises the points of view of the State and the consumer rather than those of the trades voiced by the National Sea Fisheries Protection Association, namely, State control, co-operative enterprise, and development of the fisheries of the Dominions. 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.

NEXT Tuesday, March 18, Prof. A. Keith will deliver the first of a course of four lectures at the Royal Institution on British Ethnology: The People of Scotland. On Thursday, March 20, Prof. C. H. Lees will give the first of two lectures on Fire Cracks and the Forces Producing Them. The Friday discourse on March 21 will be delivered by Prof. W. W. Watts on Fossil Landscapes; and on March 28 by the Right Hon. Sir J. H. A. Macdonald on The Air Road.

THE death is announced of Major H. G. Gibson, who fell a victim to influenza probably contracted in the course of investigations on this disease. Major Gibson, with Major Bowman and Capt. Connor, published a paper in the *British Medical Journal* for December 18, 1918, in which they brought forward evidence that the influenza virus is of a "filterable" nature, *i.e.* is so minute that it will pass through a fine porcelain filter. Sputum from influenza cases was diluted and filtered through a Pasteur-Chamberland filter, and the filtrate was then inoculated subconjunctivally and intranasally into monkeys. The animals suffered from a condition resembling influenza, and the post-mortem condition found was in many respects comparable with that obtaining in human cases.

AN article by Dr. C. Davison in the *Observer* for March 9 deals with Prof. de Quervain's suggestion that a portion of the high explosives left in this country should be used for experimental explosions (NATURE, vol. cii., p. 371). After describing the principal results that might be expected from such experiments, the author points out that the firing of large amounts of explosive (Prof. de Quervain suggests fifty tons) is unnecessary. The sound from the explosion of 24½ tons of dynamite on the Jungfrau railway in 1908 was heard for 112 miles, and that of the explosion of 197 tons of gunpowder at Wiener Neustadt in 1912 for 186 miles. On the other hand, the reports of the minute-guns at Spithead in 1901 were heard to a distance of 139 miles, and in this case seven-pound charges were fired from at the most thirty men-of-war, or a total of less than two hundred-weight, even supposing that the guns were fired simultaneously.

INFLUENZA has again made a steady increase in its virulence over the British Isles, and the Registrar-General's return for the week ending March 1 shows that in London (county) the deaths from the epidemic were 808, and in the ninety-six great towns, including London, they were 3889, both of which are the highest numbers since the closing week of November. The deaths from influenza in London had risen to 32 per cent. of the deaths from all causes, whilst in the preceding week they were only 25 per cent., but pneumonia had decreased from 14 per cent. to 12 per cent., and bronchitis from 16 per cent. to 13 per cent. In London there was some improvement in the general health, the total deaths from all causes having decreased from 2643 in the preceding week to 2501, and the annual death-rate per 1000 of the aggregate population had decreased from 34·2 to 32·4. In London 47 per cent. of the deaths from influenza during the week ending March 1 occurred at the ages from twenty to forty-five. In the twenty-one weeks since the commencement of the epidemic in October of last year influenza has caused 32 per cent. of the deaths from all causes, pneumonia 12 per cent., and bronchitis 9 per cent.

SIR ARTHUR EVANS in the *Times* of March 4 acts as spokesman of an influential committee formed under the auspices of the British Academy, and representing various learned societies interested in archæological research, which has presented a memorial to the Lords of the Treasury strongly urging the creation of an Imperial British Institute of Archæology in Cairo, with the aid of a State subsidy. Sir Arthur Evans justly points out that the position occupied by British archæologists in Egypt is markedly inferior as compared with the French and Germans, who already possess institutes of this kind, and with the Americans, who have large resources at their disposal. It is true that the Egyptian Exploration Fund and the British School of Archæology in Egypt, in spite of a very limited income, have done admirable work. But they are hampered by lack of funds to provide a home for their workers, instruction for their students, and an adequate library. Experts working under this system receive neither suitable remuneration nor any guarantee that they will be able to follow up their archæological career. Hence, while many of our university students are ready to assist in the work, they have little encouragement to make archæology their profession. It is also probable that the classes which contributed to these enterprises before the war will be unable to maintain their subscriptions.

A SPECIAL clinical and scientific meeting of the British Medical Association will be held in London on April 8–11. A popular lecture, on the surgery of the war, will be given by Major-Gen. Cuthbert Wallace. An exhibition of surgical instruments, hospital furniture, drugs, foods, sanitary appliances, etc., will be held at the Imperial College of Science and Technology, South Kensington, from Wednesday, April 9, to Friday, April 11, both days inclusive. On the evening of April 9 the Royal Society of Medicine will hold a reception at its house, 1 Wimpole Street, W. The guests will be received by Sir H. D. Rolleston, president of the society. The following discussions have been arranged; the names given are those of the introducers:—*Section of Medicine:* "War Neuroses," Lt.-Col. F. W. Mott; "Influenza" (in conjunction with the Section of Preventive Medicine and Pathology), Major-Gen. Sir W. Herringham, Capt. M. Greenwood, and Major Bowman; "Venereal Disease," Brevet-Col. L. W. Harrison; and "Prognosis in Cardio-vascular Affections," Dr. T. Lewis. *Section of Surgery:* "Gunshot Wounds of the Chest," Col. T. R. Elliott and Col. G. E. Gask; "Wound Shock," Prof. W. M. Bayliss and Dr. H. H. Dale; and "A Review of Reconstructive Surgery," Major R. C. Elmslie and Major W. R. Bristow. *Section of Preventive Medicine and Pathology:* "The Dysenteries: Bacillary and Amœbic," Col. L. S. Dudgeon and Prof. W. Yorke; "Influenza" (at a joint meeting with the Section of Medicine); and "Malaria," Lt.-Col. S. P. James.

THE introduction of the aniline dye industry has, as is well known, ruined the art of vegetable dyeing; and though we possess ancient fabrics dyed with vegetable colours, it is often not possible to trace the plants which yielded them. The aborigines of America were well versed in the art, and many Peruvian textiles are remarkable for their beautiful and permanent colours. Mr. W. E. Safford, in the Journal of the Washington Academy of Sciences (vol. viii., No. 19), gives an interesting account with figures of the xochipalli, or flower-paint of the Aztecs, which has hitherto been unidentified. The plant was described and figured three centuries ago, and has been supposed to be a species of Tagetes, but Mr. Safford has proved that the plant is really *Cosmos sulphureus*, and has verified his discovery by obtaining the rich orange-red from a decoction of the flowers, which is the colour of xochipalli described by Hernandez. Several of the other beautiful pigments derived from vegetables, used by the ancient Mexicans for the picture-writing of their celebrated codices, are referred to in this paper, and the names of the plants are given.

IN the February issue of *Man* Dr. W. Crooke discusses the question of hut-burning in India. In recent years several notices have been published of a custom prevailing from the Punjab southward to the Central Provinces of barren women burning pieces of thatch taken from the roofs of seven huts in the hope of obtaining offspring—a custom which in some places has led to fires and loss of life. The practice was explained by the late Mr. R. V. Russell on the theory that the woman burns the thatch in the hope that the spirit of one of the children of the family may be reincarnated in her body. It is true that dead children are often buried under the threshold in the belief that their spirits may be reborn in one of the women of the family, but, as Dr. Crooke observes, the intentional destruction of animal life is repugnant to many Hindus, and examples of reincarnation, as suggested in the present case, do not seem to be forthcoming. Dr. Crooke suggests another explanation. A barren woman is naturally regarded as being under taboo, sterility being universally attributed to the agency of malignant spirits. He quotes many instances to show that it is the custom that when a man or woman is accused of adultery or other offences against the laws of caste, the offender is purified by passing through seven straw booths which are successively set on fire. This leads to the conclusion that, in the case of barren women, the rite is a form of purgation which relieves her of the impurity to which sterility is attributed.

PROF. D'ARCY THOMPSON, in the January–February issue of the *Scottish Naturalist*, continues his most interesting notes on whales landed at the Scottish whaling stations, dealing in the present instalment with the bottle-nose, humpback, and finner whales. During the six years covering the period of these observations only twenty of the first-named species were landed at the Scottish stations, and this, not because of its rarity, but because it does not pay commercially to take these animals in small numbers, when they have to be towed ashore to be "tried out." Of the specimens landed none were fully adult. Of the humpback whales only thirty-one specimens were landed in Scotland during this period. Twenty-three were males, the largest of which measured 51 ft. in length. July was the chief month of capture. The finner, or common rorqual, is by far the commonest species taken at these stations, as is shown by the fact that during the period under review no fewer than 2409 were killed. The largest of the females, which slightly exceed the males, measured 81 ft. in length. Finally, in regard to all the species, Prof. Thompson gives some valuable figures as to the relation of the girth to the length, and much very acceptable information as to migration.

MR. C. RAUNKIAER (*Kgl. Danske Videnskab. Selskab. Biol. Meddel.*, i., 3, 1918) contributes a paper (in French) of considerable detail entitled "Statistical Investigations on Plant Formations," dealing more especially with those of northern Europe. A general description is given of the frequency and distribution of the species entering into the formations, of the relative proportions of the species, and of the common biologic characteristics by which the species of a formation adapt themselves to their habitat. The chief points to be noted for a complete ecological description of any given area are summarised, and a scheme is drawn up for a scientific description of plant formations.

THE Department of Agriculture of the Union of South Africa has issued a useful little pamphlet (Bulletin No. 5, 1918) entitled "Agricultural Grasses and their Culture," by Mr. H. A. Melle. In the early days, when the open veld afforded large areas of excellent pasture, little, if any, attention was given to the improvement of pastures. But the smaller farms consequent on a denser population of the country has necessitated experiments with exotic grasses for the improvement of pastures. The pamphlet gives an account of the grasses and some of the forage plants grown at the Botanical Experiment Station, Pretoria, and the writer discusses the merits and characteristics of the different species, so that farmers may judge for themselves which particular grass will be best suited for their purpose and locality.

VOL. VI. of "Fossil Vertebrates in the American Museum of Natural History" has just been received from the Department of Vertebrate Palæontology of that institution. It includes contributions 168 to 192, which appeared during the years 1915 to 1917 inclusive, from the studies of Osborn, Matthew, Brown, Granger, Gregory, Mook, Anthony, Watson, and von Huene. These articles are collected from the Museum Bulletin volumes of the corresponding years. The edition is limited to sixty copies, and is distributed to the principal research centres in various countries.

MR. R. H. PARSONS contributes a valuable paper on the coal consumption of steam-power plant to the *Electrical Review* of February 21. He points out that if the consumption of coal in a power station be plotted against the horse-power developed, all the points lie practically on a straight line. If W be the number of pounds of coal consumed and P the brake-horse-power developed, then, in symbols, $W=a+bP$, where a and b are constants which depend on the plant in the station. Similarly, if W' be the number of pounds of steam consumed, we have $W'=c+dP$, where c and d are constants. These laws are practically identical with the laws which Willans proved in connection with high-speed engines. We deduce, for instance, that the steam consumed per brake-horse-power developed will be W'/P, *i.e.* $d+c/P$. It is suggested that the mean lines should be found which give the graphs of W, P and W′, P for the central station. If all the actual points shown on the curve lie very near this line, then the station is being worked economically. Whenever the points lie considerably above the mean line there is need for inquiry, and the fault will be found either in the boiler- or in the engine-room.

AN article on the economic size of concrete ships appears in *Engineering* for February 14. The author —Mr. E. O. Williams—plots a series of curves, and deduces from them the following information:—After 1500 tons dead-weight the displacement increases more rapidly than the increase in dead-weight. Minimum indicated horse-power per ton dead-weight occurs at 8000 tons dead-weight. Minimum cost of hull occurs at 4000 tons dead-weight. From these points it appears that the economic limit to concrete ships is between 5000 and 8000 tons dead-weight. At 1500 tons dead-weight the concrete ship is most favourably compared with a steel ship for displacement and indicated horse-power. The saving in steel at 1500 tons dead-weight is 74 per cent., and at 8000 tons dead-weight 38 per cent. Vessels above 8000 tons dead-weight are not economic in concrete; there is no saving in steel at 12,000 tons dead-weight; the displacement and the cost of the hull per ton dead-weight increase rapidly above 8000 tons. Concrete ships are most economical between dead-weights of 1500 and 4000 tons, and the best size is in the neighbourhood of 3500 tons dead-weight.

THE leading article in *Engineering* for February 21 deals with concrete roads, and considers the requisites of a good road with the view of discussing how far concrete fulfils the requirements. There is no question regarding the hardness of well-made concrete, but the length of life depends upon various other considerations. The road should offer low resistance to the movement of traffic over it. Recently some experiments were made in California with the view of ascertaining the pull necessary on different road surfaces to keep three tons of load in motion after it had been started. With water-bound macadam in good condition the pull was 64 lb. per ton; on a bituminous road, 49 lb.; on unsurfaced concrete, 28 lb. In other words, the load which would be kept in motion by four horses on unsurfaced concrete would require seven horses on an asphaltic surface and nine on a water-bound macadam. Concrete roads do not disintegrate under the traffic, and do not soften with rain or snow; there is, therefore, neither dust nor mud. Cleansing the surface can be carried out easily and rapidly without damaging the surface in any way whatever. The surface of a properly made concrete road does not work into waves, nor does it disintegrate or develop holes. The ideal road must not be slippery, and modern concrete roads possess surfaces which afford a good grip for hoof or tyre. Owing to the readiness with which water runs off the surface a much smaller camber may be employed, and there is thus less temptation for drivers to use the middle of the road only. Concrete roads are not affected by climatic conditions. The initial cost is higher, but the maintenance cost is much lower, than both water-bound and bituminous macadam.

The maintenance cost of the experimental stretch of concrete on the London to Chatham road, laid in 1915, has been *nil* during the four years.

A NEW series entitled "Manuals of the Science of Industry" is announced by *Messrs. Longmans and Co.* It will be edited by E. T. Elbourne, and the first volumes will be "Labour Administration," the Editor; "Law and Industry," A. S. Comyns Carr; and "Health and Industry," W. H. Judson. These are in active preparation. The *Open Court Co.* will publish shortly "Lectures on the Philosophy of Mathematics," J. B. Shaw. The *Wireless Press, Ltd.*, has in the press "The Year-Book of Wireless Telegraphy and Telephony, 1919"; "Continuous-wave Wireless Telegraphy," Dr. W. H. Eccles, part i.; "Telephony without Wires," P. R. Coursey; "Alternating-current Working," A. Shore; "Principes Elémentaires de Télégraphie sans Fil," R. D. Bangay; and "Manual de Instruccion Tecnica para operadores de Telegrafia sin Hilos," J. C. Hawkhead and H. M. Dowsett.

THE latest catalogue (No. 177) of Messrs. W. Heffer and Sons, Ltd., Cambridge, mainly deals with books treating of subjects outside the range of a journal such as NATURE, but one section gives particulars of some recent purchases of works relating to scientific subjects. Among them we notice vols. i. to xiii. of the *New Phytologist*; Moore's "Lepidoptera Indica," 10 vols.; Moore's "The Lepidoptera of Ceylon (Rhopalocera and Heterocera)"; "Catalogue of the Birds in the British Museum," "Catalogue of Birds' Eggs," "Hand-List of Birds," "General Index," in all 38 vols.; Sowerby's "English Botany, or Coloured Figures of British Plants, with their essential Characters, Synonyms, and Places of Growth," and the index, with the Supplements, and MS. index; Parkinson's "Theatrum Botanicum: The Theatre of Plants, or an Herbal of a Large Extent," first edition; and Roscoe's "Monandrian Plants of the Order Scitaminæ."

THE special catalogues of Messrs. J. Wheldon and Co., 38 Great Queen Street, Kingsway, W.C.2, are always worthy of note, being very carefully classified and containing books not easily procurable. The one just issued (new series, No. 86) is no exception to the rule, and should be seen by all entomological readers of NATURE. It contains particulars of more than 1100 volumes dealing with entomology in its various branches, conveniently arranged under the headings Lepidoptera, Coleoptera, Arachnida, Myriapoda, Diptera, Hemiptera, Hymenoptera, Neuroptera, Orthoptera, General Entomology, and Economic Entomology. In addition, attention is directed to sets and long runs of many scientific serials. The catalogue is sent post free on receipt of 2*d*.

OUR ASTRONOMICAL COLUMN.

THE REFORM OF THE CALENDAR.—It will be remembered that this subject was much to the fore before the war, and it is now again attracting attention. The *Comptes rendus* of the Paris Academy of Sciences for January 6 and 20 contain papers upon the subject by M. G. Bigourdan and M. H. Deslandres respectively. Both agree that each quarter should consist of two months of thirty days each, followed by one of thirty-one. This makes each quarter just thirteen weeks. There would be a supplementary day at the middle of the year; in leap-year an additional one at the end. M. Deslandres (but not M. Bigourdan) is in favour of putting these days outside the weekly reckoning, so that every year would have the same days of the week on the same days of the month. There is no question that the existing calendar, with its irregular months, short February, and leap-day at the end of the second month, is very ill-contrived; it is only the difficulty of agreement as to the best alternative that has permitted it to survive so long.

DARK MARKINGS ON THE SKY.—Prof. Barnard has often described these dark patches of definite outline, which strongly suggest, by their appearance and by the abrupt alteration in star-density, that they are due to clouds of obstructing matter. He gives a catalogue of 182 of these objects in the *Astrophysical Journal* for January. They are mainly, but not wholly, in the Galaxy. He suggests that in many regions of the sky there is enough background luminosity, due either to unseen stars or diffused nebulous matter, to throw them into relief; one such is in R.A. 4h. 22m. 50s., N. decl. 46° 21′; it is a dark, elliptical space 15′ × 10′. It is curious that Prof. Barnard's paper is in juxtaposition with one by Dr. Harlow Shapley on the distances of the globular clusters; taken in conjunction with recent evidence of the wide distribution of calcium in cosmic clouds, it tends to weaken our confidence in the perfect transparency of space which is one of the postulates of Dr. Shapley's deductions. Prof. Barnard gives photographic reproductions of nine of the dark regions in the galactic clouds. In some cases they are fairly round and regular, in others they present complicated and contorted forms.

THE ASTROGRAPHIC CATALOGUE.—Vol. ii. of the Hyderabad section of this Catalogue has just been published, containing the measures of the stars on the plates the centres of which lie in decl. −18°. There are 61,378 stars in the volume, which is at the rate of $3\frac{1}{2}$ millions to the whole sky. Their x, y co-ordinates are given, and the measured diameters. A separate formula is calculated for each plate, of the form $A-B\sqrt{d}$, to reduce to the ordinary magnitude scale. The limiting magnitude for most of the plates appears to be about 13. Standard co-ordinates are also given for all the stars that occur in the Algiers or Washington Astr. Gesellschaft catalogues, which are for the same epoch (1900) as the present catalogue. There are also auxiliary tables for forming the R.A. and declination of any star, if required.

This volume has a pathetic interest in that the director, Mr. R. J. Pocock, has died since it was sent to press. In spite of war difficulties, he accomplished a great deal of work during his few years at Hyderabad. Much of it is still unpublished.

A SUGGESTED GOVERNMENT CHEMICAL SERVICE.

AN important memorandum has been drawn up by the council of the Institute of Chemistry, which desires to direct the attention of the Government to the increasing and vital importance of chemical science in affairs of the State. The memorandum is published in the Proceedings of the institute, part iv., recently issued.

The council is of opinion that the time is opportune for taking steps to secure for the profession of chemistry a position corresponding with that occupied by other learned professions. It considers that much would be accomplished towards the attainment of that aim if, in the first place, adequate and uniform conditions of appointment were accorded to chemists directly engaged in the service of the State. These include chemists occupied in research, in analysis, and in technological work, as well as those employed in educational work. It is chiefly to the first three branches that the memorandum relates.

Only persons possessing recognised qualifications should be eligible for appointment as chemists in the Government chemical service. Such appointments should be rendered attractive to those who have reached the required standard of efficiency, and there should be no confusion between these chemists and their unqualified assistants.

The council regards it as a first principle that steps should be taken to remove the confusion (existing in this, but in no other country) which arises from the use of the title "chemist" by those who practise pharmacy.

It is suggested that the appointment of chemists should be based on a system of selection by properly constituted authority, and not by examination or nomination. Further, the persons appointed as chemists should be graded as Civil Servants in the higher division, preferably as members of a professional division, with status, emoluments, and pension comparable with those of the members of other technical and learned professions employed by the Government.

A further suggestion is that, subject to satisfactory service being given, the system should provide for certainty of promotion, independently of the occurrence of vacancies, up to a definite rank, not necessarily the highest, but one securing an adequate salary to a married man. This is regarded as essential if men of the best type are to be obtained. A chemist should be constantly increasing in efficiency, and this should be recognised by the provision mentioned.

Suitable titles for the service, it is considered, would be Chief Chemist (with a special departmental title in certain cases), followed by Deputy Chief Chemist, Superintending Chemist, and Assistant Chemists (Principal, Senior, and Junior). The rank held by the head chemist would be determined by the size of the establishment and the nature of the work carried out. The secondary staff, to whom the title of chemist would not apply, should be classified into Chemical Assistants, Laboratory Assistants, and Laboratory Attendants. The first of these three classes would include men of good education, but without full professional qualification; on obtaining this they would be eligible for appointment as chemists.

The council of the institute believes that direct advantage would accrue to the State from such an organisation, and that the status of the profession of chemistry would be raised. This would, incidentally, contribute to the advancement of chemical science.

ROGER BACON (1214–94).

IN a paper entitled "Notes on the Early History of the Mariner's Compass" in the *Geographical Journal* for November, 1918, Mr. M. Esposito ably shows the difficulty of stopping a fable when it has once gone forth, and, incidentally, reveals the small amount of knowledge possessed even by eminent men of science of the actual facts of the life of the first modern man of science. Mr. Esposito clearly demonstrates to the scientific public what was already known to Baconian scholars: that Roger Bacon, great as are his titles to remembrance, was neither the inventor nor introducer of the mariner's compass.

At a time when the claims of Englishmen to a leading place in the history of science are being pressed with so much vigour, it is disheartening to find that the great founder of modern scientific thought, though himself an Englishman, is usually forgotten or his work misunderstood. Oxford, his *alma mater*, with her thoughts and gaze turned to the remoter past, has scarcely glanced at Bacon, and, save for the faithful labours of Prof. Little, Dr. Withington, and the late J. H. Bridges, has only thought fit to regard one of the greatest of her sons as a buffoon for her pageant. Italy has her national edition of Galileo; France has produced, at the expense of her Government, two monumental editions of the works of her national philosopher, Descartes; and even little Denmark has found a private patron to provide the magnificent definitive edition of Tycho Brahé. Yet the writings of Bacon remain neglected, many of them unprinted, most of them in old or inaccurate editions. Even more astonishing is the fact that not a single important work of Bacon has appeared in English. Were it not for the public spirit of Mr. R. R. Steele, who for years has been labouring at the text, and whose fascicules have been issued from the Clarendon Press, Bacon, the herald of the new dawn, would have been almost forgotten in his own university.

The ideas in circulation as to the achievements of Roger Bacon are usually so vague that it may be convenient to place on record, in categorical form, his claims as a scientific pioneer:—

(1) He attempted to set forth a system of natural knowledge far in advance of his time. The basis of that system was observation and experiment. He was clearly the first man in modern Europe of whom this can be said.

(2) He was the first man in modern Europe to see the need for the accurate study of foreign and ancient languages. He attempted grammars of Greek and Hebrew along definite scientific lines. He also projected a grammar of Arabic. Moreover, he laid down those lines of textual criticism which have only been developed within the last century.

(3) He not only expatiated on the experimental method, but was himself an experimenter. The criteria of priority were not then what they are now, but his writings are important in the development of the following sciences:—

(*a*) *Optics*.—His work on this subject was a text-book for the next two centuries. He saw the importance of lenses and concave mirrors, and showed a remarkable grasp of mathematical optics. He described a system which is equivalent to a two-lens apparatus, and there is trustworthy evidence that he actually used a compound system of lenses equivalent to a telescope.

(*b*) *Astronomy* was Bacon's perpetual interest. He spent the best part of twenty years in the construction of astronomical tables. His letter to the Pope in favour of the correction of the calendar, though unsuccessful in his own days, was borrowed and re-borrowed, and finally, at third-hand, produced the Gregorian correction.

(*c*) *Geography*.—He was the first geographer of the Middle Ages. He gave a systematic description, not only of Europe, but also of Asia and part of Africa, and collected first-hand evidence from travellers in all these continents. His arguments as to the size and sphericity of the earth were among those that induced Columbus to set out on his voyage of discovery.

(*d*) *Mechanical Science*.—Suggestions described by him include the automatic propulsion of vehicles and vessels. He records also the working out of a plan for a flying-machine.

(*e*) *Chemistry*.—The chemical knowledge of his time was systematised in his tracts. His description of the composition and manufacture of gunpowder is the earliest that has come down to us. It is clear that he had worked out for himself some of the chemistry of the subject.

(*f*) *Mathematics*.—His insistence on the supreme value of mathematics as a foundation for education recalls the attitude of Plato. It was an insistence that the method of thought was more important than its content.

Summed up, his legacy to thought may be regarded as accuracy of method, criticism of authority, and reliance on experiment—the pillars of modern science. The memory of such a man is surely worthy of national recognition. CHARLES SINGER.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE seventy-first meeting of the American Association for the Advancement of Science was held at the Johns Hopkins University, Baltimore, Md., on December 23–28, 1918, under the presidency of Dr. John Merle Coulter, of the University of Chicago.

The arrangements for the meeting were made before the close of the war, and the armistice in November was, naturally, not anticipated. It had been intended originally to hold this meeting in Boston, but the place was changed on account of the fact that Baltimore (in close proximity to Washington) was most convenient for the small army of scientific workers who were engaged at the national capital. In the interval between November 11 and the Christmas holidays, however, the character of the programme was largely altered, and reconstruction papers were substituted in many cases for war papers, and some of the symposia were altered accordingly. The total attendance approximated eight hundred, and the following affiliated societies met with the association:—Americal Physical Society, Optical Society of America, Association of American Geographers, Geological Society of America, American Society of Naturalists, American Society of Economic Entomologists, Ecological Society of America, Botanical Society of America, American Phytopathological Society, American Anthropological Association, Psychological Association, American Metric Association, Society of American Bacteriologists, American Society of Horticultural Science, Society of American Foresters, School Garden Association of America, and American Association of the University Professors.

The outstanding character of the meeting is indicated by the titles of some of the addresses and symposia, a few of which may be mentioned. The address of Dr. H. J. Waters, of Section M, is entitled "The Farmers' Gain from the War," and this was followed by a symposium on "The Agricultural Situation in Europe and Measures for Reconstruction." Members of the American Agricultural Mission, recently returned from Europe, took part in this symposium. The address by Dr. H. S. Drinker, before Section D, was on "The Need of Conservation of our Vital and Natural Resources as Emphasised by the Lessons of the War."

The American Foresters' Association held a symposium on "Forest Reconstruction." Section L held one on "The Education of the Disabled Soldier." The Optical Society of America presented a symposium on applied optics, and the address of the president, Dr. F. E. Wright, was on the optical industry in war-time. Before the Association of American Geographers Prof. G. A. Condra read a paper entitled "Potash a Factor in Winning the War," and Prof. R. DeC. Ward on "Weather Controls over the Fighting during the Autumn of 1918."

Section F, in a joint meeting of the American Society of Naturalists, held an important symposium on the subject of "The Need of Securing Better Co-operation between Government and University Laboratory Zoologists in the Solution of Problems of National Importance." This symposium is the direct outcome of the war, the university men having become convinced that they can help the Government more than they have in the past.

Dr. R. A. Harper, of Section G, discussed "The Stimulation of Botanical Research after the War," and Dr. G. T. Moore "Botanical Participation in War-work." The programme of the American Phytopathological Society contained several discussions of war emergency projects in regard to crop diseases.

The programme of Section H and of the American Anthropological Association dealt almost entirely with questions relating to the war. Some of the titles may be mentioned:—"A Unified Blank of Measurement to be Used in Recruiting in Allied Countries: A Plea for the Unification of Anthropological Methods," by Prof. Fabio Frasetto, of the Royal Italian Embassy, and also of the University of Bologna; "The War Museum and its Place in the National Museum Group," by Dr. W. H. Holmes; "Race Origin and History as Factors in World-Politics," by Dr. J. C. Merriam; "The Effect of the War upon the American Child," by Ruth McIntire, of the National Child Labour Committee; "The War and the Race," by Dr. A. Hrdlička, U.S. National Museum; and "Examinations of Emotional Fitness for Warfare," by Dr. R. W. Woodworth, of Columbia University. There were also several papers before Section H relating to the psychological examination of the American troops by officers of the Reserve Army.

Section I (Social and Economic Science), as usual, presented a varied programme, but on the last day of the meeting held a reconstruction symposium, in which several very important papers were read. Dr. David J. Hill, formerly United States Ambassador to Germany, gave an address on "Germany after the War"; M. Edouard de Billy, of the French High Commission, spoke of France after the war; Dr. William H. Welch, of the Johns Hopkins University, spoke of the health problems of reconstruction; Mr. Charles Pergler, Commissioner in the United States of the Czecho-Slovak National Council, gave an address on the future of the Czecho-Slovak State; Sir H. Babington Smith, of the British Embassy, spoke on the reconstruction of Great Britain following the war; and Mr. J. W. Bain, of Canada, on the reconstruction after the war in Canada. Mr. John Barrett, Director-General of the Pan-American Union, who presided at this session, gave an address on the subject of "Pan-Americanism after the War."

The retiring president of the association, Prof. Theodore W. Richards, of Harvard University, was to have given his address at the opening meeting of the session on the subject "The Problem of Radio-active Lead." Most unfortunately, Prof. Richards was seized with "Spanish" influenza when on the point of leaving Boston, and was unable to be present at the Baltimore meeting. The proceedings at the general session were, therefore, brief, and consisted of an address of welcome by Dr. F. J. Goodnow, president of the Johns Hopkins University, and a reply by President-elect Coulter.

The titles of the addresses of the retiring vice-presidents of the sections which met at Baltimore were:—Section A, Prof. Henry N. Russell, of Princeton, "Variable Stars"; Section B, Dr. W. J. Humphreys, of the U.S. Weather Bureau, "Some Recent Contributions to the Physics of the Air"; Section C, Prof. W. A. Noyes, of the University of Illinois, "Valency"; Section D, Dr. H. S. Drinker, president of Lehigh University, "The Need of Conservation of our Vital and Natural Resources as Emphasised by the Lessons of the War"; Section E, Prof. G. H. Perkins, of the University of Vermont, "Vermont Physiography"; Section F. Prof. Herbert Osborn, of the University of Ohio, "Zoological Aims and Opportunities"; Section G, Prof. Burton E.

Livingston, of the Johns Hopkins University, "Some Responsibilities of Botanical Science"; Section H, Prof. E. L. Thorndike, "Scientific *Personnel* Work in the United States Army"; Section L, Prof. E. F. Buchner, of the Johns Hopkins University, "Scientific Contributions of the Educational Survey"; and Section M, Prof. H. J. Waters, of the University of Kansas, "The Farmers' Gain from the War" (Prof. Waters was unable to be present, and the address was not read).

The effect of the meeting on those who attended was inspiring, and the emphasis which the war has placed upon the value of scientific investigation was strongly shown throughout the whole list of papers.

The council arranged for a permanent committee on grants, to consist of nine members, of which Prof. Henry Crew was made chairman, and Prof. Joel Stebbins secretary, both of the University of Illinois. The council, through its committee on policy, also proposed at the general session a complete revision of the constitution of the association, which reorganises and simplifies the work of the association to a very great degree. The full revision will be published in the journal *Science*, and acted upon at the next meeting of the association.

At the meeting of the general committee Dr. Simon Flexner, of the Rockefeller Institute for Medical Research, was made president of the association for the coming year, and St. Louis was chosen as the meeting place, the next meeting to begin on December 29 next. The following officers were also elected:—Vice-presidents (chairmen of sections): Section B, Prof. Theodore Lyman, of Harvard University; Section C, Prof. B. F. Lovelace, of the Johns Hopkins University; Section E, Prof. C. K. Leith, of the University of Wisconsin; Section F, Prof. William M. Wheeler, of Harvard University; Section G, Prof. L. H. Pammel, of the Iowa State College; Section H, Prof. R. M. Yerkes, of the University of Minnesota; Section L, Prof. V. A. C. Henmon, of the University of Wisconsin; and Section M, Dr. A. F. Woods, president of the Maryland Agricultural College. Elections of vice-presidents of Sections A, D, I, and K were postponed to the spring meeting of the council.

Dr. George T. Moore, director of the Missouri Botanical Garden, was elected general secretary, and Prof. James F. Abbott, of Washington University, was elected secretary of the council.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Sir J. J. Thomson has expressed his desire to resign the Cavendish professorship of experimental physics, and at the same time has generously offered to continue his services in the promotion and direction of research work in physics without stipend. It is considered of such great importance for the school of physics that Sir J. J. Thomson should continue to be associated with it as a professor that the syndicate to which the question has been referred recommends that a new professorship without stipend, to be called the professorship of physics, should be established for him. It is proposed that this professorship should terminate with his tenure of the office unless the University should meanwhile determine otherwise. The Cavendish professorship of experimental physics has accordingly been declared vacant, and the election of a professor will take place on April 2. Candidates for the vacant professorship are requested to communicate with the Vice-Chancellor, and to send such evidence as they may desire to submit to the electors on or before Wednesday, March 26.

The election to the professorship of mechanism and applied mechanics will take place on March 28.

Mr. R. A. Peters, of Gonville and Caius College, has been appointed senior demonstrator of biochemistry.

MR. A. J. TURNER has been appointed to the chair of textile technology in the College of Technology, Manchester. Mr. Turner had a distinguished career at Gonville and Caius College, Cambridge, and during the latter part of 1912 he was engaged in research work in organic chemistry at Cambridge under Sir William Pope. He later accepted an appointment upon the scientific staff of the National Physical Laboratory, where he was chiefly engaged in research work on fabrics and dopes for aeronautical purposes. Following this he was appointed to the charge of the fabrics laboratory of the Royal Aircraft Establishment.

A STATEMENT for the year 1918 as to the Rhodes scholarships has just been issued. Only nine scholars were in residence during the year. Of these four had previously been on active service, two had been rejected for service on medical grounds, and three were carrying on their medical studies with a view to early qualification. There were also in residence in the course of the past year fifteen holders of overseas scholarships, granted by the Rhodes Trust and certain other bodies. Of the fifty scholars elected for 1917, forty-six took military service, two were rejected on medical grounds and accepted Government work instead, and two have been otherwise employed. The election of scholars, postponed on account of the war, will be resumed in October of the present year (1919). It is hoped that by that time the demobilisation of the armies will be so far completed that intending candidates who have taken military service will have an opportunity to compete. It is proposed to fill up in October of this year only the 1918 and 1919 postponed scholarships. During the years 1917 and 1918 the organising secretary of the Trust, Dr. G. R. Parkin, visited most of the States of the American Union and the provinces of Canada, and made an exhaustive study, in consultation with university and college authorities, of the operation in those countries of the system pursued in the selection of scholars since the foundation of the Trust. As a result of this investigation certain changes in the methods of selection have been under consideration. Among other changes it has been decided that candidates in the United States who are otherwise eligible shall no longer be required to pass a qualifying examination, but shall be selected, with due reference to the suggestions of Mr. Rhodes, on the basis of their university or college standing, subject to any further test which the committees of selection may, in their discretion, impose.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 27.—Sir J. J. Thomson, president, in the chair.—Hon. R. J. **Strutt**: Scattering of light by solid substances. Glasses of all kinds show a strong internal scattering of light. The beam viewed laterally is strongly, but not completely, polarised. Yellow and smoky quartz also show a strong scattering. One specimen gave a polarisation so nearly complete that an analysis set for minimum intensity transmitted only 0·7 of 1 per cent. of the scattered light. If a polarised beam is passed along the axis of such a quartz crystal, there are for a given wave-length maxima and minima of scattered light along the length of the beam. This is due to the rotatory property. Owing to rotatory dispersion the period is different for different wave-lengths, and coloured bands result. The clearest and whitest quartz has some scattering power, though much less than that of glass or liquids. In one case examined the intensity was about eight times that due to dust-free air at atmospheric pressure. This small scattering is considered to be due to inclusions, as in the case of visibly smoky or yellow quartz. The regular atomic structure, which has a period small compared with the wave-length of ordinary light, should give no scattering. For very short wave-lengths (X-rays) the well-known diffraction effects of crystals come in.—Sir James **Dobbie** and Dr. J. J. **Fox**: The constitution of sulphur vapour. Investigations based on the determination of the vapour density leave the question of the existence of sulphur molecules intermediate in complexity between S_8 and S_2 unsettled. The present paper contains an account of an attempt to solve the problem by the study of the absorptive power of the vapour of sulphur for light under various conditions of temperature. When light from a suitable source is passed through the vapour and examined with the spectroscope at successively higher temperatures it is found that the amount of absorption caused by the vapour gradually increases up to about 650° C., after which it decreases as the temperature rises until 900° C. is reached, above which no further change occurs.—Dr. W. G. **Duffield**, T. H. **Burnham**, and A. H. **Davis**: The pressure upon the poles of the electric arc. For many reasons the projection of electrons from the cathode of an electric arc is to be expected, and the mechanism of the arc appears to require it. If this projection exists, it is likely to occasion a mechanical recoil upon the cathode. A pressure was looked for in 1912 and discovered. It remained to determine if the magnitude was such as to be accounted for by electronic projection. Numerous sets of observations upon anode and cathode were taken with varying current and arc-length and different dispositions of apparatus. The pressure was found to be about 0·17 dyne per ampere, or when convection current effects were eliminated so far as possible, 0·22 dyne per ampere. The effect does not appear to be due to radiometer action, and is about two hundred times too small to be referred to the expulsion of carbon atoms at the boiling-point of that element. Such evidence as has been obtained thus favours the recoil being due to the projection of electrons.

Physical Society, February 14.—Prof. C. H. Lees, president, in the chair.—S. **Skinner** and R. W. **Burfitt**: Temperature coefficient of tensile strength of water. The liquid is forced under pressure through a capillary constriction between two limbs of a U-tube. By trial the pressure is adjusted until the speed in the capillary is sufficient to produce rupture. This is judged by the sound and also the appearance. The whole U-tube is immersed in a bath, the temperature of which can be varied. Actual observations of rupture, velocity, and temperature are recorded up to about 100° C., from which it is deduced that the tensile strength becomes zero in the neighbourhood of 245° C., which is in agreement with theory.—Prof. W. H. **Eccles**: Vector diagrams of some oscillatory circuits used with thermionic tubes. The method of the crank or vector diagrams used commonly in the study of alternating-current circuits is applied in the paper to the assemblage made up of an oscillator, the thermionic relay maintaining it in oscillation, and the devices linking these two parts. The diagrams then serve as substitutes for the usual treatment of the problem by differential equation, and from them may be obtained all the formulæ. They have, besides, the advantage of exhibiting to the eye the phases of the currents and voltages in every part of the circuits. In forming the diagrams the potential drop across the oscillator is calculated by the usual rules of the alternating-current diagram, and added geometrically to the potential drop across the tube. This total is made equal, in magnitude and phase, to the voltage applied at the instant to the grid multiplied by the voltage factor of the relay. In its turn the voltage applied to the relay depends upon, and is obtained from, the current running in a portion of the oscillator. The fitting together of these lines gives all the conditions to be satisfied for the maintenance of steady oscillations.—Prof. W. H. **Eccles** and F. W. **Jordan**: A small direct-current motor using thermionic tubes instead of sliding contacts. In this motor the rotating part is an ebonite disc with iron teeth on its periphery, and the stationary part comprises two electromagnets with their poles close to two teeth. One electromagnet is connected to the grid of a thermionic relay, the other is included in the plate circuit. When during rotation a tooth passing the grid magnet induces a voltage in its winding, the consequent transient increase of current through the other magnet causes this magnet to exert a pull on the tooth approaching it. We thus have a small motor without commutator or spark which may under no-load be driven up to a speed of 4000 to 6000 revs. per min. from the lighting supply.

Geological Society, February 21.—Mr. G. W. Lamplugh, president, in the chair.—Annual general meeting.—G. W. **Lamplugh**: Presidential address: The structure of the Weald and analogous tracts. (1) The anticline of the Weald is a superficial structure dependent upon an underlying syncline. The lens of sediments thus bounded was deposited in a gradually deepening trough, which was afterwards shallowed by partial recovery. (2) The Jurassic rocks of the rest of England have had a similar history, and show an analogous structure modified by unequal uplift. (3) The Triassic and most of the Carboniferous rocks of England appear also to have been accumulated in deepening troughs or basins, which were afterwards shallowed by differential uplift where the deposits were thickest. (4) Where the formations dealt with lie above sea-level, the present outcrops represent the areas of maximum development, and therefore coincide roughly with the position of the deepest parts of the old troughs. This factor may be of wide application, and has a practical bearing.

February 26.—Mr. G. W. Lamplugh, president, in the chair.—Col. T. W. Edgeworth **David**: Geology at the Western Front.

Zoological Society, March 4.—Dr. A. Smith Woodward, vice-president, in the chair.—G. A. **Boulenger**: Fishes from Lake Tanganyika, including three new species.—Miss Joan B. **Procter**: The skull and affinities of *Rana subsigillata*. Attention was directed to several cranial characters either peculiar to this frog or held in common with *R. adspersa*, its nearest ally.

DUBLIN.

Royal Irish Academy, January 27.—Mr. T. J. Westropp, vice-president, in the chair.—R. Ll. **Praeger**: Species of Sedum collected in China by L. H. Bailey in 1917. The collection included three new species, *S. limuloides*, *S. baileyi*, and *S. quaternatum*, the first being a remarkable plant of doubtful affinities, and the second a member of a group (Involucrata) confined as hitherto known to the Caucasus and Asia Minor.

February 10.—Prof. G. H. Carpenter, vice-president, in the chair.—A. **Henry** and Miss M. G. **Flood**: The history of the London plane, *Platanus acerifolia*. This tree, unknown in the wild state, and invariably propagated by cuttings, is much planted in the streets of towns in Europe and the United States, where it surpasses all other trees in resistance to evil conditions of soil and atmosphere. It has all the characters of a first cross, its leaves and fruits being intermediate between the two wild species, *P. orientalis* and *P. occidentalis*, while its vigour is remarkable. It moreover produces, when its seeds are sown, a mixed and diverse crop of seedlings, in which are variously combined the characters distinctive of the two parent species. The London plane probably originated as a chance seedling in the Oxford Botanic Garden some time before 1670. Specimens of its foliage, preserved in the Sloane Herbarium at Oxford, were collected by Bobart about that date, and bear the label *Platanus media*, showing that it was then recognised as a hybrid between the Oriental and Occidental planes. This date agrees with the recorded age of the largest London plane known, a magnificent tree at Ely, 110 ft. in height and 23 ft. in girth. Certain cultivated varieties, as *P. pyramidalis*, *P. hispanica*, etc., appear to have originated at a later date as chance seedlings of *P. acerifolia*, as is shown by their history and a careful study of their botanical characters. A complete description of the fruit and leaves of all the species of the genus and of the hybrids is given. The lobing of the leaves, an important character, is measured by a new method.—J. A. **McClelland** and P. J. **Nolan**: The nature of the ions produced by phosphorus. Previous work by the authors and J. J. Nolan has shown the existence of groups of ions of different mobilities produced by spraying water or by bubbling air through mercury or alcohol. The present work shows that similar groups of ions are present in air which has passed over phosphorus. The mobilities range from 0·22 cm. per sec. to 0·000053 cm. per sec. in a field of 1 volt per cm. Drying the air before passing it over the phosphorus brings the more mobile groups into prominence. Three groups of ions of lower mobilities than the atmospheric large ion were observed. The conclusion as to the nature of the phosphorus ions is that they are composed mainly of water.

PARIS.

Academy of Sciences, February 24.—M. Léon Guignard in the chair.—C. **Richet**, P. **Brodin**, and Fr. **Saint-Girons**: Some hæmatic phenomena in anaphylaxy and antianaphylaxy. Three new facts are brought out by experiments on dogs. In anaphylaxy the blood is profoundly modified by the appearance of nucleated red corpuscles, by an increase in concentration, and by the disappearance of the polynuclear cells.—A. **Blondel**: Application of the theory of the two reactions to the calculation of the forced oscillations of synchronised alternators.—M. **Balland**: Military soups.—M. Daniel Berthelot was elected a member of the section of physics in succession to the late E. H. Amagat.—A. **Denjoy**: A property of functions with complex variables.—M. **Risser**: Formulæ representative of trajectories.—M. **Mesnager**: Maximum values of the tension near the lower face of a square plate supporting a single load concentrated at its centre.—E. **Faure**: The gyroscopic force of liquids.—A. **Véronnet**: The central temperature of the sun.—A. **Sanfourche**: The oxidation cycle of nitric oxide in presence of water. The oxidation of nitric oxide in presence of water gives nitrous anhydride, and not nitrogen peroxide, as the intermediate product.—E. **Léger**: The α- and β-oxydihydrocinchonines and their *rôle* in the production of certain isomers of cinchonine.—F. **Grandjean**: Some new examples of the calculation of the extraordinary rays for certain structures of anisotropic liquids.—J. **Renaud**: Difficulties met with in the study of storms as a result of the uncertainty of the time of the observations. The change over from Greenwich time to summer time causes difficulty with self-recording instruments, and in several cases it is not clear from the records whether the chart was changed on the date of the change of time.—L. **Joleaud**: The migrations of the genera Hystrix, Lepus, Anchitherium, and Mastodon at the Neogene epoch.—Em. **Bourquelot** and H. **Hérissey**: Application of the biological method to the study of the leaves of *Hakea laurina*. The extraction of a glucoside (arbutin) and quebrachite. By the successive action of invertin and emulsin, these leaves were proved to contain cane-sugar, quebrachite, and two hydrolysable glucosides, one of which, arbutin, was identified.—G. **Petit**: Remarks on the morphology of the phrenic centre of mammals.—P. **Armand-Delille**: Considerations relating to the unicist conception of the hæmatozoa of benign and malignant tertiary fever.—MM. **Boquet** and L. **Nègre**: Infection, sensibilisation, and immunity in epizootic lymphangitis of the Solipeds.—E. **Belot**: The economical organisation of commercial motor transports in a large town.

BOOKS RECEIVED.

Essentials of Volumetric Analysis. An Introduction to the Subject. Adapted to the Needs of Students of Pharmaceutical Chemistry. By Prof. Henry W. Schimpf. Third edition, rewritten and enlarged. Pp. xiv+366. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 7*s.* net.

Integral Calculus. By Prof. H. B. Phillips. Pp. v+194. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) 6*s.* net.

Elements of General Science. By Prof. Otis William Caldwell and W. L. Eikenberry. Revised edition. Pp. xii+404. (London: Ginn and Co., 1918.) 5*s.* 6*d.* net.

Agricultural Laboratory Exercises and Home Projects Adapted to Secondary Schools. By Henry J. Waters and Prof. Joseph D. Elliff. Pp. vi+218. (London: Ginn and Co., 1919.) 4*s.* 6*d.* net.

A Century of Science in America. With Special Reference to the *American Journal of Science*, 1818–1918. By Edward Salisbury, Dana, and others. Pp. 458. (New Haven: Yale University Press; London: Oxford University Press, 1918.) 17*s.* net.

Military Geology and Topography. A Presentation of Certain Phases of Geology, Geography, and Topography for Military Purposes. Edited by Herbert E. Gregory. Prepared and issued under the auspices of the Division of Geology and Geography, National Research Council. Pp. xv+281. (New Haven: Yale University Press; London: Oxford University Press, 1918.) 5*s.* 6*d.* net.

A Practical Handbook of British Birds. Edited by H. F. Witherby. In eighteen parts. Part i. Pp. xvi+64+2 plates. (London: Witherby and Co., 1919.) 4*s.* net per part.

Introductory Meteorology. Prepared and issued under the auspices of the Division of Geology and Geography, National Research Council. Pp. xii+150. (New Haven: Yale University Press, 1918.) 4*s.* 6*d.* net.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-fifth annual issue. Pp. vii+333. (London: Charles Griffin and Co., Ltd., 1918.) 9*s.* net.

The Science of Labour and Its Organisation. By Dr. Josefa Ioteyko. Pp. viii+199. (London: George Routledge and Sons, Ltd., 1919.) 3*s.* 6*d.* net.

La Genèse de la Science des Cristaux. Par Hélène

Metzger. Pp. 248. (Paris: Félix Alcan, 1918.) 5.50 francs.

A Garden Flora. Trees and Flowers Grown in the Gardens at Nymans, 1890–1915. By L. Messel. With illustrations by Alfred Parsons. Foreword by William Robinson. Notes by Muriel Messel. Pp. ix+196. (London: *Country Life* Offices and George Newnes, Ltd., 1918.) 10*s*. 6*d*. net.

The Quantitative Method in Biology. By Prof. J. MacLeod. (Publications of the University of Manchester. Biological Series, No. 11.) Pp. xii+228. (Manchester: At the University Press; London: Longmans, Green, and Co., 1919.) 15*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—Dr. A. D. Waller: Concerning Emotive Phenomena. III.: The Influence of Drugs upon the Electrical Conductivity of the Palm of the Hand.—Dr. W. L. Balls: The Existence of Daily Growth-rings in the Cell Wall of Cotton Hairs.

ROYAL SOCIETY OF ARTS, at 4.30.—D. T. Chadwick: The Report of the Indian Industrial Commission.

MATHEMATICAL SOCIETY, at 5.—J. Hammond: The Solution of the Quintic.—L. J. Mordell: A Simple Algebraic Summation of Gauss's Sums.—Major P. A. MacMahon: Divisors of Numbers and their Continuations in the Theory of Partitions.—S. Ramanujan: (1) Congruence Properties of Partitions; (2) Algebraic Relations between Certain Infinite Products.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. L. Addenbrooke: Dielectrics in Electric Fields.

OPTICAL SOCIETY, at 7.—Major C. W. Gamble: Some Photographic Apparatus used in Aerial Photography.

FRIDAY, MARCH 14.

PHYSICAL SOCIETY, at 5.—C. C. Paterson and Dr. Norman Campbell: Some Characteristics of the Spark Discharge, and its Effect in Igniting Explosive Mixtures.—Major R. W. Wood: Demonstration entitled "Invisible Light for Military Purposes."

ROYAL ASTRONOMICAL SOCIETY, at 5.—J. Evershed: The Spectrum of Nova Aquilæ.—Nautical Almanac Office: Numerical Differences for 1923 between E. W. Brown's Tabular Places of the Moon and the Places according to Hansen; Tables with Newcomb's Corrections.—A. Pannekoek: Distribution of the Stars of the 11th magnitude.—J. Lunt: The Dark Line Spectrum of Nova Aquilæ No. 3.—G. J. Newbegin: Solar Prominences, 1918.—Cambridge Observatory: Photographic Magnitudes and Effective Wave-lengths of Nova Aquilæ.—A. Stanley Williams: Further Observations of Nova Persei (1901).—Royal Observatory, Greenwich: Preliminary Values of Variation of Latitude, 1918.—E. W. Maunder: Notes on Some of the Sun-spots Measured on Photographs taken at the Royal Observatory, Greenwich, in 1915.—*Probable Papers*—J. H. Jeans: The Internal Constitution and Radiation of Gaseous Stars.—A. F. and F. A. Lindemann: Preliminary Note on Some Applications of Photoelectric Photometry to Astronomy.

ROYAL INSTITUTION, at 5.30.—Prof. A. Keith: The Organ of Hearing from a New Point of View.

MALACOLOGICAL SOCIETY, at 7.—A. S. Kennard and B. B. Woodward: *Helix revelata*, Britt. auctt. (*non* Férussac, *nec* Michaud), and the Validity of Bellamy's Name of *Helix subvirescens* in lieu of it for the British Mollusc.—A. Reynell: Forbes's Notes on Loven's "Index."—H. Watson: Notes on *Hygromia limbata* (Drap.).

SATURDAY, MARCH 15.

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

MONDAY, MARCH 17.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. W. A. Bone: Coal and its Conservation.

VICTORIA INSTITUTE, at 4.30.—Dr. A. B. Rendle: Bible Natural History.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Lt.-Col. N. M. MacLeod: Survey by Air Photographs.

ARISTOTELIAN SOCIETY, at 8.—A. E. Heath: The Scope of Scientific Method.

TUESDAY, MARCH 18.

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

BRITISH ASSOCIATION GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—Prof. W. H. Bragg and Dr. Crichton Mitchell: The Measurement of Pulsations in the Vertical Component of the Earth's Magnetic Force by means of Horizontal Coils.—Prof. Hubert Cox and Prof. Ernest Wilson: Recent Investigation of the Geological Bearing of Local Magnetic Disturbance in a certain Region.

ROYAL STATISTICAL SOCIETY, at 5.15.—Prof. G. Diouritch: A Survey of the Development of the Serbian (Southern Slav) Race. An Economic and Statistical Study.

MINERALOGICAL SOCIETY, at 5.30.—L. J. Spencer: Curvature in Crystals.—Lieut. A. B. Edge: Siliceous Sinter from Lustleigh, Devon.—Dr. G. T. Prior: The Meteorites Adare and Ensisheim.

ZOOLOGICAL SOCIETY, at 5.30.—H. R. A. Mallock; Some Points in Insect Mechanics.—F. Martin Duncan: Photographs and Lantern-slides of Marine Zoology.—H. F. Blaauw: The Breeding of *Oryx gazella* at Gooilust.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—M. A. Ockenden and Ashley Carter: Plant Employed in the Percussion Systems of Drilling Oil Wells.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting), at 7.—R. P. Howgrave-Graham: Oscillatory Electric Discharge.

WEDNESDAY, MARCH 19.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Dugald Clerk: The Distribution of Heat, Light, and Motive Power by Gas and Electricity.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Prof. Leonard Hill: Atmospheric Conditions which Affect Health.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. J. Bronté Gatenby: An Account of Work on Cytoplasmic Inclusions of the Cell.—Lt.-Col. J. Clibborn: A Standard Microscope.—Dr. Nathan Mutch: A Simple Method for the Isolation of Single Bacteria for the Preparation of Pure Cultures (Demonstration).

THURSDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Prof. C. H. Lees: Fire Cracks and the Forces Producing Them.

LINNEAN SOCIETY, at 5.—F. Lewis: Notes on a Visit to Kunadiyaparawitta Mountain, Ceylon, with List of the Plants Observed and their Altitudinal Distribution.—Miss May Rathbone: Specimens of Plants Preserved by Formalin Vapour.—H. R. Amos: Wheat-breeding with Mr. W. O. Backhouse in Argentina.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—Sir Thomas Kirke Rose: The Volatilisation of Gold.—W. S. Curteis: Cobar Stope Measurement Methods.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on G. L. Addenbrooke's Lectures on Dielectrics in Electric Fields.

CHILD-STUDY SOCIETY, at 6.—Discussion opened by Mrs. K. Truelove: Training of th School Girl in Infant Care.

CHEMICAL SOCIETY at 8.

FRIDAY, MARCH 21.

ROYAL INSTITUTION, at 5.30.—Prof. W. W. Watts: Fossil Landscapes.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. C. Armitage: Jigs, Tools, and Special Machines with their Relation to the Production of Standardised Parts.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8, with Royal Society of Medicine (Electrical Section).—R. S. Whipple: (1) Electrical Methods of Measuring Body Temperatures; (2) The Electro-cardiograph.

SATURDAY, MARCH 22.

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

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