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National Aspects of the Fine Chemical Industry.

IN a speech rarely equalled for its quality and delicately woven argument, Lord Moulton recently put into clear perspective the case for fostering the fine chemical industry in this country. All who during the war-years shared with him the terror of what the chemical industry enabled our enemies to do will accept his view as to the imperative need of treating this as a key industry and stabilising it on a thoroughly satisfactory and efficient foundation. However vaguely we may visualise the boundaries of key industries in general, no one has any doubt as to whether the fine chemical industry comes within them.

One aspect of the importance of this industry may be compared with that of the shipping industry, for just as our maritime supremacy depends upon the strength of our Navy, and hence upon the ability to man it with a race of seafaring men directed by able officers, so also does our future position depend upon our chemical ability, and hence upon the employment of skilled workers directed by trained chemists engaged in a successful organic chemical industry. The necessary conditions for training our seamen are inherited as a birthright, while those for training our chemical workers have to be created. Such workers as those employed in the manufacture of organic chemicals and optical lenses must be trained from early life, and they become proficient only after many years.

It is reported from many quarters that German interests are making a determined effort to destroy those fine chemical manufactures already set up in this country by selling the particular commodities concerned at prices well below the cost of production here, whilst charging exorbitant prices for those chemicals of which they retain the monopoly. Such efforts should be resisted at all costs. The object is to relegate to the scrap-heap the costly plant set up in this country, and to terrorise those who might otherwise be willing to risk capital in developments of a like nature. As a nation we must in the long run pay more if we succumb to this attack and again allow the German monopoly to be established. Not only will a great loss of capital be incurred, but we shall also ultimately pay very dearly for the products now being sold at such low prices, because in a few years' time the far-reaching influence of the war debt will bring about a rise of production costs in Germany. It is also to be presumed that the exchange will become in a measure equalised.

Research workers in this country naturally feel concerned lest the machinery which the Government will make use of to effect the desired protection may adversely influence their work by limiting the supply, or increasing the cost, of research chemicals. It is to be hoped that the terms of the Bill will be such as can be interpreted to give satisfactory safeguards in both these respects. It cannot be supposed that British chemical manufacturers will welcome any measure which seriously hinders research, of which they have recently learned to appreciate the value so well. The patriotic manner in which the manufacturers of fine chemicals responded to the call made upon them at the outbreak of hostilities, and the unselfish service which many of them gave throughout the war, may be taken, we hope, as indicating their attitude in this matter. However, on account of the cost of labour, it is self-evident that the prices of chemicals made in this country must for a time be somewhat higher than those ruling in Germany. German workers to-day are paid the equivalent of 5*d.* an hour, while similar workers in England receive 2*s.* an hour. It is therefore clearly impossible immediately to equalise the prices of chemicals, even should we completely counteract the German effort to destroy the industry.

It is interesting to follow the course which the prices of many of these organic chemicals have taken since 1914. As soon as the supply of German products in the hands of dealers was insufficient to meet the demand, prices rose pre-

posterously high; but as the manufactures became established here they were brought back to a level very near to, though a little higher than, the pre-war figure. This adjustment took place before the resumption of German competition. It may be assumed that the same factors will operate to reduce the cost of any new manufactures which are undertaken, if only we can patiently put up with the difficulties during the present years of transition.

Owing to the rate of exchange, it is possible for the moment to purchase research chemicals from Germany at very low prices. It is timely to remind those who have been ready at once to resume purchasing organic chemicals from Germany of the already successful efforts to supply research chemicals which have been made in this country at the instigation of the Association of British Chemical Manufacturers. Although it has been clearly impossible since the war to prepare a complete collection of the innumerable organic compounds required for research, like that previously held in Germany, a very considerable number of such compounds of British manufacture are now offered through trade channels.

British manufacturers should be encouraged to go on adding to their collection, temporarily supplementing it as may be necessary by purchasing abroad. Research chemicals being required in very small amounts, it cannot pay the manufacturers to continue their efforts unless they receive a large body of support.

The development of British chemistry is aided by any steps which result in giving employment and openings for more chemists. The extension of our chemical industries, especially in the domain of organic chemistry, helps not only by attracting to the profession men of ability who in the choice of a career must be guided by opportunities for useful service with good remuneration, but it helps also by supplying a good training ground for the graduated student who otherwise would not find the right opportunity for specialisation.

Chemists find employment in the organic chemical industry in great numbers because of the variety of ways in which they are needed. Complex reactions of the type involved must be controlled in every stage of manufacture by a chemist. Even old-established processes call for continued investigations both for the purpose of improving them and for grappling with new difficulties which are continually arising. There are also in every large works research, analytical, and process-control laboratories, in each of which young men are engaged under competent direction. These laboratories constitute a very valuable training ground for chemists, who in reality always acquire an important proportion of their chemical knowledge during the years following the completion of their university curricula. With the expansion of the fine chemical industry there would be fewer of those cases where young men of great talent have given up their career in chemistry because the opportunities were so few and the prospects so poor.

The general effect of expanding chemical industry will be to enhance the status of chemical science in this country. The academic life of a people is profoundly affected by the national industries, and any measures designed to foster and preserve those industries which call for the greatest exercise of scientific knowledge and skill are, therefore, closely concerned also with purely scientific studies. It is largely on this account that we give our support to action which will help to safeguard the fine chemical industry in this country.

A Physical Theory of the Universe.

Space, Time, and Gravitation: An Outline of the General Relativity Theory. By Prof. A. S. Eddington. Pp. vii+218. (Cambridge: At the University Press, 1920.) Price 15*s.* net.

"THE mind is not content to leave scientific truth in a dry husk of mathematical symbols, and demands that it shall be alloyed with familiar images. The mathematician, who handles x so lightly, may fairly be asked to state, not indeed the inscrutable meaning of x in Nature, but the meaning which x conveys to *him*."

This is a quotation from the preface to the work now before us, and it aptly summarises the author's task. It is a commonplace to say that no modern development of scientific thought has evoked such a widespread attempt on the part of the layman to understand its import. It would be equally true to say that no other development ever contained within itself such formidable barriers to comprehension. For the theory of relativity, in its general form, deals with conceptions which have had no place in the usual mode of thought, and a large part of our mental scaffolding must be pulled down before we are in a condition to attempt to form a picture of the external world which shall satisfy us as our older pictures have done. Other treatises on the subject now exist, but none which proposes, without the

use of symbols beyond the simplest type and in small number, to tell us what x conveys to a relativist. This is the task of Prof. Eddington, who has already done more than any other authority in this country to clarify the whole subject, and to reduce it from a somewhat arid desert of mathematical symbolism, of a type unfamiliar even to most mathematicians, to something which can appeal to the mind of one used to the concepts of physics. This work is an attempt to make the appeal yet more general in its scope, and at the outset we should say that it is difficult to imagine a greater degree of success possible in regard to such a theory. As it leaves the pen of the author, this theory, while yet the same, is scarcely recognisable as the same, for in place of a scheme of pure mathematics we now have a fully developed physical theory of the universe expressed in physical terms.

The reader is first presented with a symposium —between an experimental physicist, a pure mathematician, and a relativist, who discuss the nature of space and of geometry—which brings out vividly the defects of our mental scaffolding in so far as it consists of ideas of space and time. He passes to the Michelson-Morley experiment and the FitzGerald contraction of matter in the direction of its motion. These are now almost matters of general knowledge. But there is a wealth of illustration from everyday events to give point to rather recondite or merely unusual ideas. The confusion of the aviator and his spectator, with their cigars, on pp. 24–25, cannot well fail to give to any reader, in a humorous way, an exact idea of a great part of the simpler restricted principle of relativity; and this type of illustration, which at once captures the mind, abounds throughout. It is made quite clear that in accepting this principle we are merely giving up some unproved and unprovable hypotheses which are an actual barrier to the comprehension of Nature.

The principle itself follows, with a survey of æthers of various historical types, and a general summary of the reasons which make the principle necessary. We do not, in this review, give any account of the theory itself. The world of four dimensions follows, and of this it is sufficient to say that it will probably focus the reader's interest more than anything else, and that it is by far the best realisation of the analysis into ordinary prose —if the author's vivid prose is ordinary—which we have seen or imagined. It is a relief to find that the author does not enter, or deem it useful to enter, into metaphysical speculations on the meaning of "imaginary time" as it appears in the Minkowskian world, but frankly descends to real time for his exposition.

After chapters on fields of force and types of space, we come to a comparison of the new and the old laws of gravitation. To a mathematician or physicist called upon by his lay friends to explain, several times in a week, just what awful fate has overtaken Euclid and Newton, this discussion seems completely indispensable, for the author has found words in which to express the matter to a lay friend, and such words have always failed the reviewer and probably many others. Included is a simple indication of the nature of the calculation—of deflection of light by the field of the sun—which observers, including Prof. Eddington, went far afield to test.

Much space could be occupied by a mere table of contents of this volume. Every aspect of the theory is touched upon, and all the alternative interpretations of the phenomena which have at various times been suggested receive due and fair consideration. We have a clear statement on all such points as "mass is a measure of energy," and so forth, which puzzle the uninitiated. The "weight of light" has a chapter to itself. The final chapter is of a highly metaphysical type, to follow on the conclusion of the theory. Apparently addressed to philosophers, we can see it raising many heated controversies. Perhaps we may, as we began with a quotation, also end with one—the penultimate paragraph of this chapter:—

"The theory of relativity has passed in review the whole subject-matter of physics. It has unified the great laws, which by the precision of their formulation and the exactness of their application have won the proud place in human knowledge which physical science holds to-day. And yet, in regard to the nature of things, this knowledge is only an empty shell—a form of symbols. It is knowledge of structural form, and not knowledge of content. All through the physical world runs that unknown content which must surely be the stuff of our consciousness. Here is a hint of aspects deep within the world of physics, and yet unattainable by the methods of physics. And, moreover, we have found that where science has progressed the farthest, the mind has but regained from Nature that which the mind has put into Nature."

A disappointing conclusion, perhaps, to many —but we congratulate the author on the way he has dealt with a task all the harder because the results read so easily and simply; we also congratulate the Cambridge University Press on the technical excellence of the volume, which is everything that we usually associate with the series to which this work belongs. J. W. N.

The Methods of Cancer Research.

Some Conclusions on Cancer. By Dr. Charles Creighton. Pp. xiii+365. (London: Williams and Norgate, 1920.) Price 42*s.* net.

"THERE is something common to all tumour-malignancies, which I take to be cells feeding on the substance of blood to their own aggrandisement, instead of metabolising it, storing it, or transmitting it to an ulterior end. But that risk arises in various ways. In all cases there must be an unfortunate occurrence of a number of factors, of which one may be prerogative in one case, another prerogative in another" (p. 83).

In these words Dr. Creighton summarises his conclusions on the nature and mode of origin of cancer. It is necessary to add that the cells involved are only rarely the cells of the specific parenchyma of the organ in which cancer arises. In most cases they are endothelial cells or plasma cells. The apparent reproduction of the structure of the specific parenchyma in the cells of the new growth is a mimicry, a pseudo-differentiation which it may at once be confessed has deceived three generations of pathologists. Metastases arise by a similar transformation of cells of distant organs, and not by embolism as currently believed. The similarity in structure to the primary growth which they present is mysterious —"mystical"—and no explanation is offered or suggested.

The credibility of a hypothesis is judged by the number of different observations which it harmonises: its utility by its power to suggest new methods and lines of work. In both directions Dr. Creighton's book is of little value. The author recognises that his views do not harmonise with the observations of others. He has a short way with them. The other observers are wrong. This is particularly well exemplified in his discussion of the histogenesis of carcinoma of stratified squamous epithelium. It is stated to arise from cells of a cambium layer lying between the basal layer of the stratum Malpighii and the corium in squamous cell carcinoma of the skin and tongue. In the œsophagus the same type of growth arises from capillary loops which penetrate the superjacent squamous epithelium. The evidence for these remarkable statements is based on rough semi-diagrammatic figures of large growths, several of which are ulcerated. A laborious summary is given of the earliest work on the subject by Thiersch and Waldeyer. The beautifully illustrated monographs of Ribbert and Borrmann on the same subject, in which new growths of microscopic size are analysed, almost cell by cell, are not mentioned. There is one short reference to the confirmatory work of Butlin in this country. The whole argumentation is irrelevant, and does not shake in the least the evidence that squamous cell carcinoma arises in minute circumscribed areas in stratified squamous epithelium. Once the primary transformation has been accomplished, no evidence can be found for increase in size by transformation of surrounding cells into cancer.

The origin of metastases is dealt with in the same way. Large nodules with vascular connections with the surrounding tissues are adduced in illustration of a transformation of the surrounding cells into new growth. The earliest stages in which cancer cells lie among unaltered blood corpuscles, such as are familiar to every working pathologist, are unknown to the author. The confirmatory evidence furnished by the experimental reproduction of blood-stream metastasis and by subcutaneous inoculation of cancer in laboratory animals is too damning to ignore, and a chapter and a half are devoted to the subject of "mouse-cancer." Here the author is completely out of his depth. Where the facts are too patent, they are passed over in silence or simply contradicted, as, for example, the absence of cancer in selected families inbred for generations, and the occurrence of cancer in female mice which have never borne young and in wild mice.

The origin of grafted tumours from introduced cells is denied, and the figures in which the continuity is traced day by day are described as showing an origin from nuclear débris lying in a formless mass of disorganised protoplasm. The adjacent intact cells in which mitosis proceeds are regarded as having nothing to do with the formation of the new tumour. The general confirmation in the rat, rabbit, guinea-pig, and dog of the observations on new growths of the mouse is not even mentioned.

It is unnecessary to review in detail the other chapters on chorion-epithelioma, glioma, cancer of the mamma, stomach, and rectum. It is only too evident that the author has approached the subject with vague preconceived ideas, any illustration of which can be made to function as rhetorical proof. As he naïvely remarks in the preface, "he can imagine nothing better for the future progress of these studies than that others, bringing their own prepossessions, should resort to the same cabinets [of slides in the pathological department of a great hospital] to find in the infinite variety of phenomena the proofs which they seek." As may easily be imagined, a work conscientiously written throughout in this spirit contains little that is suggestive for new investigations, whether

histogenetic or experimental, and in this direction also the book fails of justification.

Cancer research, in addition to its occupation with the empirical treatment of the disease, is concerned with the answer to two questions. In what way do cancer cells differ from cells of the same kind which are not cancerous? What are the changes by which ordinary cells become cancerous? At present our knowledge only suffices to give the most general and superficial answer to the first question, and to the second no answer as yet can be given. In the unvarying parenchymata of transplantable tumours we possess an ideal material for investigating the first of these problems and for testing hypotheses framed to solve it. The advances which are even now being made in the experimental production of cancer are providing the means for a rational attack on the second. The time has come when speculation and hypothesis must take their proper place as servants in the investigation of cancer, not substitutes for observation, experiment, and proof.

J. A. MURRAY.

Virgil's Botany.

The Trees, Shrubs, and Plants of Virgil. By John Sargeaunt. Pp. vii + 149. (Oxford: B. H. Blackwell, 1920.) Price 6*s*. net.

THERE are many lovers of Virgil who are neither scholars nor botanists, and their number seems to be increasing, just lovers of his poetry, who are content without any great knowledge of grammatical criticism—content with translating *quercus* and *robur* by the same word "oak," for whom *taeda, picea, pinus, abies* are equally "fir" or "pine," though they would, for the most part, hesitate to affirm on the authority of Gallus that "Violets are black and blaeberries (*vaccinia*) too." To all such the book now before us, written by a former master at Westminster, who grows Virgilian plants in his English garden, and has travelled in Italy, comes with the promise of help. We hope with its aid to attain to a better understanding and, therefore, to a truer appreciation of the poems, especially of the "Eclogues" and "Georgics," the country poems. And at first we are not disappointed.

It is true that we have to get over the initial difficulty of the title; for are not trees and shrubs plants too? Why not say "herbs"? It is as though we were to write of men and animals. Letting that pass, however, we find a very interesting introductory chapter, which deals with the geography and the distribution of plants in the valley of the Po two thousand years ago: what enormous changes, natural and artificial, have been wrought in the intervening years, turning Gallia Cisalpina of Virgil's day into Lombardy of our own!—the wolf no longer descends from the dense forests of the Apennines to ravage the flocks; the olive now flourishes on the shores of Benacus. Then we come to a very interesting discussion of the colours mentioned by Virgil—*purpureus* and *ferrugineus, niger* and *ater, candidus* and *albus, flavus, luteus* and *fulvus*; the particularly elusive *caeruleus* is, however, not mentioned, and it is a pity that when fields of ripe corn, yellow sands, auburn hair, gold are given as examples of objects to which the colour *flavus* is attributed, *flava oliva* is not given too. The subject of these colour names is a very obscure one. We know very little about it, and that "in some contexts white means little more than not black and black little more than not white" is wisely said. Might not the saying be further extended? Do not we, on the other hand, very often insist too minutely on the differentiation and discrimination of natural colours and of colour names? People have been known to fall out and almost to quarrel over the colour of autumn saffron, *Colchicum autumnale*: is it pink or is it mauve? What is mauve?

But when we pass from the introduction to the body of the book we are disappointed: it is full of solid and valuable information, but the many inaccuracies, some of which are so obvious that a very slightly informed reader can scarcely fail to detect them, rob it of a great part of its value and inspire a strong mistrust of even the better part.

P. 66. The true laurel is the bay (*Laurus nobilis*), from which we get camphor and cinnamon.

P. 97. The capsules [of *Papaver somniferum*] abound in opium or hashish.

Less obvious at a first reading are the wrong attribution of Acanthus to the Scrophularineæ (not Scrofularineæ); the statement (p. 37) that the purple crocuses of our gardens are *Crocus versicolor*, whereas they are *C. vernus*; and the confusion (p. 137) between Viscum, our mistletoe, and Loranthus, which, according to Arcangeli, grows on oaks and chestnuts.

What can be the meaning (p. 91) of: "The victors in the games are crowned with olive blossoms, which drop upon their yellow pollen" ("Æ." v. 309)? The line in the original is: . . . *flavaque caput nectentur oliva*. And why should the foliage of both the olive and the oleaster be called "heavy"? Is this a misprint for "hoary"?

Florentes ferulas et grandia lilia quassans: this is said of Silvanus and not of Pan—of Silvanus, *agresti capitis honore,* crowned with a wreath of oak leaves, and bearing in his hand, brandishing, *quassans,* flowering ferules and tall white lilies, leading in a train of weeping nymphs to Pan, over whose ruddled face the bloody juice of the dwarf elderberries trickles down. Cannot we see them all? *Panaque, Silvanumque senem, Nymphasque sorores.*

No. The book is not what we had hoped for, a safe guide, a trustworthy friend, a welcome companion, in the study or in the garden; it is disappointing. Such a book is needed—it has yet to be written. Why should not the author of this one write it? Here he has the first sketch of it, the half-carved block; the design is good, the material is good, they are worthy of further work. On his title-page he tells us that he was prompted by *tantus amor florum*; let him not omit to carry plenty of *suburra,* and he will be amply rewarded by the *generandi gloria mellis.*

G. H. W.

Our Bookshelf.

William Sutherland: A Biography. By Prof. W. A. Osborne. Pp. 102. (Melbourne: Lothian Book Publishing Co. Pty., Ltd.; London: The *British Australasian,* 1920.) Price 7*s.* 6*d.*

THE friends of the late William Sutherland will welcome this little biography by Prof. Osborne. It is a faithful portrait of the man charmingly conveyed by a judicious selection of incidents from his life. William Sutherland's was a remarkable character, and he was an unexpected product of a new country, where a leisured class scarcely exists. This biographer has done justice to his extraordinary versatility and modesty. Many who valued his society on account of his knowledge and appreciation of literature, painting, and music will, no doubt, be surprised to learn from his biography that he possessed a world-wide reputation as an investigator in molecular physics, and was the author of upwards of fifty papers dealing with some of the fundamental properties of matter.

Sutherland had no private fortune, but, nevertheless, abstained from devoting more of his time to earning money than was necessary. Occasional work for the Press and infrequent examinerships produced sufficient income to supply his modest needs. This peculiarity kept him from accepting permanent academic posts. It is a matter for regret, however, that a small chair, which would have provided him with a laboratory, and brought him into contact with students, was not available for him. The value of the work he did with such devotion would have been enhanced thereby, and what a gain his inspiration would have been to any institution!

At the end of the volume Prof. Osborne has gracefully referred to Sutherland's saintliness. This is no exaggeration of his biographer. Although I loved him well and sought his society frequently, I was never quite comfortable in it because he was so singularly devoid of vices and so tolerant of other people's weaknesses. Notwithstanding his delightful sense of humour, it was scarcely more possible for us to attain complete harmony than for a drunkard to be quite at ease in the society of a teetotaler.

C. J. MARTIN.

Maryland Geological Survey: Cambrian and Ordovician. Pp. 424+lviii plates. (Baltimore: The Johns Hopkins Press, 1919.)

THE Maryland Geological Survey has always been noted for the educational aspect of its publications, which are by no means a dry record of observations for the use of scientific specialists. They help the ordinary citizen to understand his State, and in so doing to appreciate the aims and methods of research. The results of much careful work in petrology and palæontology are brought together in the well-known green-covered volumes, so as to be accessible in private libraries and in schools. The present volume, by R. S. Bassler, covers a part of the Atlantic slope from the crest of the Alleghanies to the sea, thus including the three great belts of contrasted scenery that stretch from New England to Mississippi. The British controversy as to the nomenclature of the older Palæozoic systems is interestingly re-stated, and the author, on grounds of fairness to the original workers, would like to use Taconic and Cambrian for the systems now styled Cambrian and Ordovician respectively. He effects a proper compromise, however, and fairly discusses Ulrich's Ozarkian and Canadian systems.

There is certainly no "writing down" to a popular level in the stratigraphical and palæontological descriptions, though in one place, in a sketch of the life-processes of Cryptozoon, "lime" is accidentally used for "calcium carbonate." The results of investigations in other fields are brought together, and local fossils are illustrated by notable specimens, such as *Olenellus Thompsoni* from Vermont, which add interest to those already found in Maryland. Cryptozoon occurs in the Cambrian and Ordovician of Maryland, and its algal nature seems to be established, though the Cambrian fauna is generally poor. Does the author refer to this fact when he makes the general statement on p. 32 that the Pelecypoda appear for the first time in Ordovician strata?

The numerous photographs of wayside sections and rolling farmland country are a pleasing feature. Plate ii. shows, from the Virginian side, the fine gorge of the Potomac cut across the Cambrian sandstones at Harper's Ferry, a scene known alike to history, geography, and geology.

G. A. J. C.

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.*]

A Quantum Theory of Vision.

IN a paper appearing in the February issue of the *Philosophical Magazine* I have described a theory of vision which ascribes visual stimuli to the activity of light quanta in liberating electrons from the visual purple. Various phenomena associated with scotopic and photopic vision are considered. Those coming under the designation of simultaneous contrast did not appear to me, at the time of writing, referable to purely retinal actions. Since then it has occurred to me that simultaneous contrast effects find explanation in a very simple way on the same data as serve to explain successive contrast, *i.e.* in the external location of the sensitiser with reference to the cones and in the motion of these organs attending light stimulus.

Consider the case of a grey patch bordered by a black area. This disposition secures unused sensitiser around the retinal image of the central patch. When those cones which are covered by the image of this central patch retract, the unused sensitiser flows in around them. The conditions are, therefore, favourable to specially luminous sensation, and the grey patch looks bright. In the other case, when the grey patch is surrounded by a white area, the reverse conditions prevail. The retreat of the cones involves the inflow of used-up sensitiser around the cones covered by the central image. The conditions are favourable to lowered luminous sensation, and the grey area looks dark. When we substitute for the white border a coloured border, then the sensitiser invading the central area of the retinal image is "fatigued" for the particular tint of the border, and hence the central grey looks tinted with the complementary colour. The tissue-paper, which when laid over the patches accentuates these effects, acts probably in two ways. It renders good fixation impossible and, by the increased luminosity which it brings in, it causes the cone-movements to become more active.

In my paper I have invoked the "latent image" familiar to photographers. I think it explains more even than I claimed for it.

The latent image in the photographic plate may be ascribed to electrons which, having travelled a certain distance from their point of origin, become loosely attached to atoms. Afterwards they take part in the chemical effects attending development, or, if exposure is carried so far as to cause an accumulation of electrons to the point of instability under increasing electrostatic forces, the latent image runs down of itself. This is "solarisation" or "reversal." There may be a succession of such reversals under continued exposure.

It is quite to be expected that something of this sort will occur in the case of the cones, and possibly of the rods also. After-images find explanation in this way, and their theory becomes very complete when the motion of the cones under light stimulus is taken into account. As briefly referred to in my paper, the latent image serves also to explain the "dark" electrical response of the retina—a response which has the same sign as the "light" response. To understand this we have to consider that the latent image in the nerve-substance has less stability, very probably, than that which forms in the photographic plate, owing to the nature of the medium. It is probably kept in being by the continuous inflow of electrons from without the cone, and, normally, is also continually breaking down. When light is cut off, the whole accumulation runs down, attracted back to the positively charged ions developed around the cone. Hence there is a second stimulus, and it will, of course, be of the same sign as that attending the primary movement of the electrons. The final discharge of the latent image may be relatively slow, as the curves in some cases show. Looking at such a curve as that which Piper obtained for a pigeon's eye under brief periods of darkness alternating with light intervals, it needs little imagination to picture the happening of these events.

Fröhlich's results on the Cephalopod eye seem to involve the same effects. In this case the latent image builds up rapidly within the rods which are exposed directly to the light and as rapidly runs down, giving rise to rhythmic electrical responses from 20 to 100 per second. Just on account of this extreme instability of the latent image there is no definite dark response. In short, the dark response is a phenomenon connected entirely with the quasi-stability of the latent image, and is probably favoured by the location of the sensitiser external to the nerve.

From all this I think we must conclude that the stimulus is ascribable ultimately to the motion of the electron, its amount depending upon the kinetic energy, and this, in turn, upon the particular quantum which activates the electron. The return of the electron in some cases, under the electrostatic attraction at the point of origin, involves a fresh stimulus. This is a phenomenon similar to that which Lenard invokes in his explanation of phosphorescence.

On this view colour is appreciated in terms of the energy of the stimuli; brightness in terms of the concentration or density of the stimuli. Rhythmic succession of stimuli is not required, and does not exist. It will be understood that this theory does not involve views respecting the origin of the quantum. Thus, whether we believe that quanta originate at the source of light or come into existence upon its absorption—as Sir Oliver Lodge has suggested—the basis of the theory remains. The one thing essential is the relation between the energy of the photo-electron and the frequency of the light which gives rise to it.

I conclude with a question: Are there any good data available respecting the rate of motion of the cones under light stimulus? It is generally stated that it is slow even with strong lights (and faster for violet than for red). Definite information on this point seems worth seeking. For if the reaction towards the light were rapid, we could regard it as diminishing the effects of dispersion in the refractive system. It is probable (in harmony with the present theory) that the displacement would be greater for violet than for red rays. This would tend to bring cones illuminated by violet light nearer to the lens than cones illuminated by red light. There would be at least a partial correction for dispersion.

J. JOLY.

Trinity College, Dublin,
January 30.

The Constitution of Lithium.

POSITIVE rays of the alkali metals were first obtained by Gehrcke and Reichenheim by using as anode a heated metal strip upon which a suitable salt was

melted. Later they substituted for this a specially constructed composite anode which yielded the rays without the necessity of external heating.

Both these methods have been employed recently at the Cavendish Laboratory to investigate the constitution of lithium, the rays produced being analysed by Sir J. J. Thomson's "parabola" method which gives ample resolving power for this element.

By means of the composite anode (G. P. Thomson, Proc. Camb. Phil. Soc., vol. xx., p. 211, 1920) a number of plates were taken showing in several cases double parabolas corresponding to 6 and 7, but owing to the fact that spurious doubling had occasionally occurred, due to instrumental trouble, publication was withheld.

It has now been found possible to apply the externally heated anode, employed by Dempster in 1918 for potentials of about 1000 volts, to high potential rays. This arrangement is used at very low pressures, and under these conditions *metallic rays only* appear to be produced.

Exceedingly satisfactory parabolas corresponding to lithium have been obtained, a strong one at 7 and a faint companion at 6 (Na=23). The intensity of the latter appears to correspond well with the accepted atomic weight 6·94.

The foregoing results appear to leave no doubt that lithium is a complex element with isotopes of atomic weights 6 and 7. Of course, no accuracy can be claimed for these figures until higher resolution has been applied, but there seems no reason to doubt that they are very nearly whole numbers.

F. W. ASTON.
G. P. THOMSON.

Cavendish Laboratory,
February.

The Elementary Particle of Positive Electricity.

THE name "negative electron" was applied to the elementary particle of negative electricity after the experimental evidence for the variation of its mass with velocity had generally convinced physicists that its whole inertia was due to its electric charge. This meaning of the term "electron" was in accord with Dr. Johnstone Stoney's original use of the word to denote the elementary unit of electric charge. With the introduction of the principle of relativity it became clear that the variation of mass with velocity was no characteristic attribute of electrical inertia, and that therefore we have no proof that the negative electron's inertia is wholly electromagnetic in origin. In fact, the investigations of Abraham, Webster, and others have shown that there must be some mass present other than that due to the electron's electric field. If we abide by Dr. Stoney's original meaning of the word, it is therefore more than doubtful whether we are justified in calling this negatively electrified particle of matter an electron. Nevertheless, the term is now so well established in the literature that we use "electron" to denote this elementary particle regardless of our view concerning the origin of its mass.

The arguments for and against the electrical origin of the mass apply in exactly the same manner to the elementary particle of positive as to the corresponding particle of negative electricity. If the negative particle can legitimately be termed an "electron," it is thus equally legitimate to apply the term to the positive particle, since it likewise carries the fundamental unit of electric charge. Why not, therefore, denote both these elementary particles by the same generic term "electron," distinguishing the "positive" from the "negative" electrons when necessary, as several writers have long been accustomed to do?

It seems to me that the application of a distinctive name, such as "proton" or "hylon" or "hydrion," to the elementary particle of positive electricity can only suggest a distinction between the nature of the positive and negative electrons, which, so far as we are aware, does not exist. Thus, for example, when an atom of hydrogen is split into its two components the negative electron is just as really a hydrogen ion as is the positive electron. The fact that both components possess equally fundamental units of electric charge and are equally fundamental divisions of matter should suggest that the same generic name "electron" be applied to each.

ARTHUR H. COMPTON.

Washington University,
St. Louis, U.S.A.,
January 25.

The Peltier Effect and Low-Temperature Research.

I SHOULD like to inquire whether the Peltier effect has ever been considered as an aid to the production of very low temperatures. I understand that the lowest temperatures yet obtained are those produced by Dr. H. K. Onnes, of Leyden, who, by reducing the temperature of metals to that of liquid helium, has got down to within less than 4° of the absolute zero of temperature, or more than 450° below zero Fahrenheit. Onnes, moreover, found that at such a temperature pure metals lose practically all electrical resistance and become nearly perfect conductors.

The suggestion is to apply the Peltier effect, which consists in an observed diminution in temperature when an electric current is passed in a particular direction through a thermo-couple to obtain still lower temperatures.

At ordinary temperatures, when the metals composing the thermo-couple have appreciable resistance, the Peltier effect is largely masked by the C^2R heat produced in the metals by the passage of the current. At the temperatures attained by Onnes, when resistance practically vanishes, this condition should not obtain, with the result that the application of the Peltier effect would appear to give possibilities of obtaining materially lower temperatures than have yet been reached. A. A. CAMPBELL SWINTON.

66 Victoria Street,
London, S.W.1,
February 16.

Heredity and Biological Terms.

IT seems to me that the arguments of Sir Archdall Reid (NATURE, February 3, p. 726) and Sir Bryan Donkin (February 10, p. 758) leave the question of the meaning and use of the term "acquired characters" very much where it was before. Sir Bryan Donkin asks whether it may not be justly argued that if a child has a hand like its parent there is no change in "nature" or "nurture"; that if the child has a sixth digit which the parent had not there is a change in nature or heritage, but none in nurture; and that if the child has a scar there is no change in heritage, but only one in nurture. But I fail to perceive anything new in this or any difference from the usual conceptions which are general among biologists. It is a mere matter of terms and synonyms. The modern biologist would say that the normal hand was hereditary, or innate, or due to certain factors or genes in the chromosomes which usually

are handed on unchanged "down the germ-tract"; that the sixth digit was a mutation, due to some change in the genes in the chromosomes, and therefore gametogenic; and that the scar was due to an injury which resulted in regenerative processes producing new tissue. Sir Bryan Donkin states that the scar is an "acquired difference," but in terms of the germ-plasm the hand and the scar indicate no change. What, then, is the objection to terming the scar an "acquired character"? Every biologist would agree that it does not indicate a change in the chromosomes. Its possible subsequent effect on heredity is expressly excluded from the discussion.

Yet Sir Bryan Donkin insists that the division of human characters into two groups, "innate" or "acquired," "constitutional" or "environmental," is a cause of much confusion—apparently because, as Sir Archdall Reid insists, "a vague terminology has caused neglect of the evolution of the power of developing in response to functional activity." But, so far as I know, that writer has produced no evidence of such an evolution, no evidence that functional activity has more effect in the higher animals than in the lower. It is difficult to think of cases of different functional activity among individuals in lower animals, but if we take conditions such as quantity and quality of food, we know that the difference between worker bees and queen bees is entirely due to this difference of "nurture"—in fact, is an "acquired character." Probably Sir Archdall Reid would consider insects as lower than man, though biologists would not admit that he was right. Sir Bryan Donkin writes that like exactly begets like when parent and child develop under like conditions; if we say, then, that the differences due to unlike conditions are acquired characters, what is the objection?

In my previous letter (January 13, p. 630) I criticised some of Sir Archdall Reid's statements by pointing out that they contradicted each other. In reply he referred to some supposed views as to what were acquired characters put forward in other publications of mine. But he is not entitled to do this. I made no offer to discuss my own views; I was merely criticising the arguments by which he attempted to show that all characters were "innate and acquired in exactly the same sense and degree." What I may have written elsewhere is not relevant to the present discussion. In the letter in the issue of NATURE for February 3, Sir Archdall Reid takes the case of a normal Englishman and a scarred negro as an example, and states that they differ in scars by acquirement, but that the scars are not acquired any more or less than the skin-colour. It follows, then, either that an acquirement is not acquired or that the skin-colour is also acquired in the same sense and degree as the scars. But the latter is not the case, for the different skin-colours will develop under the same conditions—that is, they do not correspond to different conditions, while the scars are related to a difference of conditions or stimuli, namely, injury in the one case which is absent in the other. If Sir Archdall Reid means that no character could be acquired unless the living substance of the organism had the potentiality of developing in a certain way under certain conditions or under a certain stimulus, that is, of course, a truism which does not require to be stated. But he has entirely failed to prove that all characters are innate and acquired, somatic and germinal, exactly in the same sense and degree. His own arguments and examples prove the contrary.

J. T. CUNNINGHAM.

Coloured Thinking.

IN view of Prof. Fraser Harris's letter in NATURE of February 3 and of his implied complaint that so little has been written on the phenomenon since Galton discovered it, possibly the record of some observations that I made upon my own son more than eleven years ago, when he was between seven and a half and eight years old, may be worth notice. I was in correspondence with Galton about the case shortly before his death; and, in fact, a letter to him, reporting the result of further inquiries suggested by him, was lying on my desk ready to be posted when I opened the daily paper and read the announcement of his death.

Having accidentally discovered that my son had coloured concepts, I noted down a series of these in the late autumn of 1909, taking great care to avoid any approach to leading questions or suggestions. Then, three months later, having meantime ignored the matter, I again tested him; and on this occasion, at Galton's suggestion, I carried the inquiry rather further. I will deal first with the numerals, since these afforded the most interesting results. Their colours were:

	In 1909	In 1910
1	Any sort of colour.	Black.
2	,, ,, ,, ,,	Brown.
3	(Not noted.)	White.
4	Blue.	Blue.
5	Yellowish.	Yellow.
6	White.	White.
7	Red.	Pink.
8	Rather dark red.	Red.
9	Greenish.	Green.
10	Black.	Not asked
11	Brown.	,, ,,
12	Blackish-grey.	,, ,,
35	Not asked.	White and yellow.
36	,, ,,	White and white.
55	,, ,,	Yellow and yellow.
80	,, ,,	Red.
800	,, ,,	Red.
100	,, ,,	Black.

On the second occasion I tested the obvious inference from his description of the colours of 35, 36, and 55, by asking him the colours of 49, 72, and 14; and my notes state that he made "ready replies."

49 was blue and green.
72 ,, pink and brown.
14 ,, black and blue.

I had already noted his statement that the colours of 35, 36, and 55, were "in their proper order."

Now obviously there is a marked difference between the colours of the numerals above 19—or possibly above 10—in this case and those seen by Miss A. M.; for she sees apparently all the twenties, thirties, forties, etc., in the colour of the first digit; whereas my son saw each digit in its own colour and unaffected by the combination with another. The deliberate tests with 49, 72, and 14, following his account of 35, 36, and 55, and the remark about the "proper order" of the colours, were conclusive on this point.

There is another matter of interest. Having told me the colour of 8 already, he was surprised at my asking the colours of 80 and 800, and replied that of course they were the same as 8. In other words, the zero was really zero to him, and therefore had no colour. Now in teaching him arithmetic during the preceding months I had endeavoured to make

him realise that the value of a digit depended upon its position, and that the zero was simply a shorthand symbol for an empty place. His coloured thinking satisfied me that I had completely succeeded, and that the cipher o was really *nothing* to him.

I note that Miss A. M. sees 20, 30, 40, etc., coloured as 2, 3, 4, etc.; but since, apparently, 20–29 are coloured as 2, 30–39 as 3, and so on, there is no such inference possible in her case. It would, however, be of interest to learn whether she sees o coloured or not.

There was one exception to this nonentity of zeros in my son's mind; for he described 1000 as always yellow, adding that "it ought to be black really [*i.e.* the colour of 1], but it is not; that's the funny thing; it does not come in proper order." My interpretation was that a thousand seemed to him something so big and important that it stood by itself and rather out of relation to the lower numbers; and I suspect that, had he known it only as "ten hundred," it would have been duly black.

It will be observed that, although on the earlier occasion he gave no specific colours to 1 and 2, yet his colours for 10, 11, and 12 accorded pretty well with the colours assigned on the second occasion to 1 and 2. Otherwise there is no discrepancy between the two records.

I obtained from him also the colours of the points of the compass, of the names of various towns and countries, and of sundry other names; but too much space would be occupied by the account and discussion of these. He told me that "nearly everything I can think of is coloured."

My daughter similarly has coloured concepts; but she has also what I do not remember ever to have seen described in anyone else until I read Prof. Harris's letter, and that is *coloured tastes*. I think, too, that tastes are more strongly coloured for her than for Miss A. M. She has frequently, to our amusement, spoken of things having "a mauve taste"; and when we were discussing coloured thinking last vacation she remarked that "of course all tastes are coloured."

Prof. Harris emphasises the normally hereditary character of coloured thinking. A few words have always been coloured for me, and in a vague and misty way many probably are; but if I try to see (mentally) what precisely the colours are, I cannot succeed. It seems rather as though some words had polished or glittering surfaces, or a sheen, and reflected light, while others were sombre and light-absorbent. When I read Galton's book about thirty years ago I realised that I saw the numerals in a psychogram.

My wife, after declaring that coloured thinking was utterly unintelligible to her, mentioned that, of course, the vowels are coloured, and that she had supposed they were for everyone, but that the consonants are not. It appears, therefore, that my children started from a slight, but twofold, hereditary tendency to coloured thinking. FRANK H. PERRYCOSTE.

Polperro, Cornwall, February 12.

The Effects of Oil from Ships on Certain Sea-birds.

SIR ARTHUR E. SHIPLEY has recently directed attention to the probable effects upon our fisheries of the discharge of oil from ships into the sea. I should like to refer to another side of this matter, viz. the effects upon certain species of sea-birds.

For our present purpose we may divide sea-birds into three groups according to the number of eggs they hatch per season, and, further, in each group we may distinguish certain species as divers. All, I believe, are single-brooded.

In the first group we have those species which hatch a single egg each season, such as the petrels, fulmars, sherewaters, and the razorbill, kittiwake, guillemot, little auk, puffin, etc. In the second group are the terns and the great northern and black- and red-throated divers, usually hatching two eggs per season. With the exception of the cormorant and the shag, Group 3 consists of the more littoral species (chiefly Laridæ), which produce three or more eggs per season, and scarcely bear upon the present subject.

During the past five years large numbers of those species which dive beneath the surface of the water in order to obtain their food have been washed up on the Fife coast and elsewhere dead or in a dying condition and covered with a thick coating of oil. The actual total of dead birds must be enormous. In one day we counted more than 300 kittiwakes and almost the same number of razorbills and guillemots, and dozens of little auks and puffins, and this is of frequent occurrence. On the west sands at St. Andrews in October last dozens of dead gannets in a similar condition were washed ashore. Even admitting that these represent a concentration from a great sea area, the oft-repeated occurrence indicates a new factor of disturbance which is proving inimical to a large percentage of these birds. If this continues, or the disturbing factor grows more serious, the possibility of the extermination of such species seems not at all unlikely.

It is a generally accepted biological principle that the rate of reproduction of a species is a character very slow to change, and in the case of slow breeders, such as the species here referred to, any unusual factor leading to a higher rate of mortality can only lead to very serious consequences.

WALTER E. COLLINGE.

The University, St. Andrews.

The Annular Eclipse of the Sun on April 8.

As the annular eclipse of the sun on April 8 next may be of considerable interest to amateur observers, I am preparing a list of observations which may be made both within and without the region of annularity, and also full instructions for making the observations. Should any readers of NATURE care to suggest observations which might be made with small telescopes and the equipment generally possessed by an amateur, I should be very glad to receive their suggestions. May I also add that I am proposing to observe the eclipse from a point near the central line (probably Benbecula, in the Outer Hebrides), and if other amateurs would care to join me, would they please communicate with me with the view of forming a party? J. HARGREAVES.

The Priory, Royston, Herts, February 2.

A Rare Example of Melanism.

I WOULD like to record the occurrence of a rare case of melanism. Mr. Carl Carinus, in Rhodesia, sent me the complete skin and skeleton of an adult female oribi. It was entirely black, without any trace of white or red. The female was in the company of an adult male of normal colour.

F. W. FITZSIMONS.

Port Elizabeth Museum, Port Elizabeth, January 27.

French Chemical Industry during the War.

IN the November–December issue of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* Prof. Haller gives a detailed and interesting account of the way in which the requirements of the fighting forces in munitions were met, and of the activities of French chemists in extending, improving, and creating processes for the manufacture of the necessary materials on the large scale.

The official policy before the war was to lay in stocks of explosives sufficient, in the judgment of the military authorities, to last out a "short, sharp war." The phenol required was obtained from Germany. In the middle of September, 1914, the use of explosives by the artillery was exceeding very considerably the amount estimated by the military authorities, and it was necessary to provide daily 40,000–50,000 75-mm. cartridges and to make schneiderite and ammonium perchlorate for trench mortars. The need for explosives continually increased, and it became evident that the character of the war was not at all like that for which the country had been prepared. A great national effort was required, and the part which the chemists of France played in this can be appreciated from the following table, giving the requirements of the Army in metric tons per day:

	Propellants	Nitrogenous explosives	Chlorate and perchlorate explosives
Mobilisation	24	0	0[1]
January 2, 1915	80	100	—
June 6, 1915	104–135	125–195	—
October 19, 1915	238–313	351–654	109–135
December 25, 1916	441–550	728–936	150–159
June 25, 1917	484–640	859–940	124–148
February 28, 1918	444	625	—

[1] Provided in stocks accumulated.

After April, 1918, the requisitions for explosives amounted to about 390 tons per day.

Sulphuric Acid.—Before the war there were 87 scattered works for the manufacture of sulphuric acid, producing 13,500,000 tons of 53° Bé. acid, of which 975,000 tons were used for the manufacture of superphosphates and the rest concentrated to 66° acid. This output was reduced by 15–20 per cent. by enemy occupation of territory. The production of explosives called for large quantities of concentrated acid, and steps were taken to force the production of the chambers from 5–6 kg. of acid per cu. m. to 7–8 kg., and to increase the Kessler and Gaillard concentrating plant in the ratio of 1 to 20. The use of acid was also restricted in industry, and nitre-cake began to be used in August, 1915. The Volvic lava of Puy-de-Dôme proved invaluable in the construction of concentrating apparatus. In addition, there were needed for the transport of acid 2000 20-ton tank wagons, 600 platforms for which were made in England and Spain.

Oleum containing 20 per cent. of sulphur trioxide was exclusively used, the consumption amounting to 1·5–1·9 tons per ton of nitrocellulose, and 2·2 tons per ton of trinitrotoluene. The oleum was, at the outbreak of war, made in a few works only, one of which, at Thann (Alsace), came under fire in 1914, and was transported by night to Saint Denis, where it was re-erected and came into operation in 1916. All the common processes (Tentelew, Grillo, and Mannheim included) were used, and a monthly output of 21,000–22,000 tons was secured. New works were put in hand, and in the meantime oleum was imported from America. The monthly consumption of sulphuric acid and oleum was as follows, in metric tons:—

	66° Bé. acid	20 per cent. oleum
February, 1915	6,000	1,000
January, 1916	42,000	5,000
January, 1917	80,000	20,000
January, 1918	60,000	19,000
June, 1918	40,000	18,000

Nitric acid was produced before the war almost exclusively from Chile nitre by the retort process, and during the war great extensions of these plants were made. The stock of nitre at the end of 1915 amounted to 90,000 tons; it increased during 1916, but from the beginning of 1917, when the submarine campaign was begun, the stocks of nitre diminished. In 1917 numerous ships laden with nitre were torpedoed. On account of the large amounts of raw material (coal, pyrites, and nitre) required in the manufacture of explosives, necessitating great shipping demands, it was decided in 1917 to ask the American Government to supply explosives ready-made. A programme was agreed upon, but the actual deliveries from America fell far short of the promises. Help was also given by Great Britain. The consumption of nitre and nitric acid (calculated as sodium nitrate) in metric tons per month was as follows:—

January, 1915, 3,600	March, 1916, 25,000
August, 1915, 9,600	July, 1917, 42,000

On account of the transport and storage difficulties it was decided to produce nitric acid by synthetic methods. These had an additional advantage, *i.e.* the economy in sulphuric acid which would otherwise be required in decomposing the nitre, which was even more important than the nitric acid. Before the war synthetic nitric acid was made by the Pauling arc process at La-Roche-de-Rame at the rate of 2 tons of 50 per cent. acid per day. This was continued, but a new factory on the Birkeland-Eyde principle was erected by the Société norvégienne de l'azote at Soulom, utilising 12,000 kw. from the hydro-electric installation in the Hautes Pyrénées of the Compagnie des chemins de fer du Midi. This works delivered 300 tons of nitric acid a month, partly as nitrates. The ammonia oxidation process was also largely used, the ammonia being derived from cyanamide. The first works was installed at the Poudrerie nationale d'Angoulême. Carbide was imported

from Switzerland and converted into cyanamide by the Société des Produits azotes, nitrogen being obtained by the Claude process at Martigny, Notre-Dame de Briançon, and especially Bellegarde. From 2650 to 3500 tons of cyanamide per month were delivered at Angoulême. The first oxidation plants were operating in the autumn of 1916, and the whole were in operation in 1917. The programme was much enlarged in 1917 on account of the submarine warfare, and it was then decided to erect factories for making 500 tons of nitric acid and 150 tons of ammonium nitrate per day by the oxidation of ammonia. This programme required 800 tons of calcium carbide per day and 125,000 kw. Water-power from the Pyrenees, Central France, and the Alps, and even central steam-power plants at Nanterre and Carmaux, were brought into requisition. The most important works was at Lannemezan (50,000 kw.), and new oxidation works were installed at Toulouse, Bassens, Sorgues, and Saint Chamas. Toulouse and Bassens had begun to operate at the armistice, and the others were nearly finished. These works would have supplied all requirements in nitric acid and ammonium nitrate.

Alcohol was used, apart from minor requirements in the purification of trinitrotoluene and xylite, for the manufacture of ether for the gelatinisation of gun-cotton. Great economy was effected during the war in the latter process, the quantity of alcohol per ton of Poudre B being reduced, by solvent recovery, from 20 hl. to 8 hl. A sixty days' stock of alcohol had been accumulated and arrangements made with distillers for the regular supply of 550 hl. per day, sufficient for the estimated need of 24 tons of Poudre B. As the war proceeded, new supplies had to be obtained from the distillation of beets, molasses and cider, the saccharification of grain, horse-chestnuts and sawdust, and by recovery from stocks of confiscated absinthe and from liqueurs. Before the war the production of alcohol in France was 2,000,000 hl. per annum, with 6000 hl. of brandy per day, and was principally obtained from beets cultivated in the Départmente du Nord. The German occupation deprived the nation of this source, and there were labour difficulties. In August, 1915, the distilleries and stocks were requisitioned, and forced production was begun. From absinthe 40,000 hl. were obtained, 10,000 hl. from apples mixed with beets, and 500,000 hl. were imported from Canada and the United States. Experiments were made on synthetic alcohol from acetylene, with encouraging results. The total consumption of alcohol to (and including) 1918 was 4,713,607 hl.

Ether was made at the rate of 74 tons per day in 1915, 119 in 1916, and 166 in 1917, mostly in Government factories.

Aromatic hydrocarbons (benzene, toluene, and xylene) were used in large quantities, and their provision was one of the most difficult problems to be solved. The pre-war annual production of crude benzol from coking plants did not exceed 16,000–18,000 tons, the rest being imported from England and Germany. The yield from coking plants in occupied territory was a considerable loss during the war, and not more than 3–4 tons per day could be expected from the remaining plants, although 50 tons in 1915, and later as much as 250 tons, per day were required. Needs were supplied by the requisition of stocks, imports from England and (to a less extent) from America, the re-starting and erection of recovery ovens, extraction from town gas and from Borneo petroleum. The use in private factories was restricted, and every available means of rectification was brought into requisition. From one-third to one-fourth of the weight of crude benzol was recoverable as toluene, although the English supplies had been detoluated previous to export. Borneo petroleum was an important source (35–40 tons per day). Three fractions were obtained. The benzene fraction boiled at 80–81° C., the toluene fraction at 110–112°, and the xylene fraction at 130–132°. These fractions were nitrated and the unattacked hydrocarbons distilled off. The mononitrotoluene and mononitroxylene were converted into trinitrotoluene and xylite, the nitrobenzene being sent to the aniline factories for conversion into diphenylamine for use as a stabiliser. The production of trinitrotoluene rose from 10 tons per day in 1915 to 50 tons in 1916 and 60 tons in 1917.

Phenol and *metacresol* were used for nitro-explosives. Before the war all the phenol had been imported from Germany, and a large amount of work was necessary before the production from benzene (by fusion of sodium benzenesulphonate with caustic soda, and 2–3 tons per day from aniline by diazotisation) was in operation. The supplies of synthetic phenol (excluding relatively unimportant American imports) rose from 200 tons in 1914 to a maximum of 52,747 tons in 1917.

After the explosion in the *Liberté* in 1911, large quantities of gun-cotton were thrown into the sea outside Toulon. This was recovered in excellent condition and utilised. The two State factories of Angoulême and Moulin-Blanc were developed for the manufacture of propellants. New factories were later erected at d'Empalot (Toulouse) and Bergerac. The maximum productions of gun-cotton per day reached 120 tons at Angoulême, 38 tons at Moulin-Blanc, 140 tons at Toulouse, 100 tons at Bergerac, and 35 tons from private firms. Cotton cellulose was exclusively used. The preliminary washing and extraction of grease were carried out mainly at Angoulême, and to a less extent in paper- and dye-works. More than thirty works supplied 240 tons of cotton daily, sufficient for 360 tons of gun-cotton, which was brought up to 433 tons in 1916 by American importation. Nitration, with a mixture of nitric and sulphuric acids, was before the war carried out in pots. This method required much less apparatus than the new methods of Selwig and Thomson, which were introduced only when a crisis in the supply was feared. Pots were used at Toulouse, Angoulême, Bracqueville, and Bergerac. Angoulême later installed a Selwig

plant for 60 tons, and replaced a pot installation by one using the Thomson process. The same change was effected at Bracqueville, and a Selwig plant was installed at Bergerac. The nitro-cotton, after washing, was stabilised by boiling with water, pulped, and dried to 30 per cent. moisture. Two varieties were made, CP_1 with 11 per cent. of nitrogen, soluble in a mixture of alcohol and ether, and CP_2 with 13 per cent. of nitrogen, insoluble in that mixture.

Poudre B was made by masticating the requisite proportions of these two varieties with a mixture of alcohol and ether, pressing into filaments, and drying. This was carried out at Le Bouchet, Pont-de-Buis, Ripault, Saint Médard, Sevran-Livry, Bergerac, and Toulouse. The maximum productions in tons per day from these works were 10, 48, 60, 140, 35, 60, and 130 respectively. Private industry furnished a maximum of 20 tons of ballistite (gelatinised nitro-cotton with nitroglycerin). The total production of Poudre B in France from 1914 to 1918 amounted to 306,693 tons, and 117,000 tons were during this period imported from America.

The manufacture of nitro-explosives was accompanied by strenuous endeavours to improve the methods of production and to replace these substances by others less difficult to produce. The 75-mm. shells, for example, were filled with ammonium nitrate and dinitronaphthalene; chlorates and perchlorates were introduced for filling hand grenades; and experiments were made with liquid air for charging aeroplane bombs.

The nitro-bodies picric acid and trinitrometacresol could be manufactured by known methods, but the production of trinitrotoluene, xylite, dinitrophenols, and mono- and di-nitronaphthalenes was introduced during the progress of the war. These explosives were used both alone and in the form of mixtures.

Three methods are available for the manufacture of picric acid (trinitrophenol): nitration of phenol in presence of sulphuric acid by nitric acid or sodium nitrate; chlorination of benzene, transformation of monochlorobenzene into dinitrochlorobenzene 1, 2, 4, saponification of this with formation of dinitrophenol, and trinitration of the latter; direct oxidation and nitration of benzene with nitric acid and mercury. The method of direct nitration alone was used. The second method was in use in Germany prior to the war, but as it required the use of pure chlorine it was not suited to French needs. Nevertheless, 1000 tons of chlorine were ordered from America in order to commence production in France. After the German gas attack of April 22, 1915, on the Belgian front, this chlorine was devoted to experiments on the new method of warfare. In the meantime the production of phenol had increased, and there was no longer any point in making use of the method of chlorination. The yield by the third method was poor (140 of picric acid per 100 of benzene, as compared with 190 with phenol), and the recovery of the mercury was difficult. The latter was important in view of the pressing need of mercury for the manufacture of fulminate. Picric acid so prepared may also contain small amounts of mercury picrate, which renders it very sensitive to shock.

There were three picric acid factories in operation before the war. Several chemical and dye factories in the Lyons district were requisitioned, including one of the Badische firm. State factories were also erected. Some of these factories were destroyed by explosions. The total productions of picric acid and trinitrotoluene, in tons per day, were as follows:—

Production of Trinitrotoluene in metric tons per day.

August, 1914, 0·31	January, 1917, 66·71 (maximum
August, 1915, 8·93	January, 1918, 24·02
August, 1916, 55·87	

Production of Picric Acid in metric tons per day.

August, 1915, 0·50	July, 1917, 166·1 (maximum)
January, 1916, 11·95	January, 1918, 58·86
January, 1917, 145·47	

Lack of cresol led to the use of dinitrophenol, made by nitrating phenolsulphonic acid. Picric acid was also formed, but as a mixture of the two substances was finally used, this was immaterial. The preparation by the nitration of chlorobenzene led to the installation of electrolytic chlorine apparatus producing 20 tons of chlorine per day.

The explosive *schneiderite* was used in large quantities, and was prepared by triturating in mills a dry mixture of 88 parts of ammonium nitrate and 12 parts of dinitronaphthalene. The ammonium nitrate was prepared to some extent by double decomposition of accumulated stocks of Norwegian calcium nitrate (for agricultural purposes) with ammonium sulphate, by neutralising nitric acid with ammonia solution, and by the interaction of ammonium sulphate and sodium nitrate according to a process worked out by M. Fosse, of Bordeaux, and by M. Danne, of Gif. Nearly all the ammonium nitrate, however, was imported from Norway at the rate of 200 tons per day.

Chlorate and perchlorate explosives were also manufactured. Paraffined ammonium perchlorate was tried for filling 75-mm. shells, but proved too sensitive to shock. It was, however, extensively used for trench-mortar bombs, hand grenades, and aeroplane bombs. Sodium chlorate and a mixture of 61·5 parts of ammonium perchlorate, 30 of sodium nitrate, and 8·5 of paraffin were used. The chlorates and perchlorates were made electrolytically at Cheddes, Vonges, Castres, and Grenoble, the production being 79 tons of ammonium perchlorate and 77 tons of sodium chlorate per day.

Many new products were made. Mustard gas, known as "yperite," was produced at the rate of 6 tons per day at the signing of the armistice, and plant for the manufacture of 12 tons per day was ready to be put into operation. A daily production of 24 tons was planned. Liquid nitrogen

peroxide was produced at the rate of 70–80 tons per day at Angoulême, and of 25–30 tons at Bassens. It was used with a hydrocarbon in the manufacture of "anilithe" for aeroplane bombs.

Switzerland, Italy, and Spain delivered machinery and raw materials of various kinds; Chile furnished millions of tons of sodium nitrate; and Norway supplied more than 200,000 tons of ammonium nitrate. England supplied benzene, naphthalene, and coal, and America sent raw materials and finished explosives.

The tremendous strides made during the war may be appreciated from the following table, giving the productions in tons per day :—

	Before 1914	July, 1917
Poudres B	15	370
Nitro-explosives	6	700
Chlorate explosives	4	176

War-time Archæology.[1]

THE volume before us might truly be described as a "war number," for it represents not only the published work of the British School at Athens for the first regular session after the armistice, but also mainly the results of observations made while on duty by actual and former students. The seven students of the British School of Archæology who lost their lives during the war, and the school's distinguished and learned librarian, F. W. Hasluck, who died early in 1920 of a malady caused or aggravated by war service in Greece, are appropriately commemorated, and a brief summary shows the war work which fell to other students. It is a striking and varied record. If the school had done nothing beyond training for eventual public service in Greece and the Near East so large a body of men accustomed to observe accurately, handle native labourers tactfully and economically, and act with expert knowledge and executive efficiency, it would have earned many times over the miserable allowance which it receives annually from the Treasury. Special mention is made in the annual report and in a letter of thanks from the Secretary of State for Foreign Affairs of the services of the director, Mr. A. J. B. Wace, who was attached to the British Legation at Athens during the war while carrying on the school as a hostel for British officers in transit or on duty in Greece.

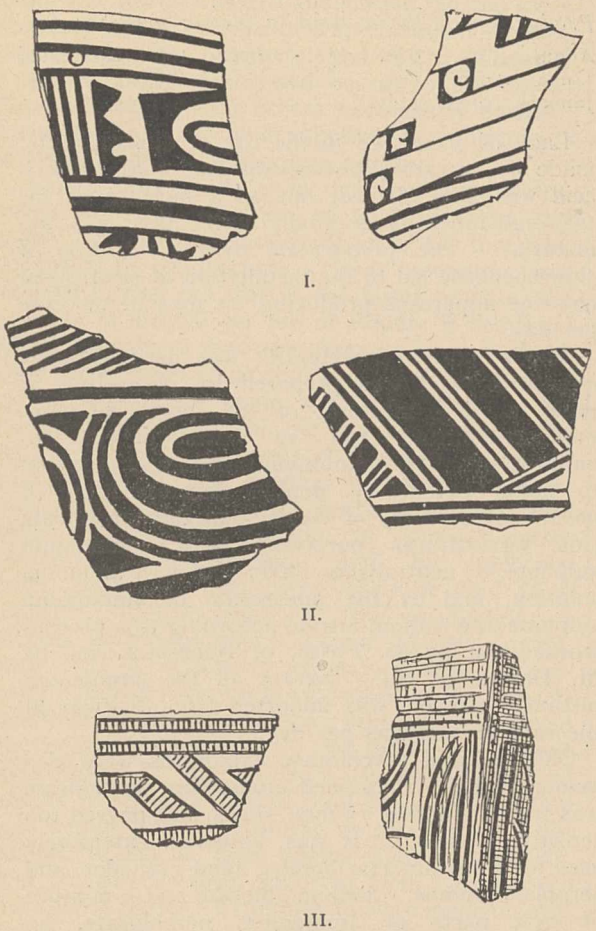

FIG. 1.—Specimens of prehistoric pottery from Dikilitash. I. Dimeni ware; fine reddish biscuit, surface usually bright chestnut; patterns, a mixture of geometrical and curvilinear figures in dull brown paint. II. Black or red biscuit; patterns, geometrical designs, parallel lines in sets of threes, and rows of concentric circles, in dull white paint. III. Coarse black or red biscuit; patterns, similar to those of I. and II. filled in with cross-hatching or painted; specimen on right is painted and incised. From "The Annual of the British School at Athens."

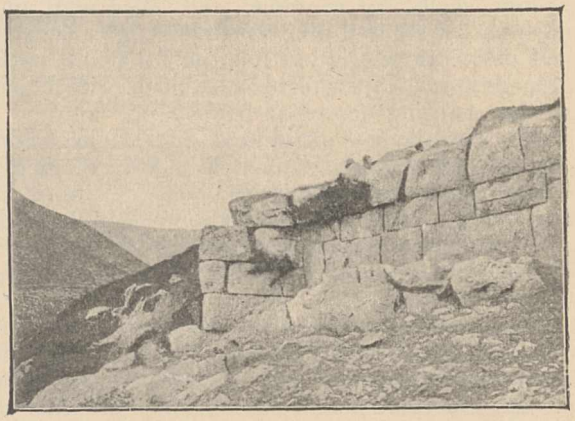

FIG. 2.—Wall of ruined fort near Kato Kastelli, in ancient Doris. From "The Annual of the British School at Athens."

The greater part of the volume is devoted to the publication, by Prof. E. A. Gardner, Messrs. Carson, Welch, Woodward, and others, of sites, inscriptions, and other antiquities discovered during the British occupation of Salonica. This district was previously very ill-explored, but numerous finds were made in trenching operations and military surveys. The contents of the museum formed at British G.H.Q. have now been presented by the Greek Government to the British

[1] "The Annual of the British School at Athens." No. xxiii. Session 1918–19. Pp. xvi+260+xvi pls. (London: Macmillan and Co., Ltd., n.d.) Price 30s. net.

nation, and are placed in the British Museum. The corresponding discoveries in the French zone of occupation, further west, are summarised by Capt. Ch. Picard, now director of the French Archæological School at Athens. The finds in both zones were of all periods. The most novel illustrate the earlier periods from the Neolithic to the early Iron age, revealing new distributions of pottery styles, and types of primitive figurines, and raising a number of questions which can only be solved by systematic excavation as soon as local conditions allow.

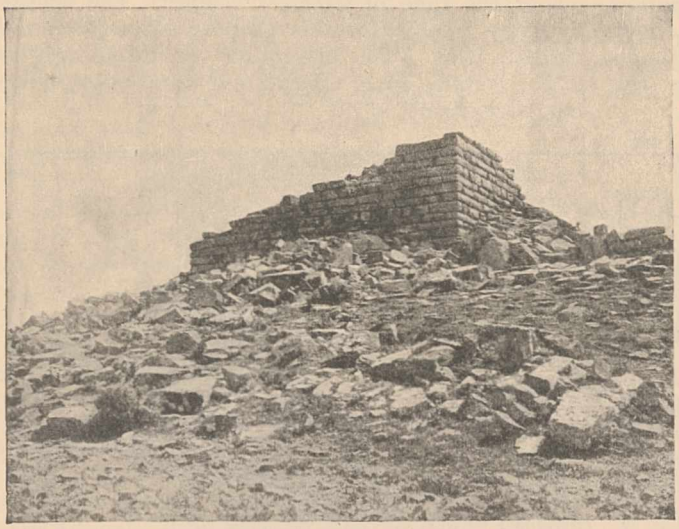

FIG. 3.—Ruins at Hagia Sophia in Lemnos. From "The Annual of the British School at Athens."

Mr. M. N. Tod publishes twenty-five Greek inscriptions from the same district, and Mr. A. M. Woodward adds a note on the Byzantine castle of Avret-Hissar (*Gynaikokastro*).

Other war surveys are published by Mr. F. W. G. Foat, who was in charge of "educational work on topography and archæology" at the Y.M.C.A. rest camps in ancient Doris, and on the island of Lemnos by Mr. F. L. W. Sealy, who appends also notes on birds and fishes observed there. Mention should also be made here of Mr. Hasluck's paper on "The Rise of Modern Smyrna."

Further afield, Mr. S. Casson, who was for a while in charge of the Salonica Museum, made good use of a flying visit to the Caucasus and Western Turkestan to describe an extensive series of prehistoric mounds, and to throw fresh light on Herodotus' account of the ancient routes eastward from Scythia.

Other papers, such as those on the fictitious legend of "Saint Gerasimos and the English Admiral" and on "The Folklore of a Turkish Labour Battalion," illustrate more special aspects of research under war conditions, and also the great variety of subjects which are studied by members of the British School at Athens.

The Annular Eclipse of April 8.

By DR. A. C. D. CROMMELIN.

THE occurrence of a central solar eclipse within the limits of the British Isles is a somewhat rare event. On the average, one total eclipse is visible here in seventy years, and one annular eclipse in about sixty years. It is, therefore, noteworthy that the decade now commencing supplies examples of both. There has been no British total solar eclipse since 1724, the interval being about three times the average; the last annular eclipse was in 1858. After the present decade there will be totalities in 1999 and 2090, and annularity in 2093.

The central line on April 8 passes across South Uist, just misses Cape Wrath, and then runs a few miles north-west of the Shetlands. The south limit of annularity enters Scotland near Ardnamurchan Point, and runs nearly parallel to the Caledonian Canal, emerging near Wick. Thus practically the whole of the counties of Ross and Cromarty, Sutherland and Caithness, and a corner of Inverness, together with the Outer Hebrides, Skye, and the Orkneys and Shetlands, will enjoy the annular phase.

The eclipse occurs about 9 a.m., the sun's altitude being about 23°; the duration of annularity is 111 sec., the width of the annulus of sunlight being 26″. This implies that 1/19 of the sun's disc will remain uncovered; in other words, the illumination will exceed normal sunshine on the planet Jupiter. Remembering what a resplendent object Jupiter appears in the night sky, it will be seen that there will be nothing approaching darkness. Venus will doubtless be readily visible, about 20° east of the sun; it will be a slender crescent, inferior conjunction occurring a fortnight later. The only other object that may possibly be visible is Vega, which will be high in the west, three hours past the meridian.

Dr. J. K. Fotheringham, who has made a special study of the records of ancient eclipses, intends to examine the question of its visibility, as it is important to know what degree of solar obscuration is implied by the frequently recurring phrase, "Stars were visible." It is used, for example, by Thucydides with reference to an eclipse which was not total anywhere.

As regards useful observations that may be made in the coming eclipse, the exact times of the beginning and end of annularity can be accurately noted, especially by the method of projection upon a white screen; they serve to correct the position of the moon; those who cannot deter-

mine absolute time can still do good work by timing the exact duration of annularity; this applies especially to observers fairly near the limit of annularity. Prof. Newcomb found numerous records of this kind, made in England during the total eclipse of 1715, which enabled him to correct Hansen's value of the centennial motion of the moon's node. Photographs taken about mid-eclipse, on as large a scale as possible, would be of value for determining the difference of the diameters and ellipticities of sun and moon.

Useful spectroscopic work can also be done, the diminution of sky-glare being of service in photographing the prominences or reversing layer. The British Astronomical Association, which has experience of a great number of eclipses, is prepared to organise work if a sufficient number of observers send in their names.

It is possible to reach observing stations by rail, either on the line to Wick and Thurso, or on that running westward from Dingwall to Loch Alsh (for Skye); the journey from London to the eclipse zone is in the neighbourhood of twenty-two hours, and the return fare (third class) in the neighbourhood of 8*l*. at present rates. The season is probably too early for the steamboat services, otherwise these would afford a ready means of reaching observing stations on the mainland or islands.

Besides astronomical work, the eclipse affords opportunities for at least three other studies: (1) Meteorological. The temperature is directly affected, and there are frequent indirect effects on barometer, wind, and cloud formation. (2) Magnetical. The work of the Carnegie Institution of Washington, under Prof. L. Bauer, has established a connection between eclipses and the elements of terrestrial magnetism. Such a connection is in no way surprising, for the diurnal variation in these elements has long been known, so it is to be expected that the interposition of the moon should act similarly to the interposition of the earth during the night hours. (3) Wireless telegraphy. A notable improvement in the clearness of signals has been observed during eclipses, which is again analogous to what happens during the hours of darkness. Advantage might be taken of this to make time comparisons for longitude about the time of greatest eclipse. The eclipse is large enough for this purpose throughout the British Isles. The magnitude at Edinburgh is 0·95; Dublin, 0·94; Oxford and Cambridge, 0·89; and Greenwich, 0·88.

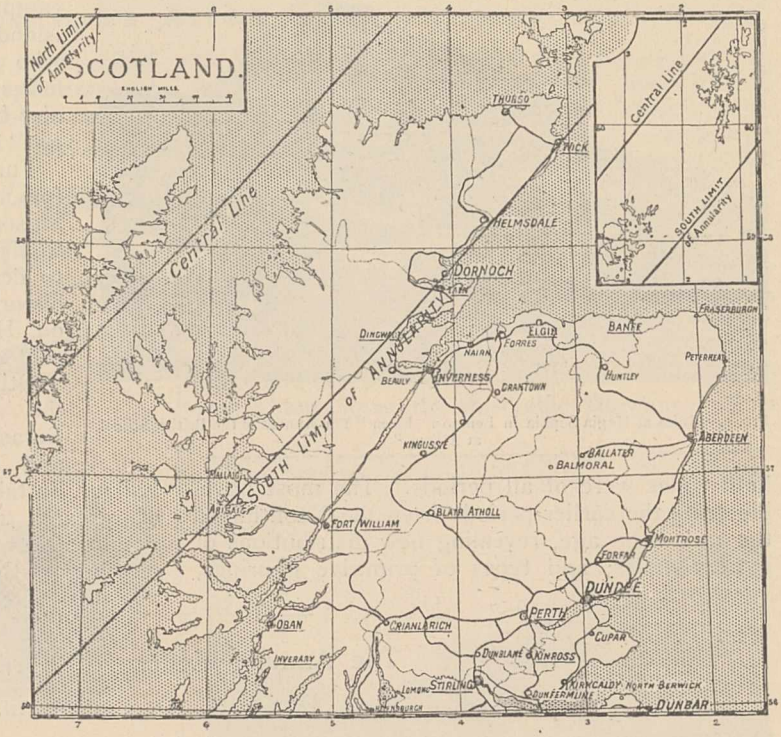

FIG. 1.—Track of the annular eclipse of April 8, 1921.

There will be a total solar eclipse in England and Wales on June 29, 1927 (civil). The central line will run from near St. David's Head to near Whitby, where the sun will have risen about $1\frac{3}{4}$ hours, and totality will last 24 sec. At the total eclipse of January 24, 1925, the track of totality will graze the Western Hebrides, but with a very low sun. It will be necessary to go to the neighbourhood of New York for effective observations on that occasion.

Obituary.

PROF. EMILE BOURQUELOT.

BY the death of Emile Bourquelot, Professor of galenical pharmacy in the University of Paris, science has sustained an irreparable loss. Born in a small village in the Ardennes in 1852, Bourquelot was apprenticed in a pharmacy in Sedan while the town was still occupied by the Germans. He afterwards became chief pharmacist in the Hôpital Laeonec, and then successively assistant professor and professor of galenical pharmacy in the Ecole Supérieure de Pharmacie, now the faculty of pharmacy in the University of Paris. Bourquelot at once devoted himself to the investigation of various pharmaceutical problems, but gradually restricted himself almost entirely to the study of the enzymes occurring in drugs and various plants, their action and the changes brought about by them in the constituents of

drugs and their galenical preparations. His researches in this direction, often in conjunction with M. Hérissey, M. Bridel, and other of his assistants and pupils, gained for him a world-wide reputation. His investigation of the constituents of gentian root and of the changes brought about by enzymes during the drying of the root and the making and keeping of preparations made from it may well serve as a model for future workers. The latter years of his life were mainly devoted to the study of the synthetical as well as the analytical action of enzymes, in which field remarkable results were obtained.

To his scientific attainments Bourquelot added a personal charm that fascinated everyone brought into contact with him. His unfailing courtesy and friendly disposition endeared him to all. He was one of the most eloquent of lecturers, and those who were fortunate enough to hear his lecture on "The Synthesis of Glucosides by Ferments" at the International Congress of Pharmacy at The Hague in 1913 will long remember his admirable lucidity, clear enunciation, and exquisite delivery.

Though Bourquelot had been in indifferent health for the last two or three years the end came with dramatic rapidity, and pharmacy was robbed of one of its most brilliant exponents.

Col. R. A. Wauhope.

Col. R. A. Wauhope, whose death is announced, was, perhaps, better known for the splendid quality of his practical work at map-making on the Indian frontier (and beyond it) than for researches into those branches of geodetic science which form the special objective of that section of the Indian Survey Department which is centred in Dehra Dun. He was one of the first and best of those surveyors who reformed the antiquated methods of geographical reconnaissance and proved that sound square mapping may be evolved on precisely the same principles of triangulation and topography in the field of an expedition or a campaign as govern the output of Ordnance mapping in the quiet fields of home survey.

Col. Wauhope's science consisted in the clever combination of exact methods, where they were possible, with the scientific adaptation of inexact methods (that is to say, methods not ordinarily recognised as permissible under normal conditions of map-making), and obtaining therefrom results which have proved to be satisfactory. The best instance of such adaptation was afforded when he fixed the initial point of the Russo-Afghan boundary at the head of Lake Victoria, in the Pamirs, by the method of instrumental resection from distant Himalayan peaks (the position of which had been determined by a regular geodetic series of the Indian triangulation) in circumstances where direct intersection from a regular series across the Himalayas was impossible. Such a direct series was eventually carried through with much difficulty and at great expense of money and time from India to the same point, when it was found in the first place that the result in absolute values of latitude and longitude was almost coincident with Wauhope's value, and, in the second, that it was doubtful whether the result of direct triangulation completed under abnormal conditions was the more trustworthy of the two. In this special case it must be remarked that few surveyors possess that physical capacity which enabled Col. Wauhope to attain the elevations necessary for observation. T. H. H.

Mr. George Clinch, the librarian of the Society of Antiquaries, whose death, on February 2, we regret to record, joined the staff of the society in January, 1896, having previously been employed at the British Museum. In May, 1886, he exhibited to the society a collection of flint implements found by him during eight years in West Wickham, Kent. In December, 1888, Mr. Clinch reported to the society the results of excavations made by him during the ten previous years in the supposed pit-dwelling at Hayes Common, in the same county. Later, he published a volume entitled "Antiquarian Jottings," describing in a popular manner these and other researches in the same district. Mr. Clinch also wrote a number of the "Little Guides," and a work on old English churches. He prepared the annual Lists of Archæological Papers after they had been discontinued by Sir Laurence Gomme. As librarian he earned the esteem of the fellows and others using the library by his courtesy and readiness to assist. He was in his sixty-first year.

The death is announced, in his sixty-sixth year, of Dr. William Thompson Sedgwick, who had been connected with the Massachusetts Institute of Technology since 1883 as successively assistant professor, associate professor, and full professor of biology. He had also been, since 1897, curator of the Lowell Institute, Boston, and since 1902 a member of the advisory board of the hygienic laboratory of the U.S. Public Health Service. Prof. Sedgwick was author of "Principles of Sanitary Science and Public Health," and joint author of "General Biology," "The Human Mechanism," and "A Short History of Science."

We much regret to announce the death, on February 17, at ninety-one years of age, of Dr. W. Odling, F.R.S., Waynflete professor of chemistry at the University of Oxford from 1872 to 1912; also on February 21, at seventy-eight years of age, of Prof. L. C. Miall, F.R.S., Emeritus professor of biology at the University of Leeds; and on February 22, in his eighty-fifth year, of Prof. R. B. Clifton, F.R.S., lately professor of experimental philosophy in the University of Oxford.

The death is announced, on February 16, in his seventy-ninth year, of Mr. C. Grover, for many years astronomical assistant at Sir C. E. Peek's observatory at Rousdon, Devon.

Notes.

LORD MOULTON has been elected an honorary member of the Institution of Civil Engineers.

AT the meeting of the Royal Society on May 12 a discussion on "The Quantum Theory of Line-Spectra" will be opened by Sir Ernest Rutherford, followed by Dr. N. Bohr.

THE thirtieth annual meeting of the Royal Society for the Protection of Birds will be held at the Middlesex Guildhall, Westminster, S.W., on Tuesday, March 8, at 3 p.m. The Right Hon. Field-Marshal Lord Methuen, vice-president of the society, will occupy the chair.

PROF. C. S. SHERRINGTON, president of the Royal Society, has been elected a member of the Athenæum under the provisions of the rule of the club 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."

THE council of the Royal Statistical Society will in November next award the Frances Wood memorial prize, value 30*l.*, for the best investigation of any problem dealing with the economic or social conditions of the wage-earning classes. Particulars may be obtained from the honorary secretaries of the Royal Statistical Society, 9 Adelphi Terrace, W.C.2.

THE twenty-fifth anniversary of the discovery of the "Zeeman effect" will take place on October 31 next. A committee has been formed by scientific men in Holland to mark the occasion by showing their appreciation of the importance of the discovery and of the distinguished services which Prof. Zeeman has rendered to science. It is intended to raise a fund to be placed at his disposal for researches to be conducted in the physical laboratory of the University of Amsterdam. Any contributions to this fund may be sent to Sir Arthur Schuster, Yeldall, Twyford, Berkshire, who will forward them to the Dutch committee.

THE annual general meeting of the Institute of Metals will be held in the room of the Institution of Mechanical Engineers on Wednesday and Thursday, March 9 and 10. A paper on the recrystallisation of aluminium sheet by Prof. H. C. H. Carpenter and Constance F. Elam, and another on calcium by Mr. P. H. Brace, will be presented at the morning session on March 9. The afternoon session of the same day and the morning session of March 10 will be devoted to four papers on copper and copper alloys by Prof. C. A. Edwards and Mr. A. M. Herbert, Mr. H. Moore and Mr. S. Beckinsale, Mr. H. Moore, Mr. S. Beckinsale and Mr C. E. Mallinson, and Dr. J. L. Haughton. The afternoon session of March 10 will take the form of a visit to the National Physics Laboratory. The annual dinner of the society will be held on the evening of March 9.

SIR FRANCIS YOUNGHUSBAND, president of the Royal Geographical Society, announced to the society on Monday that since the previous meeting of the Mount Everest Committee further progress had been made with the organisation of the expedition. Subject to the approval of the Government of India, Major Morshead and Capt. Wheeler will accompany the expedition as survey officers. Dr. Kellas, who has for many years devoted himself to Himalayan exploration, has accepted an invitation to join the expedition, and also Mr. G. L. Mallory and Capt. George Finch. Sir Francis Younghusband added:—"Our party for the reconnaissance is thus complete, and we are now engaged in equipping it in the best possible manner for the important work it will have to do this summer in examining the mountain from every angle and testing the possible ways by which its summit may be reached."

AT the annual general meeting of the Association of Economic Biologists, held in the Imperial College of Science on Friday last, the following were elected officers and councillors for the year 1921:—*President:* Sir David Prain. *Hon. Treasurer:* Dr. A. D. Imms, *Hon. Secretary (Gen. and Bot.)* Wm. B. Brierley. *Hon. Secretary: (Zool.):* Dr. S. A. Neave. *Hon. Editor (Bot.):* Wm. B. Brierley. *Hon. Editor (Zool.):* D. Ward Cutler. *Council:* Dr. W. Lawrence Balls, Prof. V. H. Blackman, F. T. Brooks, A. B. Bruce, Dr. E. J. Butler, F. J. Chittenden, A. D. Cotton, J. C. F. Fryer, Prof. J. B. Farmer, E. E. Green, Dr. G. A. K. Marshall, and Dr. E. J. Russell. In view of the very great increase in the publishing costs of the *Annals of Applied Biology*, it was decided to establish a "Publication Fund," to which all interested in the progress of biology and in its application to the welfare of man are invited to subscribe. Sir David Prain then delivered his presidential address on "Some Relationships of Economic Biology."

AT the annual general meeting of the Physical Society held on February 11, the following officers were elected:—*President:* Sir W. H. Bragg. *Vice-Presidents who have filled the office of President:* Dr. C. Chree, Prof. H. L. Callendar, Prof. R. B. Clifton, Sir Richard Glazebrook, Sir Oliver J. Lodge, Prof. C. H. Lees, Prof. A. W. Reinold, Sir Arthur Schuster, Sir J. J. Thomson, and Prof. C. V. Boys. *Vice-Presidents:* Prof. W. Eccles, Prof. A. S. Eddington, the Right Hon. Lord Rayleigh, and Prof. Sir Ernest Rutherford. *Secretaries:* Mr. F. E. Smith, National Physical Laboratory, Teddington, and Dr. D. Owen, 62 Wellington Road, Bush Hill Park, N. *Foreign Secretary:* Sir Arthur Schuster. *Treasurer:* Mr. W. R. Cooper, 82 Victoria Street, S.W.1. *Librarian:* Prof. A. O. Rankine. *Other Members of Council:* Dr. G. B. Bryan, Mr. C. R. Darling, Prof. C. L. Fortescue, Dr. E. Griffiths, Dr. F. L. Hopwood, Dr. E. H. Rayner, Dr. A. Russell, Mr. T. Smith, Dr. J. H. Vincent, and Prof. W. B. Morton.

REPORTS have appeared in the daily Press respecting a serum treatment for tuberculosis introduced by M. Henri Spahlinger, of Geneva, shortly before the outbreak of war. Preliminary trials of the serum have been made upon a small number of selected cases by

physicians in London and Paris, and it is stated that cases treated in 1913 are still alive and well. The nature and mode of preparation of the remedy do not appear to be disclosed, but according to a communication made by Prof. D'Arsonval to the Paris Academy of Sciences, M. Spahlinger divides tuberculosis cases into two classes for purposes of treatment, (1) acute cases treated by means of "complex antitoxic and bacteriolytic serums" and (2) chronic cases treated by "vaccination with a series of antigens and ferments," the former being derived from the bacillary substance of the tubercle bacillus. Patients are finally treated with a series of injections of the different antigens given separately. The preliminary trials have apparently been so successful that a tuberculosis specialist is being sent by the Ministry of Health to Geneva to investigate at first hand the Spahlinger cure.

CONSIDERABLE concern has been expressed at the announcement that the Treasury contemplates the withdrawal of grants hitherto given to the Industrial Fatigue Research Board, and at the recent conference on this subject at Olympia a resolution was carried urging the Government to revoke this decision. It appears that the withdrawal of the grant is regarded as a measure of economy, but anyone conversant with industrial matters is aware of the great waste occasioned by unnecessary fatigue, both in slowing down the speed of production and in leading to accidents and ill-health. Rightly regarded, therefore, researches having for their object the elimination of such fatigue are essentially "economical." The work of the Board has hitherto been conducted on a modest scale, and its expenditure has been small in comparison with the importance of its field of operations. Other countries, we believe, have followed our lead in instituting such inquiries, and their discontinuance would be most regrettable. It is also to be feared that the step proposed in regard to the Industrial Fatigue Research Board will constitute a regrettable precedent by discouraging investigators from taking up work of this nature, and that it may be followed by the restriction or withdrawal of facilities for research in other directions. We sincerely hope that the efforts being made to induce the Treasury to revoke the decision will be successful.

IN accordance with the provisions of the Dyestuffs (Import Regulation) Act, 1920, the President of the Board of Trade has appointed the following Committee to advise the Board of Trade with respect to the granting of licences under the Act:—Mr. V. Clay (joint managing director, Robert Clay, Ltd.), Mr. G. W. Currie, Mr. G. Douglas (managing director, Bradford Dyers' Association, Ltd.), Mr. E. V. Evans (treasurer of the Society of Chemical Industry), Dr. M. O. Forster (director of the Salter Institute of Industrial Chemistry), Mr. C. C. Railton (director, Calico Printers' Association, Ltd.), Mr. H. B. Shackleton (Messrs. Taylor, Shackleton and Co., Shipley), Mr. T. Taylor (Cornbrook Chemical Co., Stockport), Mr. S. A. H. Whetmore (British Dyestuffs Corporation, Ltd.), and Mr. W. J. U. Woolcock (general manager, Association of British Chemical Manufacturers). Pending the appointment of a permanent chairman, which it is hoped to make at an early date, Mr. Percy Ashley, assistant secretary, Industries and Manufactures Department, Board of Trade, will act as chairman of the Committee. The secretary to the Committee is Mr. W. Graham, and all applications for licences should be addressed to the Secretary, Dyestuffs Advisory Licensing Committee, Danlee Buildings, Spring Gardens, Manchester.

THE Lord President of the Council has established an Inter-Departmental Committee on Patents with the following terms of reference:—(1) To consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged (*a*) as research workers or (*b*) in some other technical capacity, so as to give a fair reward to the inventor and thus encourage further effort, to secure the utilisation in industry of suitable inventions, and to protect the national interest; and (2) to outline a course of procedure in respect of inventions arising out of State-aided or supported work which shall further these aims and be suitable for adoption by all Government Departments concerned. As at present constituted, the Committee consists of the following members:—Dr. Kenneth Lee (chairman), Mr. W. St. D. Jenkins, Mr. F. E. Smith, Sir E. L. Ellington, Mr. H. W. W. McAnally, Mr. P. W. L. Ashley, Col. W. H. D. Clark, Sir H. Frank Heath, Mr. A. J. Stubbs, Dr. H. H. Dale, Mr. W. J. Coombes, Lt.-Col. P. K. Lewes, Mr. P. Tindal Robertson, Sir Richard Gregory, Mr. D. M. Kerly, and Sir Charles A. Parsons. The secretary to the committee is Mr. A. Abbott, to whom all communications should be addressed at 16 and 18 Old Queen Street, Westminster, London, S.W.1.

MR. F. H. CARR, in a paper on the post-graduate training of chemical students for industry read at a meeting of the Old Students' Association of the Royal College of Science on February 8, outlined a scheme involving the establishment of a technological teaching laboratory which would, in practice, be a miniature manufacturing concern, attached to a college, providing the necessary lectures and class-room instruction. The plant would be available for technical-scale experiments interpreting the results of research work from research institutions or elsewhere. Further, it would be utilised for the manufacture of those fine chemicals that are not ordinarily obtainable in the chemical trade, and of which a restricted and irregular supply is required by colleges and research laboratories. This manufacturing laboratory would be conducted under conditions of strict and complete business organisation and discipline. A fundamental object of the instruction suggested would be the introduction of the cost factor in relation to power, heat, labour, material, and yield, whilst a spirit of reality would be maintained by disposing of the products so far as possible through existing trade channels. The nature of the work, as exemplified in the syllabus, would be general, and would not be identified with any particular branch of industry; it

would keep in view the necessity for a training in the broad principles underlying chemical technology. If possible, arrangements would be made for the students to attend manufacturing works for courses of practical instruction, and special teaching would be provided by men actually engaged in the various specific chemical industries. An interesting feature of the discussion which followed Mr. Carr's paper was the united praise bestowed upon Prof. J. F. Thorpe's scheme—now approaching completion—of a technical-scale laboratory to be established as an adjunct to the Honours Organic Laboratory at South Kensington.

IN the January issue of *Man* Mr. T. A. Joyce describes a carved wooden coffer from British Columbia which has been recently acquired by the British Museum. It is a fine specimen of native work, the central panel on one side representing a grizzly bear protecting its cub. The eyes, ears, nostrils, and fore-paws of the bear are inlaid with abalone (haliotis) shell, while the mouth of the larger figure is furnished with twelve graduated deer-teeth. Coffers of this kind were used by men of rank for storing valuable property, such as the hereditary insignia worn by individuals who had the right of impersonating certain legendary and supernatural beings at the winter ceremonials. The British Museum is indebted for the coffer to Mr. St. George Littledale, who obtained it and generously presented it to the nation.

SOME time ago the Library Association instituted examinations in librarianship and granted certificates on the result. From the report of a discussion opened by Dr. W. E. Hoyle, and printed in the *Museums Journal* for February, it appears that the Museums Association contemplates similar action. Taking as a *sine qua non* a high standard of general education, the next essential is a good grounding in the particular branch of knowledge appropriate to the candidate's proposed work. Lastly follows a special training in museum administration and methods. Clearly it is in this last that the difficulty lies, both for training and for examining. Perhaps the most practical suggestion made in the discussion was that an apprenticeship should be served in the national museums. To some extent, by force of circumstances, that has been the case in the past, but it was not an accepted or organised method. Whether a man is to stay in the central museum or whether he is to take a post in the provinces, it is most desirable that he should pass through the mill and learn his business in the administrative and technical departments from the bottom upwards.

THE first part of vol. lxv. of the *Quarterly Journal of Microscopical Science* marks a new era in the history of that well-known periodical. Prof. E. S. Goodrich has succeeded Sir Ray Lankester as editor-in-chief, and at the same time the publication has passed from the hands of Messrs. J. and A. Churchill into those of the Oxford University Press. Unfortunately, these changes are accompanied by a rise in price from 12*s.* 6*d.* to 1*l.* 1*s.* per number. We hope that this increase will not be counterbalanced by a corresponding decrease in the number of subscribers.

THE current issue of the *Quarterly Journal of Microscopical Science* (vol. lxv., part 1) contains a rather startling paper by Mr. Arthur Bolles Lee on "The Structure of Certain Chromosomes and the Mechanism of their Division." After describing the animal chromosome as consisting normally of an axial core of basophilous chromatin twisted into a screw-like form with a spiral flange, and an investing sheath with acidophilous staining properties, he proceeds to deny that the longitudinal splitting of chromosomes which has formed the basis of so much theorising really takes place. According to Mr. Lee's view, the double character so suggestive of longitudinal splitting arises from the close approximation of the limbs of an originally **V**-shaped chromosome, and the division of the chromosome really takes place by rupture at the apex of the **V**. It will be interesting to see what other cytologists have to say about this iconoclastic statement.

WE have received a copy of a special issue of *Die Naturwissenschaften* commemorating the twenty-fifth anniversary of the discovery of X-rays by Prof. Röntgen. A portrait of the discoverer forms the frontispiece, but is a rather disappointing reproduction. Original articles are the attraction, and are written by men well known in their respective spheres. Four out of the eight articles are devoted to the part which can be played by X-rays in the determination of atomic structure in crystals and other substances. The technical developments in the manufacture of X-ray tubes are described by Knipping in a brief article, the medical uses of X-rays being dealt with by Levy-Dorn. Radiographic reproductions receive scant justice, owing to the poor quality of the paper used. The issue concludes with a long article by Pfeiffer on the vital part which X-rays have played in many problems in chemistry.

IN the November, 1920, issue of the *Journal de Physique et le Radium*, M. A. Dufour describes his cathodic oscillograph, which gives a photographic reproduction of any phenomenon which can be translated into a constant or variable magnetic or electric field so long as the frequency involved does not exceed 10^9 per second. The cathode rays utilised are produced at a plane cathode at the top of a vertical tube and are fired down through a pierced anode into a bell-shaped metal chamber, at the bottom of which a fluorescent screen or a cylindrical photographic film can be placed. The chamber can be exhausted, and provision is made for magnetic control from outside of the motor which rotates the cylinder. The electric or magnetic field is applied to the rays at the top of the bell chamber, and for low frequencies the cathode rays are moved parallel to the axis of the cylinder, which itself rotates at a uniform rate. For high frequencies the photographic film remains at rest while an auxiliary oscillation of low frequency but large amplitude at right angles to that to be studied is imparted to the rays. In order to prevent overlapping of the curves, a further slow motion of the ray parallel to the original motion is introduced by the slow change of a second auxiliary magnetic field.

WE learn from the *British Journal of Photography* for February 11 that at the meeting of the Royal Photographic Society held on February 9, Mr. Thorne Baker and Dr. L. A. Levy introduced "a new X-ray plate reducing exposure to one-twenty-fifth," and indicated its special application to radio-metallurgy. The plate is distinguished as the Imperial "Impex." Its extraordinary sensitiveness is obtained by incorporating the intensifying screen with the plate. The screen consists of a layer of calcium tungstate in soluble gelatine, and is coated on top of the emulsion which is hardened, so that after the exposure the screen can be dissolved off by water at 100° F. and development then carried out as usual. The screen being in optical contact with the emulsion, an "infinitely smaller" quantity of calcium tungstate is necessary to give the required intensification. The new plate takes a little longer to develop than usual (say 25 per cent.). The size of the particles of the calcium tungstate is some two or three times that of the particles of silver salt in the emulsion.

THE hope has often been expressed that means might be found for desensitising a photographic plate after its exposure, so that its development might be done without the extreme precautions that are necessary as to the light employed. This applies with the greatest force to highly sensitive panchromatic plates, which stand so very feeble a light that most persons prefer none at all, trusting to the time of treatment that is supposed to be suitable to the temperature of the developer. It has been found that certain substances possess the desired effect to a greater or less degree, but for one reason or another they have not proved acceptable. But "desensitol," which has just been put upon the market by Messrs. Ilford, Ltd., is simple to use and very effective. It is a solution of a red dye, and it is only necessary to dilute it with 50 parts of water and immerse the exposed plate in it, then after one minute the light may be increased to from 200 to 800 times the brightness that would previously have been safe, and the plate transferred to the developer and watched in comfort. From a scientific point of view there are many interesting points about such desensitising action, and we hope that we shall soon see the results of investigations into the changes, if any, produced by the desensitiser in the form of the characteristic curve and the proportional colour sensitiveness of plates of various kinds.

THERE can be very few officers who served in France who are not familiar with the co-ordinate reference card which was issued by the War Office to facilitate map descriptions and map measurements after the introduction of the application of a cartesian grid to all Service maps up to scales of 1 : 40,000. The same idea is embodied in the "Romer graph plotter" (A. G. Thornton, Ltd., Paragon Works, 49 King Street West, Manchester). A rectangular piece of cardboard (or celluloid), 8″×6″, is graduated along its edges with the zero graduations at the top right-hand and the bottom left-hand corners. By this means, given two rectangular axes, a point of given co-ordinates can be plotted and the co-ordinates of a given point read off without the use of squared paper and as accurately as would be possible if squared paper were employed. The advantages are obvious. Accurate graphs can be drawn in ordinary note-books or on ordinary paper; the attention of the student is concentrated on the graph rather than on the axes; and, more important still, the expense involved in the purchase of squared paper, by no means a small item, is avoided. Teachers of mathematics and science will probably not regret giving this instrument a trial.

A KINEMATOGRAPH projector of a new type was demonstrated by Mr. R. J. Trump at the Imperial College, South Kensington, on February 10. The invention of Mrs. Kingsley-Higginson, it employs, in place of the shutter and intermittent film-feeding gear of the ordinary machine, a continuously rotating ring of mirrors to stabilise the image and effect the change of picture while the film is run uniformly through the machine. The beam of light is thus always passing unobstructed to the screen, and the alternations of light and darkness produced by the shutter, which constitute the flicker of the ordinary projector, are avoided. The new apparatus can be run quite slowly if required, and in any case there is no necessity to speed it up in the way that is at present usual. The change of picture takes place zone by zone across the screen, which always shows a full image, derived from parts of two successive pictures on the film. The facets on the ring of mirrors are so arranged and set at such an angle that the two lights from the two partial film-pictures which are present at any instant in the gate are separated and transposed into their correct positions on the screen, and join up to form a complete image. There is no dark period and no overlapping or dissolving of the successive pictures into each other, as the first picture disappears at precisely the same rate that the second takes its place. A good and sharply defined image is obtained. The advantages of a uniform feed for the film are considerable, in that the wear and tear upon it are much reduced and the risk of breakage is negligible. The application of the same principles to kinemaphotography is under consideration, and there is every expectation that useful results will be obtained.

MESSRS. SOTHEBY, WILKINSON AND HODGE will sell by auction at their galleries at 34 and 35 New Bond Street, W.1, on Thursday and Friday, March 3 and 4, a large number (509 lots) of valuable works dealing with natural history and travel, the property of the late Dr. F. du Cane Godman. Many rare books are included, also several long runs of scientific journals and transactions of learned societies. The catalogue should be of great interest to many readers of NATURE.

SIR WILLIAM TILDEN has written for publication by Messrs. George Routledge and Sons, Ltd., a book on "Famous Chemists: The Men and their Work," in which the lives of twenty-one leading chemists, from Robert Boyle to Sir William Ramsay, will be dealt with in a non-technical manner. The sketches, while chiefly biographical in character, will give attention to the social and political conditions of the

times in which the subjects dealt with lived, in order to show the relation of discovery in physical science to the progress of civilisation.

A SOMEWHAT novel way of keeping a book up to date, other than by issuing new editions, has been devised by the Cambridge University Press, which has projected a series of monographs intended to serve as supplements to Dr. Norman R. Campbell's "Modern Electrical Theory." The series will be edited by Dr. Campbell, who, however, will not write all the volumes. The first three monographs will deal with spectra, the quantum theory, and the constitution of atoms and molecules. It is proposed that the series shall correspond roughly with the chapters of the original book, and eventually supersede the latter.

ANNOUNCEMENT is made of the amalgamation of the firms of Messrs. John Wheldon and Co., of 38 Great Queen Street, Kingsway, W.C.2, and Messrs. William Wesley and Son, of 28 Essex Street, Strand, W.C.2. Both firms are well known in the world of science as booksellers and publishers of repute. The business of John Wheldon was established in 1844, and was concerned mainly with supplying collectors and institutions with scientific works; recently it has developed in the direction of economic and applied natural science. Of particular value to the new firm will be the collection of scientific journals held by John Wheldon and Co. The business of William Wesley and Son was established in 1855, and dealt similarly with books and journals of science. A valuable side of the firm's activities, which will be continued by the new company, is the numerous agencies which are held for the sale of publications of foreign and Colonial Governments and societies. The establishments will be carried on in future in the name of Messrs. Wheldon and Wesley, Ltd., under the guidance of Mr. H. K. Swann and Mr. E. F. Wesley, who have been managers and proprietors of their respective firms for a number of years.

Our Astronomical Column.

A STUDY OF THE STARS OF TYPE N.—The stars of type N (Secchi's fourth type) are of great interest; they were formerly supposed to be near the end of their career as suns. However, their concentration in the galaxy is a proof of great distance, and shows that they are in the giant stage. Lick Observatory Bulletin No. 329 contains a photographic study of the spectra of two bright stars of the class, 152 Schjellerup and 19 Piscium, by C. D. Shand. Lines in these spectra are very numerous, which increases the difficulty of identification. The presence of carbon, hydrogen, iron, titanium, vanadium, chromium, sodium, manganese, calcium, scandium, and yttrium is certain; four other elements are suspected. It is difficult to decide whether apparent bright lines are really emission lines or mere spaces between absorption lines; the author inclines to the former view.

The most striking feature of the spectra is the "Swan" carbon spectrum; the cyanogen bands are also prominent, and possibly carbon monoxide is indicated. The suggestion is made that the oxygen present may all combine with carbon, thus explaining the absence of titanium oxide, which is prominent in the M stars.

Many of the N stars are variable, resembling in this point the Md stars. It was formerly suggested that the variability of these faint red stars is due to incipient crust formation, which caused accumulation of heat within, leading after a time to the melting of the obstruction. However, the discovery that these stars belong to the giant class renders the crust theory unlikely. Dr. Merrill recently suggested an alternative; he postulates a veil of blue smoke above the photospheres of these stars, producing almost complete absorption of the shorter waves, and also to some extent obstructing the longer heat-rays. An accumulation of heat results which may suffice to vaporise the occulting clouds of carbon, so that a temporary increase of light occurs.

Spectral changes at various stages of the cycle are discussed. The bright hydrogen lines are most intense at maximum and practically absent at minimum, at which time the carbon absorption becomes stronger. These changes are closely analogous to those in the Md stars.

THE MADRID OBSERVATORY.—The Anuario of the Madrid Observatory, 1921, in addition to the usual tabular astronomical data, contains full details of sun-spots and prominences during 1919, with diagrams of remarkable prominences, including the great May one seen during the total eclipse. There is also an article on the spectrum of Nova Cygni 1920 by P. Carrasco. Spectra, photographed at Madrid on nineteen days between August 23 and September 29, are reproduced in a manner making it easy to trace the progressive changes. There is a full table of wave-lengths of lines, with probable origin, and comparison with the spectra of α Cygni and β Orionis. The earliest spectra (August 23–24) are almost purely absorption spectra. The bright bands are traceable on August 25 and conspicuous from August 27 onwards. The volume also contains the meteorological observations made at Madrid Observatory in 1919.

POPULAR ASTRONOMY IN SWEDEN.—*Populär Astronomisk Tidskrift* is an attractive and well-illustrated periodical the publication of which was commenced last year by the Swedish Astronomical Society under the editorship of S. Arrhenius, K. Bohlin, N. V. E. Nordenmark, and H. von Zeipel. The articles in Häfte 3–4 deal with Nova Aquilæ, the moving cluster of the Hyades (for which a parallax of 0·027″ is found), and Dr. Harlow Shapley's work on the globular clusters. Mr. Nils Tamm contributes an illustrated article on the Kvistaberg Observatory; the work during 1920 included studies of Mars, Jupiter, Saturn, nebular photography, and magnitude determinations of Nova Cygni. Mr. Gyllensköld reproduces several pictures of auroral streamers, including some interesting photographs obtained at Bossekop, Lapland, in 1910. Some artificial auroræ obtained by Birkeland by cathode rays are illustrated, and the forms deduced from his theory are discussed and shown to agree very closely with the streamers of the solar corona in the eclipse of 1901.

Scientific and Technical Workers in the United States Civil Service.

By MAJOR A. G. CHURCH.

THE work of our Civil Service National Council in producing a scheme for reconstruction dealing with the clerical and manipulative workers in British Government Departments has its counterpart in that of a Congressional Joint Commission appointed by the United States Senate to investigate the remuneration and conditions of employment and the need for reform in the Civil Service of the Republic. The Joint Commission commenced its inquiry in March, 1919, and completed its report on reclassification and readjustment of compensation in March last. The report has now been published, and provides an interesting and illuminating commentary on the conditions which prevailed in the American Service before the war, the bewildering and chaotic multiplication of class within class, the gross anomalies in salaries, the absence of any just and sane retirement scheme, and the accentuation of this unsatisfactory state of affairs by war conditions. In this respect Washington appears to have suffered far more than London by the introduction of the "business man" element into its administrative service.

The findings of the United States Commission are particularly interesting in those sections devoted to the scientific, technical, and professional classes—classes, incidentally, which are not yet being considered as a whole by our own National Council. While recognising that the Government Service possesses distinct advantages for these classes, it considers that the advantages are offset to some extent by certain personal restrictions generally unknown in the academic and business world. It finds that "there is serious discontent, accompanied by an excessive turnover and loss, among its best-trained and most efficient employees," and that "the National Service has become unattractive to a desirable type of technical employee." It emphasises the melancholy fact that the advance in the rate of turnover among the scientific technical employees has been three times as fast as the advance for clerical employees; for the former class the average advance in salary on leaving the Government Service was 53 per cent. The resignation curve at the Patent Office is still going up so rapidly that this Department has almost ceased functioning.

To remedy this alarming state of affairs the Commission urges that every effort should be made to stimulate initiative and originality on the part of scientific and other professional workers. "It is peculiarly appropriate that the Federal Government should take the lead in research work of all kinds, but it cannot do so unless it is able to attract and retain independent thinkers of the highest type. The reduction of red tape to a minimum, the encouragement of freedom of thought and action to a maximum, and the direction of research by thoroughly trained investigators would all assist to make this possible." This passage might with equal justice and appositeness have been written as a commentary on the position of scientific workers in our own Government Departments.

For scientific and technical staffs under the reclassification scheme the following titles of classes have been adopted:—Junior, Assistant, Associate, Full Rank (indicated by the absence of any adjective), and Senior. The following table gives the salaries recommended for the various grades in dollars and £ sterling (calculated on an exchange value of £1 = 3·5 dollars). The rates of pay for skilled mechanics and unskilled labourers in the service of the State are also given for purposes of comparison:

Scientific and Technical Workers.

	Minimum	Increment	Maximum
Junior	$1800	$120	$2160
	£515	£34	£617
Assistant	$2400	$120	$3000
	£687	£34	£857
Associate	$3240	$120	$3840
	£926	£34	£1096
Full Rank (physicist, chemist, civil engineer, etc.) ...	$4140	$180	$5040
	£1185	£52	£1445
Senior	No fixed scale		

Skilled mechanic ...	$2100
	£600
Unskilled labourer ...	$1140
	£326

In addition to the above, it is recommended that the cost-of-living factor should be taken into account in determining salary scales.

For the senior-class administrative, scientific, technical, and other professional workers no fixed scales of salary are recommended. It is considered that "the incumbents of these one man or woman positions are the real leaders of the Civil Service of the Republic," and rigid salary scales might prevent their entrance or retention in the Service. The scales quoted apply to all scientific and technical workers employed by the State except medical officers, whose initial salaries are lower and increments larger, but whose final salaries are also lower than those quoted above. The qualification for appointment as a junior scientific or technical worker is apparently the same as that laid down for similar appointments under the Government of this country.

It is laid down as a principle that there should be no discrimination on account of sex; men and women should receive equal pay for equal work, and the door of promotion should be opened impartially to members of both sexes.

Among other noteworthy recommendations by this Commission are the following:

(1) The appointment of an Advisory Council of twelve members to the Civil Service Commission: six to be nominated by the President of the United States and six to be elected by the employees.

(2) The adoption of an efficiency rating system to govern promotions, demotions, and increments.

(3) Interdepartmental promotions.

(4) Upon appointment to a position in a particular class an employee should be paid at the minimum rate prescribed for such class.

(5) Annual leave to be uniform throughout all classes of employees, viz. 2½ days per month.

(6) Investigation as to the possibility of the adaptation of psychological tests to the selection of candidates for the Civil Service.

It is improbable that the last two recommendations would be likely to find much favour in the eyes of the British authorities. As for an efficiency rating system, it is easy to predict the difficulty that will be experienced in adapting any such scheme to scientific workers; in its report the Joint Commission recognises this fact.

In a detailed criticism of the Reclassification Report

Dr. Edward B. Rosa, of the U.S. Bureau of Standards, lays stress on the departure from established custom which is entailed by the fourth recommendation. He considers that such a system will make the State Service the refuge of the mediocrity, since there is no incentive to the individual worker. He would wish to see initial salaries determined by the promise of the candidate for a class.

The most serious objection which can be raised to the report is the almost complete failure of the Joint Commission to suggest a remedy for a disease which is only too prevalent in the United States Service: the lack of co-ordination and co-operation in research. Before the war each Department was watertight, the idea being to prevent the overlapping of research—which many consider vital to its prosecution—and consequent waste. It is not clear that any particular attention has been paid to this aspect of departmental practice. Above all, it is not evident that the Commission has fully appreciated the possibilities of the co-ordination of research and other scientific Departments of the State.

Efficiency in Industry.

WE referred last week to the comprehensive exhibition at Olympia organised under the auspices of the *Daily Mail* with the object of encouraging modern methods of increasing efficiency by the application of scientific principles. The range covered is large, dealing as it does with education, commercial organisation, factory equipment, and general industrial matters, but the keynote of applying scientific rather than haphazard methods to obtain the improved results now so badly needed runs through it all.

Scientific education is represented on the stand of the University of London, where, among other things, is to be found an interesting display exemplifying the development of the thermionic valve, which is the basis of most modern wireless telegraph work. This goes back to lamps fitted with internal plates by Prof. J. A. Fleming in 1887–89 for the study of the unidirectional conductivity effect discovered by Edison in 1883. Some of the original oscillation valves made as a result of these researches in 1904, and practically used in wireless telegraphy, are also shown. The later developments of the three-electrode valve are exemplified by a large number of valves of different design, including the form to which de Forest gave the name of the "audion." A recent four-electrode valve of Prof. Fleming's own design is to be seen, and the very latest development in wireless telegraphy is exemplified by a large transmitting valve made by the Marconi-Osram Valve Co. Some historic apparatus used by Sir William Ramsay in his researches upon the rare gases is also shown, and a collection of historic electrical apparatus from the laboratories of King's College includes some used by Clerk Maxwell.

Sheffield University shows exhibits relating to the production of cupro-nickel and some special apparatus developed by the department of glass technology. Armstrong College, Newcastle, shows Dr. Bedson's apparatus for the investigation of coal-dust explosions and the inhibitory power of inert dusts. A small amount of the dust mixture to be tested is blown by a puff of air on to a heated platinum wire in a glass bulb, and the sudden rise of pressure due to the little explosion is noted. Another educational exhibit is that of Loughborough College, Leicestershire, which is largely devoted to the work of students of the college. The technical training of partly disabled men occupies a deservedly large section of the exhibition, where the men are seen working at their various trades. An interesting exhibit relating to industrial efficiency is that of Major F. B. Gilbreth, consisting of a working laboratory for the recording of the actual movements of operatives in performing any given operation with the view of determining the most economical and least fatiguing way in which it can be carried out.

Among exhibits in the general engineering section it is interesting to see the Constantinesco wave system of power transmission working rock drills and other appliances on the stand of Messrs. W. H. Dorman and Co., Ltd. Attention should also be directed to an instrument for the regulation of temperature shown by British Oil and Fuel Conservation, Ltd. This is known as the Freeman precision control, and depends on the change of volume of the air in a bulb placed within the furnace or other chamber being heated. The expansion and contraction of the air drive a little column of mercury up and down an inclined tube, causing it to open or close a contact which, by means of a relay arrangement, controls the valve or other device regulating the supply of the heating medium.

Various branches of electrical engineering are represented in the comprehensive exhibit of the British Thomson-Houston Co., Ltd., including an electric welding plant in operation. Particular attention may be directed to a portable Röntgen-ray outfit employing the Coolidge tube with heated cathode. This is arranged to make up into four easily carried packages, and can be erected at the bedside of a patient. It is worked by means of a small transformer, with or without a rotary converter, from any ordinary direct- or alternating-current supply circuit. The power required is about 600 watts. Another remarkable piece of portable apparatus is a wireless receiving set, weighing no more than 20 lb. and needing no external connections, which will pick up messages from the chief Continental stations. A rectifier for charging small batteries from alternating-current circuits, acting on the same principle as the thermionic valve, is also shown.

A representative display of wireless telegraph apparatus is made by the Marconi Wireless Telegraph Co. A complete 3-kw. valve transmitting station for land use is shown, as well as several smaller sizes of valve receiving and transmitting equipments down to a 20-watt portable apparatus. Demonstrations are given by means of the "radio-megaphone," which is a combination of a wireless telephone receiving apparatus and a Creed "stentorphone." This latter in its ordinary form is a loud-speaking gramophone in which the record actuates a valve controlling a flow of compressed air, and gives purer and more powerful sounds than the ordinary gramophone. A large example used in this way is placed in the gallery, where it discourses music, etc., which can be heard all over the building. In the "radio-megaphone," however, the gramophone needle is replaced by a piece of specially designed apparatus which enables the wireless telephone receiver to actuate the control valve. One of these combination instruments on the Marconi stand is used to make audible the time-signals received from the Eiffel Tower and from Nauen, and to reproduce music and speech from a small wireless station at Surbiton. These are picked up on an aerial just outside Olympia.

Messages are also sent periodically from Surbiton in the Morse code at a high speed and are printed in

ordinary type automatically on the neighbouring stand of Messrs. Creed and Co., Ltd. The Creed type of printer was recently described in NATURE (December 9, 1920, p. 472). The apparatus here exhibited is of the improved form, in which the use of compressed air is entirely done away with and a revolving type-wheel takes the place of the lever typewriter mechanism of the older apparatus. The main principles of the selecting arrangement whereby the Morse message is translated into type are the same. The new instrument has a working speed of 175 words per minute.

The most complete line telegraph exhibit is that of the Eastern and Associated Telegraph Companies, which includes a complete set of apparatus as used on a long cable circuit. This works with a Creed printer of the older pattern used with the Muirhead type of receiving perforator. Among objects of historical interest is an example of the original form of the Kelvin siphon recorder. Attention may also be directed to examples of different forms of relays used in cable work and an example of an "electrolytic magnifier," which is somewhat similar to a relay except that instead of containing actual contacts that are opened and closed by the galvanometer portion of the apparatus, the moving pointer alters the relative position of wires dipping into an electrolyte, and makes an alteration of resistance which affects the balance of the duplex circuits and actuates the receiving apparatus accordingly.

Recent advances in optical science are exemplified by the exhibits of Messrs. Chance Brothers, Ltd. A special feature is the demonstration of the properties of "Crookes" glass for ophthalmic purposes, which relieves the eyes from strain by absorbing the ultra-violet rays while allowing the whole of the visible spectrum to pass. The company also exhibits for the first time a new "daylight" glass, by the aid of which colours may be matched by artificial light exactly as in daylight. This is a glass of a bluish tint which is accurately balanced in colour against the source of light to be used so as to absorb a selection of the rays and to allow a mixture to pass through which approximates very nearly to daylight. The problem is attacked in a different manner by the Sheringham Daylight, Ltd., who show specially constructed reflecting shades which achieve a similar result by reflection instead of by transmission. In both cases the source of light employed is the half-watt lamp. Another optical instrument which should not be missed is the Optophone, which enables the blind to read from ordinary type. This has already been fully described in NATURE (May 6, 1920, p. 295, and August 5, 1920, p. 722), and is exhibited by Messrs. Barr and Stroud, Ltd.

A very comprehensive example of the methods of modern medical research is presented by the display arranged by the Middlesex Hospital, which includes a large number of prepared sections relating to parasites and bacteria mounted in microscopes. Apparatus is also shown typifying the methods used both for routine and research in photomicrography, Röntgen-ray work, and various branches of biochemical and physiological investigation. St. Mary's Hospital Medical School has also an exhibit relating to the part played by medical research in the promotion of industrial efficiency. Among the subjects illustrated are breathing apparatus for diving, mining rescue work, and gas protection. Apparatus for the recording of muscular effort is also shown.

Human Tails.

AT a meeting of the Royal Anthropological Institute held on February 8, Dr. W. H. R. Rivers, president, in the chair, Prof. Arthur Keith, in making a report on a specimen of a human tail which had been bequeathed to the institute by the late Dr. J. C. McLachan, of Halifax, Yorks, took occasion to review the present state of our knowledge regarding the occurrence of true tails in human beings. The specimen submitted was a true human tail exactly similar to one very completely examined by Prof. Ross Harrison and described by him in the Johns Hopkins Hospital Bulletin of 1901. Prof. Harrison's specimen, which was removed from a boy aged six months, was 40 mm. long at birth, 70 mm. long when excised, contained striped muscle, and moved under various emotional states. Dr. McLachan's specimen was removed from a girl aged three months, measuring 105 mm. long in its preserved state, 11 mm. in diameter at the base, and tapering to a conical point. It also contained strands of striped muscle, and must have had the power of movement. As is the case in all such specimens, with three recorded exceptions, no vertebræ were present, nor could any segmental arrangement be observed in the central core. The skin covering the tail was studded with hair-roots and sebaceous and sweat glands.

Thanks to the labours of Keibel and Elze, and of Prof. Streeter, of the Carnegie Institution, and of his pupils, our knowledge of the development of a true tail in the human embryo may now be regarded as complete. At the end of the fifth week of development, when the human embryo is approaching 5 mm. in length, caudal (post-sacral) segments begin to be differentiated from the tail-bud represented by the growing tip of the tail. By the beginning of the seventh week, when the embryo is about 12 mm. long, the human tail reaches its maximum growth and differentiation, there being then eight to ten caudal segments within the projecting conical tail. In the seventh week retrogression of the terminal and free segments takes place, and towards the end of the eighth week, when the fœtus measures about 25 mm. (1 in.) in length, the surviving four or five basal or coccygeal segments become submerged, drawing with them the terminal atropic segments, the point of disappearance of the terminal atropic part being marked by a dimple. The caudal appendage which occasionally occurs in children represents a persistence of the terminal segmented part of the tail which normally atrophies by the end of the eighth week.

The disappearance of the tail from the body of man is not a human, but a pre-human problem. It is part and parcel of the wider problem of how and when the upright, or, as Prof. Keith would prefer to call it, the orthograde, posture was evolved. The orthograde group of Primates is represented to-day by the gibbon, orang, chimpanzee, gorilla, and man; in all of them the muscles of the spine, and of the thorax and abdomen, and all the spinal and other nerve reflexes which regulate the action of muscles, have been transformed to suit the orthograde posture; in all of them the external tail has disappeared and the basal or pelvic vertebræ of the tail have been reduced to a coccygeal form. The tail is more vestigial in the primitive small-brained gibbon than in man; it is the discovery of a pre-gibbon stock which should give us the history of the disappearance of the human tail, and from the scant data at present available we may infer that such a discovery is likely to be found in strata lying well towards the base of Tertiary deposits.

In pronograde apes, as in four-footed animals, the tail is made up of two parts which are structurally and functionally quite different. The free or terminal part is put to many uses; the pelvic or basal part is always associated with a visceral function. To it the rectum is always attached, and certain muscles which guard the pelvic outlet act upon the pelvic segments of the tail and use it as a perineal shutter. It is the external or post-pelvic segment of the tail which has disappeared from the body of man and the orthograde apes; the pelvic part has survived as the coccyx, and its visceral musculature as the levator ani muscle. With the evolution of the upright posture the pelvic muscles which act on the tail had to bear the steady burden of the abdominal viscera—had to be in action as long as the orthograde posture was maintained. They could not serve in the support of the viscera and the movements of the tail at the same time. Hence only the pelvic part of the tail was retained—the part on which the pelvic musculature acted. In pronograde apes the pelvic visceral musculature is attached to the peculiar chevron-like bones (hæmal arches) placed beneath the pelvic vertebræ of the tail; the reappearance of hæmal arches in the human embryo during the second and third months of development may be regarded as definite proof that man comes of a pronograde ancestry. Tarsius spectrum, for which Prof. Wood-Jones claims a special human relationship, is devoid of all features which mark the orthograde group of Primates; in its tail and tail musculature Tarsius is a pure pronograde Primate.

University and Educational Intelligence.

BIRMINGHAM.—The Doncaster Laboratory for Research in Mining is to be transferred to Birmingham University, under the directorship of Dr. J. S. Haldane, who has accepted the post of honorary professor.

CAMBRIDGE.—The council of St. John's College has appointed Dr. T. J. I'A. Bromwich to be prælector in mathematical science.

An interesting report issued by the Board of Research Studies shows that there are at present in residence seventy-two students admitted as candidates for the Ph.D. degree. The largest number working at any one subject is thirteen for physics. Botany and chemistry with eight each come next, followed by English and history with seven each. Graduates of British universities number thirty-three; sixteen come from Colonial universities, ten from India, and six from the United States.

An analysis of the voting last term on the admission of women as members of the University shows that there was a majority of 33 out of a poll of 405 among the resident teachers in the University in favour of their admission. The University professors also supported the proposal by 27 votes to 15.

Honorary degrees of LL.D. were awarded on Saturday to Sir Patrick Manson, G.C.M.G., and Dr. Albert Calmette, of the Pasteur Institute, Paris. Prof. J. Hjort, the oceanographer and marine biologist, was also given the honorary degree of Sc.D.

Mr. H. G. Carter has been appointed director of the Botanic Gardens.

LONDON.—The Prince of Wales has consented to attend the graduation dinner on the evening of May 5, on the afternoon of which day he will receive the honorary degrees of Master of Commerce and Doctor of Sciences, and will reply to the toast of "The New Graduates." The Guildhall has been kindly placed at the disposal of the University for this purpose by the Lord Mayor and Corporation, and the Lord Mayor has accepted an invitation to be present.

Dr. Anne Louise McIlroy has been appointed to the University chair of obstetrics and gynæcology tenable at the London School of Medicine for Women.

Prof. J. P. Hill has been appointed to the University chair of embryology tenable at University College.

The degree of D.Sc. in botany has been conferred on Miss K. M. Curtis, an internal student of the Imperial College (Royal College of Science), for a thesis entitled "The Life-history and Cytology of *Synchytrium endobioticum* (Schilb.), Perc., the Cause of Wart Disease in Potato."

The Graham Legacy Committee has appointed Mr. V. R. Khanolkar to the Graham scholarship in pathology for two years from April 1, 1921. The value of the scholarship is 400*l.* a year. Since October last Mr. Khanolkar has been assistant bacteriologist in University College Hospital.

IN response to the recent appeal of the University of Edinburgh for 500,000*l.*, the sum of 200,000*l.* has now been subscribed.

MR. W. D. EGGAR will deliver a course of four lectures on Greek mathematics at Gresham College, Basinghall Street, E.C., on Tuesday to Friday, March 1–4, at 6 p.m. Admission will be free.

PROF. E. W. SCRIPTURE, formerly of Yale University, has been appointed to the faculty of the University of Hamburg for the summer semester. He will lecture on English philology and experimental phonetics. Two articles by Prof. Scripture on the nature of vowel sounds appeared in NATURE for January 13 and 20.

AN election of Beit fellows for scientific research is to take place on or about July 15 next, and the latest date upon which applications can be received is April 19. Forms of application and information respecting the fellowships are obtainable by post from the Rector, Imperial College of Science and Technology, South Kensington, S.W.7.

IN connection with the 1920–40 Science Research Fund of Girton College, Cambridge, a fellowship of 300*l.* a year tenable for three years is being offered by the college for research in the mathematical, physical, and natural sciences. Particulars of the fellowship may be obtained from Miss Clover, Coleby, Grange Road, Cambridge, and applications for the fellowship will be received by her not later than March 31 next.

A COURSE of four public lectures on "The History of Plant Delineation" will be given in the lecture-room of the botany department of University College, London, on Wednesdays at 5 p.m., beginning on March 2. Dr. Charles Singer will deal with the art of the ancient empires and of the Dark and Middle Ages, and Dr. Agnes Arber with the period from the invention of printing to modern times. The lectures, which will be illustrated by lantern-slides, are open to the public without fee or ticket.

THE formal opening of l'Institut Français, Cromwell Gardens, S.W., will take place on Saturday, February 26, at 3 o'clock, under the presidency of his Excellency M. le Comte de Saint Aulaire, Ambassador of France. The Minister of Public Instruction, M. Léon Bérard, will represent the French Government. The English Board of Education and the

London County Council will be represented. The Paris Municipal Council and the University of Paris will each send three delegates. Among the latter will be M. Henri Bergson. The rector of the Institut's mother-University of Lille is also expected to be present.

PROF. LUIGI LUIGGI has accepted the invitation of the University of London to deliver a course of six lectures on "Recent Engineering Works in Italy" during his forthcoming visit to England. Dr. Luiggi is the professor of hydraulic engineering in the University of Rome, and also president of the Italian Society of Engineers. The lectures, which have been arranged to be given at the Institution of Civil Engineers at 5.30 p.m. on March 7, 9, 11, 15, 16, and 18, will be open to the public without fee or ticket. They will be illustrated with lantern-slides, which promise to be of particular interest. The chair at the first lecture will be taken by the Italian Ambassador.

THE Council, the Delegacy, and the Professorial Boards of King's College have resolved to found a memorial to the late Dr. R. M. Burrows, who guided the fortunes of the college with such brilliant success during his seven years' tenure of the office of Principal. The memorial will take the form of a tablet to be erected in the college chapel, together with a Ronald Burrows prize, exhibition, or scholarship to be awarded annually to a student of the college who has distinguished himself in the field of Greek studies. Prof. H. G. Atkins has consented to act as honorary treasurer of the memorial fund, and subscriptions may be sent to him at King's College, Strand, W.C.2.

THE annual general meeting of the Association of Technical Institutions will be held at the Grocers' Hall, Princes Street, London, E.C., on Friday and Saturday, March 4 and 5. The president-elect, the Right Hon. Viscount Burnham, will deliver his presidential address, and papers will be read by Principal C. T. Millis on "Junior Technical Schools: Their Status and Position," Dr. W. M. Varley on "The Report of the Departmental Committee on Scholarships and Free Places," Mr. H. Stainsby on "Technical Instruction for the Blind," and Principal W. J. Chalk on "Technical Instruction in London of the Higher Branches of Commerce." Important resolutions dealing with the necessity for closer co-operation between the technical colleges and the universities will be submitted for consideration, together with other resolutions on educational matters.

THE annual dinner of the Finsbury Technical College Chemical Society was held on February 18. The president, Mr. A. J. Hale, who occupied the chair, expressed the hope that ultimately the function might develop into a reunion between the past and present chemical students of the college. Mr. J. H. Coste, in proposing the toast of the college, referred to the splendid work which has been done in the past and how every effort was being made by the Finsbury Technical College Defence Committee and by various institutes and societies to prevent the threatened closing of the college. Until the authorities definitely decided to keep the college open, Mr. Coste urged that no effort to gain that end should be relaxed by those interested. This view was warmly supported by Prof. G. T. Morgan. Attention was also directed to the plea for keeping open the college recently made in the columns of NATURE and supported by Sir Oliver Lodge (February 10, p. 757). Mr. C. R. Darling expressed a hope that in the event of the college remaining open its present curriculum would not be altered or its freedom interfered with in any way.

Calendar of Scientific Pioneers.

February 24, 1799. Georg Christoph Lichtenberg died.—The discoverer of the dust figures on electrified planes, Lichtenberg held the chair of physics at Göttingen, and in his day was well known in both Hanover and England.

February 25, 1723. Sir Christopher Wren died.—Before he became famous as an architect, Wren was known as a mathematician. He was one of the founders of the Royal Society, and for twelve years Savilian professor of astronomy at Oxford.

February 26, 1878. Angelo Secchi died.—The successor of the Jesuit father, de Vico, as director of the observatory at the Collegio Romano, Secchi was a pioneer worker in the field of stellar spectroscopy, and his grouping of stellar spectra into types represents one of the results of his extensive studies of this subject.

February 27, 1864. Edward Hitchcock died.—Schoolmaster, minister, and, lastly, professor of chemistry and natural history at Amherst College, Hitchcock suggested and carried out the geological survey of Massachusetts. He is recognised as one of the fathers of American geology.

February 27, 1906. Samuel Pierpoint Langley died.—The great pioneer of aviation, Langley was originally a civil engineer, but abandoned that profession for astronomy. For the study of the infra-red portion of the solar spectrum, in 1880 he devised the spectro-bolometer—an electrical resistance thermometer of extreme delicacy. In 1887 he became secretary to the Smithsonian Institution. Taking up the investigation of the resistance offered to planes moving through the air, he was led to the construction of the steam-driven model flying machine which in 1896 made successful flights of half a mile. Having thus demonstrated the practicability of mechanical flight, he left the commercial and practical development of the idea to others.

February 28, 1882. Thomas Romney Robinson died.—An Irish clergyman, Robinson for many years directed the Armagh Observatory. He was also a physicist, and in 1843 invented the well-known cup anemometer.

February 29, 1744. John Theophilus Desaguliers died.—Like Dollond, Demoivre, Demainbray, and others, Desaguliers was of Huguenot extraction. Educated at Oxford, for many years he lectured there and in London, and rendered notable services to science when some acquaintance with scientific principles was first considered fashionable. He was the second recipient of the Copley prize.

March 1, 1862. Peter Barlow died.—Professor of mathematics at Woolwich, Barlow was a pioneer in the study of the strength of materials, and did much important work in terrestrial magnetism.

March 2, 1840. Heinrich Wilhelm Mathias Olbers died.—A doctor at Bremen, Olbers, by limiting his sleep to four hours nightly, accomplished much astronomical work, and was the discoverer of the minor planets Pallas and Vesta.

March 2, 1911. Jacobus Henricus van't Hoff died.—A student under Kekulé and Wurtz, van't Hoff became a professor at Amsterdam, and in 1896 professor of chemistry to the Prussian Academy of Sciences. A great physical chemist, he developed the theory of solutions, and was one of the founders of stereochemistry. With Le Bel in 1893 he was awarded the Davy medal, and in 1901 he received the Nobel prize. E. C. S.

Societies and Academies.

LONDON.

Royal Society, February 3.—Prof. C. S. Sherrington, president, in the chair.—Dr. G. B. **Jeffery**: The field of an electron on Einstein's theory of gravitation. Equations are obtained for the motion of a single electron about an atomic nucleus. If a ray of light passes through the field of the electron, provided that the distance of closest approach is not too small, the ray is deflected towards the electron. For closer approach the sense of the deflection is reversed until in the limit the ray is reflected back again along its original path. These results are used to ascertain whether any possible electric field of the sun would produce a measurable effect on the crucial phenomena of Einstein's theory. It is found that, while the sun's electric field would tend to diminish the displacement of the spectrum lines, the field required to produce compensation is of the order of 10^{13} volts per cm. at the sun's surface.—Dr. M. N. **Saha**: A physical theory of stellar spectra. Elsewhere a theory of thermal ionisation (and partly of thermal radiation) of gaseous elements has been developed and applied to the explanation of the ionisation observed in the solar chromosphere, and the absence of certain elements from the Fraunhofer spectrum. In the present paper the theory has been extended towards a physical explanation of the ordered gradation in the spectra of stars. The stellar data, particularly those accumulated by the Harvard College Observatory, are discussed from the point of view of the present theory, and it has been shown that the varying spectra of stars can be explained as functions of a single physical variable, viz. the temperature of the stellar atmosphere.—W. F. **Darke**, J. W. **McBain**, and C. S. **Salmon**: The ultra-microscopic structure of soaps. The ultra-microscopic observations of Zsigmondy and Bachmann on soap-curds have been confirmed, interpreted, and extended. The kinematograph has been employed as an aid in elucidating the formation and disappearance of the various structures observed. The curds of sodium, potassium, and hydrogen soaps are described and discussed.—Dr. J. **Mercer**: Linear transformations and functions of positive type. The paper contains developments of the theory of linear functional transformations as developed by F. Riesz in his paper "Untersuchungen über Systeme integrierbaur Funktionen" (*Math. Annalen*, vol. lxix., pp. 449–97).

Mineralogical Society, January 18.—Mr. A. Hutchinson, vice-president, in the chair.—A. F. **Hallimond**: The olivine group. Since the discussion of the densities by Thaddéef in 1896, and of the optical constants by Backlund in 1909, numerous additions have been made to the published data. These have been collected and the most probable values for the pure compounds obtained. The molecular volume of monticellite is slightly greater than the mean between forsterite and γ–Ca_2SiO_4. For the complex mixtures the density and mean refractive index yield additive relationships, but the birefringence and axial ratios follow no additive law. The conditions of plotting which must be observed if the variation of an additive property with composition is to be expressed by a straight line were briefly summarised.—W. A. **Richardson**: A method of rock-analysis diagrams based on statistics. Oxide variation diagrams, similar to those employed by Dr. Harker, can be used for expressing the chemical relations of rock groups and individuals. The diagrams obtained from plotting Iddings's selected analyses gave the maximum variation for all rocks.—L. J. **Spencer**: Identity of Trechmann's "β-tin" with stannous sulphide. A re-examination of the original material described by C. O. Trechmann in 1879 as an orthorhombic modification of tin proved that he made his crystallographic determinations on crystals of one kind (viz. stannous sulphide), whilst the chemical analysis was made on crystals of another kind (viz. metallic tin). Tin is, therefore, dimorphous and not trimorphous, "white tin" being tetragonal and "grey tin" cubic. Orthorhombic crystals of stannous sulphide (SnS) and tetragonal crystals of iron stannide ($FeSn_3$) from tin furnaces and rhombohedral crystals of tin arsenide (Sn_3As_2) isolated from a tin-arsenic alloy were described.

Linnean Society, January 20.—Dr. A. Smith Woodward, president, in the chair.—E. H. C. **Walsh**: Lhasa and Central Tibet. The lecturer gave first a brief description of the country, the people, the religion, and the government. The country extends 1600 miles in its greatest breadth, and 800 miles in its greatest width, from the Koko Nor to the southern bend of the Takiang or Blue River; the superficial area is more than a million square miles, comprises the highest portion of the earth's surface, and is bounded on its southern frontier by the Himalayas, the loftiest chain of mountains in the world. The Tibetans are a Turco-Mongolian race and speak a monosyllabic language; it is believed that they originally lived in China, but were driven out by conquering races. They are mentioned as early as 770 B.C., when they were at war with the Chinese. There are two acknowledged forms of religion, the Buddhist and the Bon, pronounced Pön; the latter has adopted some of the formulas of the former, but reversed them, as in the case of the "Swastika" or fyle-fot cross; also the Buddhist prayer-wheel, with its invocation "Om mani padme hum." The two sects lived peaceably side by side. The Dalai Lama, the Pope of the Lamaist Church, is believed to be a continuous incarnation of previous Dalai Lamas, and of the Deity Avalokiteswara upon earth. When a Dalai Lama dies his reincarnation has to be looked for in some infant born shortly afterwards, and this is ascertained by the chief oracle indicating the part of the country and some clues, and the result of local inquiries is then reported to the leading Lamas, who decide by lot the actual child to be educated as the Dalai Lama.

Physical Society, January 28.—Sir W. H. Bragg, president, in the chair.—Prof. H. **Nagaoka**: The magnetic separation of neon lines and Runge's rule. The results of an investigation of the Zeeman effect for neon lines are given. The departures from Runge's rule—that the magnetic separation of the lines are aliquot parts of the separation of the normal triplet—are discussed. It is concluded that such discrepancies are due to variations of the ratio e/m.—E. V. **Appleton**: A method of demonstrating the retro-active property of a triode oscillator. The author, following Vallauri, gives an approximate treatment of the conditions which give rise to retro-action between the grid and anode circuits of a triode valve, and describes an arrangement of circuits whereby the property can easily be demonstrated to a large audience.—Dr. D. **Owen** and R. M. **Archer**: The quickness of response of current to voltage in a thermionic tube. Steady voltages were applied between the hot and cold electrodes of a thermionic tube for intervals of time varying from 0·00001 second to a minute or longer. The mean current during the interval was measured by the Wheatstone bridge, using a null ballistic method. Two types of thermionic tube were employed, one at a high gas pressure and the other

at a higher degree of exhaustion. The initial rise of current to its maximum is followed by a fall, the rate of which diminishes with time. In the tube at the high gas pressure the final value of current may be less than half the initial value. In the case of the tubes at lower gas pressure the fall is less pronounced, say 3 or 4 per cent. This fall is not attributable merely to the high temperature of the filament, but is conditional on the thermionic current being permitted to flow.

Linnean Society, February 3.—Dr. A. Smith Woodward, president, in the chair.—M. **Christy**: Wistman's Wood. Wistman's Wood is a small grove of ancient, but exceedingly gnarled and diminutive, oak-trees (*Quercus pedunculata*) growing out of an extensive pile of huge angular blocks of granite (known as a "clatter") without a particle of visible soil. The wood is almost in the centre of Dartmoor at an elevation of about 1500 ft. It contains about 300 to 400 trees, which are overgrown by masses of moss and lichens. Particulars of the habit and age of the trees are given.—Dr. Agnes **Arber**: The leaf-tips of certain Monocotyledons. The leaves of Monocotyledons are studied from the point of view of the phyllode theory. In simple monocotyledonous foliage leaves terminating in a solid apex, and also in spathe leaves ending in a similar tip, the main part of the leaf is of leaf-sheath nature, while the apex represents a vestigial petiole. In complex monocotyledonous leaves which are differentiated into sheath, stalk, and "blade," certain cases are known in which the "blade" terminates in a solid apex. It is provisionally suggested that such apices represent the unexpanded tip of the petiole.—T. A. **Dymes**: Seeding and germination of *Ruscus aculeatus*, Linn., in the south-eastern quarter of England. The berries and seedlings perish by severe frost, although the adult is hardy. Many seeds fail to germinate because immature. Frost kills many seedlings during the first winter. Better results are obtained by sowing, as soon as the seeds are ripe, at a depth of 1 in. than at a greater depth or in the spring. Survivors in the second season produce an axis some 3 in. long, bearing about six phylloclades in the axils of scale-leaves. The radicle perishes and adventitious roots are produced. During the second winter the seedlings are unable to withstand severe frost. There is no recapitulation of the ancestry by the seedling.

Aristotelian Society, February 7.—Lord Haldane, vice-president, in the chair.—Prof. R. F. A. **Hoernle**: A plea for a phenomenology of meaning. The task of a phenomenology of meaning is to collect and examine all types of empirical situations in which signs function and meaning is present. This is the more necessary as all the higher activities and all control of social organisations depend on the use of signs. Yet current theories are fragmentary and one-sided. This is shown by an examination of the theories of F. C. S. Schiller, B. Russell, Lady Welby, C. S. Peirce, G. F. Stout, A. Meinong, and E. Husserl. A clue to a completer theory may perhaps be found in the distinction between the *indicative* and the *expressive* function of signs. We have the pure indicative function when the existence of A enables us to infer the existence (or non-existence) of B. We have the pure expressive function when an agent makes or utters signs. The two functions are curiously interlaced in intersubjective intercourse. The distinction, however, requires to be tested further by application to various kinds of non-verbal signs, to symbolic actions, and especially to the functions of sounds in music.

CAMBRIDGE.

Philosophical Society, January 24.—Prof. Seward, president, in the chair.—G. I. **Taylor**: (1) Experiments with rotating fluids. A summary of results on three subjects connected with the dynamics of rotating fluids was given without proof. The subjects treated were (*a*) difference between two- and three-dimensional motion, (*b*) stability of fluid contained between two cylinders, and (*c*) motion of a sphere in a rotating fluid. Experiments were described, and in the case of (*a*) and (*c*) some were shown at the meeting. (2) Tides in the Bristol Channel. It is shown that the Bristol Channel, which contains some of the largest tides in the world, can be represented with considerable accuracy by a channel the breadth and depth of which vary uniformly from the mouth to the head. Calculations of the effect of such a channel in increasing the tides are shown to agree well with the observed tides in the Bristol Channel. It appears, therefore, from the results obtained that the usual hydrodynamical theory of tides accounts quantitatively as well as qualitatively for the abnormally high tides which exist at the head of the Bristol Channel.—F. W. **Aston**: The deterioration of fabric under the action of light, and its physical explanation. The only serious factor in deterioration of unprotected aeroplane fabric, doped or undoped, when exposed to weather is found to be the action of sunlight. On investigation this action is shown to be relegated to the ultra-violet part of the spectrum. This deterioration appears to be due to the formation of ozone from the oxygen of the air which acts upon the fibres. This explanation is upheld by the fact that if the fabric is kept in a vacuum or in an atmosphere of hydrogen the effect is enormously reduced. Normally, ozone is formed in oxygen only by the action of light of wave-length too short to occur in sunlight at all, but this difficulty has been removed by Prof. Lindemann, who shows that the high refractive index of the fibres modifies the photo-electric action, increasing the maximum effective wave-length by a factor which brings the value up to that actually determined by experiment.—S. **Lees**: Note on constant-volume explosion experiments. An attempt is made to compute the order of the effect of temperature variations in an explosion vessel on the values of the total internal energy measured. The author gives reasons which indicate that the experimentally determined values of internal energy so obtained ought to be reduced slightly to get the corrected values for uniform temperatures. The correction is probably less than 1 per cent. for air at 1600° C. This correction is probably within the limits of experimental error at the present time.—V. **Brun**: The function $[x]$.

MANCHESTER.

Literary and Philosophical Society, November 30.—Sir Henry A. Miers, president, in the chair.—Prof. T. G. B. **Osborn**: Notes on stone implements from the Cooper's Creek District, South Australia. Most of the specimens were found in May last on old camping-grounds of the Deari tribe during a visit to Killalpannina, on the Barcoo (Cooper's Creek), in the Lake Eyre region. It seems probable that knives were manufactured in certain places and the finished articles carried away. A crude flake struck off at a single blow served as a temporary cutting instrument provided it had a sharp edge, and was then discarded. Scrapers, knives, flakes, hammer-stones, and stones for grinding and crushing food materials were found. The grinding stones were used for grinding small seeds of *Eucalyptus microtheca*, etc.; the crushing stones for breaking hard "beans" of "nardoo"

(sporocarps of Marsilea sp.).—Prof. A. V. **Hill**: The purpose of physiology. As the handmaid of medicine, the task of physiology lies in the discovery and statement of the "normal" as distinguished from the "abnormal." As a pure science it is privileged to explore the mechanisms underlying the phenomena of life by any and every means provided by scientific progress. As an applied science, in co-operation with psychology, it deals with such questions as the conditions of maintenance of the "normal," the standards of fitness, mental, moral, and physical, and the biological factors in the economic or social system. Progress may be expected in the regions where physiology verges on the other, especially on the exact, sciences, while the stimulus to the applications of physiology appears on the borders of medicine, sport and physical training, industrial fatigue, sociology or economics.

December 9.—Mr. R. L. Taylor, vice-president, in the chair.—Prof. T. E. **Peet**: Ancient Egyptian mathematics. Known to us chiefly from the Rhind papyrus in the British Museum, Egyptian mathematics is not a speculative science, but one purely practical in scope. The author dealt with the cumbrous notation; the use only of fractions the numerator of which was unity (with the one exception of two-thirds); tables for multiplication by 2 only, and with division by 2 only, larger divisions being done by trial. Problems such as the division of food, the measurement of areas, the exchange of loaves of various sizes and of jugs of beer were easily accomplished. A parallelopiped was correctly cubed, the volume of a cylinder obtained, and the circle given as the square of eight-ninths of its diameter. The existence in Egypt of a standard of rings or *shatyw* of various metals was dealt with.

DUBLIN.

Royal Dublin Society, January 25.—Dr. F. E. Hackett in the chair.—J. J. **Dowling**: A direct-reading ultramicrometer. The apparatus, which was exhibited in operation, depends on the variation of the plate current in an oscillating-valve circuit, which accompanies a variation in the capacity of the oscillating circuit. The sensitivity of the arrangement is very high, but even under unfavourable conditions it shows remarkable steadiness. Preliminary measurements show that a displacement of about 2×10^{-8} cm. is detectable under ordinary working conditions, and with suitable precautions very much greater sensitivity can be reached. Further work in connection with the apparatus is being carried out.—J. **Reilly** and W. J. **Hickinbottom**: The distillation constant of certain primary alcohols. The authors have applied their method of distillation in steam to methyl, ethyl, propyl, butyl, and *iso*amyl alcohols. Percentage of alcohol is estimated from density or by oxidation. Distillation constant varied with concentration.

EDINBURGH.

Royal Society, January 10.—Prof. F. O. Bower, president, in the chair.—The late Dr. John **Aitken**: Thermometer screens. This paper was left in manuscript by Dr. Aitken, and was completed a few days before his death. It gives a new series of experiments summing up his results communicated from time to time during the last thirty years. The points emphasised were (1) the inadequacy of the Stevenson screen, which in sunny weather always makes the enclosed thermometers read too high; (2) the uncertainty of measuring the temperature of the air, which cannot be other than a time-average varying with the thermometer used; and (3) the description of a new simple form of screen which satisfies all practical needs.—Prof. W. **Peddie**: The avoidance of relativity which is not of Galileo-Newtonian type. It is the aim of natural philosophy to find more and more inclusive laws describing the course of inanimate Nature. Examples are the conservation of matter and energy, the law of least time, stationary action, varying action, and Einstein's recent development of relativity. Their chief value lies in the fact that they give results which are independent of the particular mechanism involved. All actions which seem to occur at a distance take place, according to Newton, through a medium or æther. It is sometimes asserted that in consequence of the results of the principle of relativity the æther is non-existent; but the natural philosopher is entitled to claim that any such deduction from a theory which obtains its results independently of the mechanism involved can have no validity. Within its range the principle is of great value and constitutes the greatest advance made in connection with general laws since the introduction of the principles of action. These general laws can only be judged by the coincidence of their conclusions with observation. In this respect Einstein's principle stood successfully the test of two facts of observation, one of which was a prediction. In connection with a third the result is doubtful. It is, therefore, desirable to consider possible modifications of the basis to which the principle is applied. The only one now possible seems to be that connected with the postulate that light is propagated through a uniform æther regarded as at rest in space. If light is propagated through æthereal strain-forms associated with the atoms and moving with them, the æther itself may be at rest, but this experimental foundation for the recent extensions of relativity would disappear. On the other hand, in this case a positive result should be given by the Michelson-Morley experiment if made with light from a star moving rapidly to or from the earth. The paper concluded with a discussion of the possibility of a mechanical foundation of this view in an extension of Osborne Reynolds's theory of a granular æther.—F. **Unwin**: The transverse galvanomagnetic and thermomagnetic effects in several metals. This investigation into these minute effects gave results which were compared with certain conclusions derived by Livens from the modern electron theory. The agreement was satisfactory as regards the ratios of the effects, but not as regards their magnitudes.—P. **Humbert**: The confluent hypergeometrical functions of two variables.

PARIS.

Academy of Sciences, January 31.—M. Georges Lemoine in the chair.—The president announced the death of M. Emile Bourquelot, member of the section of chemistry.—L. **Favé**: Curves designed for the determination of orthodrome routes. On a sheet of transparent material curves are drawn representing, in Mercator's projection, a series of great circles cutting the equator at the extremities of a given diameter. A second family of curves of a different colour serve to measure the orthodrome distance.—A. P. **Dangeard**: Observations of an alga cultivated in the dark for eight years. *Scenedesmus acutus* has been cultivated in the absence of light since January, 1913, and is as green as specimens grown in the light in the ordinary way. The examination of the absorption spectrum of the chlorophyll shows no difference between the two series. A special culture medium is required, the composition of which is given.—E. **Mathias**, C. A. **Crommelin**, and H. K. **Onnes**: The

rectilinear diameter of hydrogen. Supplementing earlier work, the densities of liquid hydrogen between −239·91° C. and the boiling point, −252·76° C., have been studied. The cryostat used consisted in a bath of superheated hydrogen vapour, obtained from the evaporation of the liquefied gas and heated by electrical means. The automatic current regulator employed permitted control of the temperature to within 0·01° C. for several hours. The experiments required the preparation of about 170 litres of liquid hydrogen and 400 litres of liquid air. The ordinate of the diameter was found to be $-0{\cdot}06351-0{\cdot}00039402\,\theta$. The critical density was 0·03 and the critical coefficient 3·276. Hydrogen obeys the law of the rectilinear diameter.—Auguste Béhal was elected a member of the section of chemistry in succession to the late Armand Gautier.—G. **Fubini**: Automorphic functions.—T. **Varopoulos**: A class of multiform functions.—A. **Véronnet**: The variation of a conical trajectory under the action of the resistance of a medium.—J. **Villey**: Experimental installations for aerodynamical researches. A discussion of the recent proposal by M. Margoulis, suggesting the use of carbon dioxide under high pressures and at low temperatures as the circulating gas in the testing of aeroplane models. Apart from certain difficulties of construction which would add to the cost of the apparatus, the author is of opinion that the use of carbon dioxide could only be complementary to the use of air, and could not safely be employed instead of the latter.—M. **Curie**: The action of red and infra-red rays on phosphorescent substances. An account of experiments in which zinc sulphide and other phosphorescent substances were submitted to the simultaneous action of ultra-violet rays (mercury lamp with nickel oxide glass filter) and infra-red rays (arc lamp with cuprous oxide glass filter). The sulphides examined behaved differently from fluorescent bodies such as uranium nitrate, barium platinocyanide, and fluorescein.—M. **de Broglie**: The corpuscular spectra of the elements.—A. **Léauté**: Complement to the theory of the induced reaction for saturated alternators.—H. **Colin** and Mlle. A. **Chaudun**: The application of the law of hydrolysis to the determination of molecular weights.—A. **Mailhe**: The catalytic preparation of secondary amines and an attempt to introduce the alkyl group into these bases. Schiff's bases, mixed with a small quantity of finely divided nickel and heated to 170° C., are reduced smoothly to secondary amines by hydrogen. An attempt to prepare tertiary amines by passing a mixture of the secondary amine and alcohol over alumina heated to 380°–400° C. was not successful, as the bases were split up in contact with the catalyst.—E. **Saillard**: The balance of chlorine during the manufacture of sugar and the proportion of chlorine in the beetroot.—L. **MacAuliffe** and A. **Marie**: The study and mensuration of 117 Belgians.—P. **Audigé**: The growth of fishes maintained in a medium at a constant temperature.—E. **Rabaud**: The paralysing instinct of the spiders.—R. **Bayeux**: Respiratory insufficiency at very high altitude and its correction by subcutaneous injections of oxygen.—A. **Lumière** and H. **Couturier**: The nature of the anaphylactic shock. Further experiments tending to show that the causes of the anaphylactic shock are the same as those of the anaphylactoid crises resulting from the sudden introduction of insoluble substances into the circulation.—Et. and Ed. **Sergent**: Attempts at vaccinating against paludism in birds due to *Plasmodium relictum*.—E. **Woolman**: The *rôle* of flies in the transport of pathogenic germs studied by the technique of aseptic cultivations. These experiments show that contaminated flies remain infected for some days only. Removed from the source of contamination, they free themselves very rapidly, probably mechanically, from the infecting germs.—MM. **Kohn-Abrest**, **Sicard**, and **Paraf**.

MELBOURNE.

Royal Society of Victoria, November.—Mr. F. Wisewould, vice-president, in the chair.—E. **Ashby**: A description of the Bracebridge Wilson collection of Victorian Chitons, with a description of a new species from New Zealand. This collection was made by the late Mr. J. Bracebridge Wilson, working in connection with the Port Phillip Exploration Committee of the Royal Society, and was dealt with by E. R. Sykes in the Proc. Malac. Soc. in 1896. In addition to the five species described by Sykes as new, the author notes four other species then undescribed, *Callochiton rufus*, Ashby, which has hitherto been known only by a single type-specimen dredged in South Australia, and a new species of Lepidopleurus from New Zealand.—Dr. J. M. **Baldwin**: Application of genetics to plant-breeding. The problems of genetics are those which grow out of a study of the resemblances and differences in individuals related by descent. There are four general lines of attacking the problems: (*a*) The method of observation used by Darwin in marshalling evidence in favour of the evolution theory; (*b*) biometrical methods employed with such success by Pearson; (*c*) cytological methods, which are primarily concerned with a study of cell-mechanism; and (*d*) experimental breeding, which involves the raising of pedigreed cultures of plants. From the last method have come many stimulating ideas of heredity and variation, including the Mendelian theory of heredity, the pure-line theory of Johannsen, and the mutation theory of De Vries.

Books Received.

Journal of the Royal Statistical Society. New Series. Vol. lxxxiv., part 1, January. Pp. x+165. (London.) 7*s*. 6*d*.

A New Bristol Flora: British Wild Flowers in their Natural Haunts. By A. R. Horwood. (In 6 vols.) Vol. i. Pp. ix+244. Vol. ii. Pp. xi+243+xvii plates. (London: Gresham Publishing Co.) 12*s*. 6*d*. net per vol.

Principles of Human Geography. By E. Huntington and S. W. Cushing. Pp. xiv+430. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Rapid Methods for the Chemical Analysis of Special Steels, Steel-making Alloys, their Ores and Graphites. By C. M. Johnson. Third edition, revised and enlarged. Pp. xi+552. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 36*s*. net.

The Health of the Industrial Worker. By Prof. E. L. Collis and M. Greenwood. Pp. xix+450. (London: J. and A. Churchill.) 30*s*. net.

Poverty and its Vicious Circles. By Dr. J. B. Hurry. Second and enlarged edition. Pp. xvi+411. (London: J. and A. Churchill.) 15*s*. net.

The Mother and the Infant. By Edith V. Eckhard. (Social Service Library.) Pp. viii+256. (London: G. Bell and Sons, Ltd.) 6*s*. net.

The Microscope: Its Design, Construction, and Applications. Edited by F. S. Spiers. Pp. v+260+plates. (London: C. Griffin and Co., Ltd.) 21*s*. net.

Il Regime delle Acque nel Diritto Publico e Privato Italiano. By A. Vitale. Pp. x+480. (Milano: U. Hoepli.) 25 lire.

Diary of Societies.

THURSDAY, FEBRUARY 24.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at 11 Chandos Street, W.1), at 2.45.—Sir Frederick Mott and Dr. Hayao: The Pathology of Dementia Præcox, especially in Relation to the Condition of the Ovaries.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Balfour Browne: Mason Bees and Wasps.

ROYAL SOCIETY, at 4.30.—Sir Ray Lankester: A Remarkable Flint-implement from Selsey Bill.—Dr. E. J. Allen: Regeneration and Reproduction of the Syllid Procerastea.—E. C. Grey and E. G. Young: The Enzymes of *B. coli communis*. Part II. (*a*) Anaerobic Growth followed by Anaerobic and Aerobic Fermentation. (*b*) The Effects of Aeration during the Fermentation.—Dr. A. E. Everest and A. J. Hall: Anthocyanins and Anthocyanidins.

ROYAL SOCIETY OF MEDICINE (Tropical Medicine Section), at 5.—Sir Leonard Rogers: Presidential Address.—Dr. J. G. Thomson and Dr. A. Robertson: The Value of Laboratory Reports in the Diagnosis of Suspected Dysentery, and their Interpretation by the Clinician.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. Martin Flack: Respiratory Efficiency in Relation to Health and Disease (Milroy Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Prof. E. Wilson: Magnetic Susceptibility of Low Order. II. Susceptibility Values.

CONCRETE INSTITUTE, at 7.30.—E. S. Andrews: Methods of Securing Impermeability in Concrete.

ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—Discussion: The Use of Light as an Aid to Publicity.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.

FRIDAY, FEBRUARY 25.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 4.30.—Sir Humphry Rolleston and Others: Discussion on The Diagnosis and Treatment of Congenital Syphilis and its Effects.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—T. Smith: Tracing Rays through an Optical System.—J. Guild: The Refractometry of Prisms.—R. H. Humphry: A Note on the Hot-Wire Inclinometer.—Profs. E. Wilson and E. F. Herroun: The Magnetic Susceptibility of Certain Natural and Artificial Oxides.

TECHNICAL INSPECTION ASSOCIATION (at Royal Society of Arts), at 7.30.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—H. T. Davidge: Measurements of Precision in Engineering.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. R. M. F. Picken: The Epidemiology of Measles in a Rural and Residential Area.

SATURDAY, FEBRUARY 26.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Fowler: Spectroscopy (Celestial Spectroscopy).

MONDAY, FEBRUARY 28.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Discussion of Professional Questions.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. K. Rideal: Applications of Catalysis to Industrial Chemistry: Hydrolytic Processes (Cantor Lecture).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—W. W. James: Some Clinical Cases Associated with Dental Infection.—P. Cole: Condition of Two Pedicle Bone Grafts two years after Operation.

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.30.—Dr. J. H. Ryffel and Others: The Chemical Estimation of Gastric Function.

TUESDAY, MARCH 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Keith: Darwin's Theory of Man's Origin in the Light of Present-Day Evidence.

INSTITUTE OF CHEMISTRY (Annual General Meeting), at 4.30.—Sir Herbert Jackson: Presidential Address.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G Graham: Glycæmia and Glycosuria (Goulstonian Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. D. Johnston: A Plain Traveller's Tale, Rome to Naples.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—Jay Hambidge: Further Evidence for Dynamic Symmetry in Ancient Architecture.

WEDNESDAY, MARCH 2.

NEWCOMEN SOCIETY (at Marconi House), at 5.—L. St. L. Pendred: Trevithick's London Locomotive of 1808.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—C. Ainsworth Mitchell: The Acidity of Ink and the Action of Bottle Glass on Ink.—G. Van B. Gilmour: The Detection of Adulteration in Butter by Means of the Melting-Point of the Insoluble Volatile Acids.—S. H. Blichfeldt and T. Thornley: Method and Apparatus for Routine Determination of Melting-Points of Fats and Fatty Acids.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—E. Warren: Architectural Impressions of a Recent Tour in Mesopotamia.

ROYAL SOCIETY OF ARTS, at 8.0.—Capt. J. M. Hollis: The Re-education of the Disabled.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.—Dr. W. H. Hatfield: Automobile Steels.

THURSDAY, MARCH 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Balfour Browne: Mason Wasps.

ROYAL SOCIETY, at 4.30.—Discussion on Isotopes to be opened by Sir J. J. Thomson, followed probably by F. W. Aston, Prof. F. Soddy, Prof. T. R. Merton, and Prof. F. A. Lindemann.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.—J. W. W. Dyer: Airship Fabrics.—Major T. Orde Lees: Parachutes.

LINNEAN SOCIETY, at 5.—R. T. Günther: A Manuscript of Matthias de Lobel, from the Library of Magdalen College, Oxford.—Dr. B. Daydon Jackson: Naturalists and their Indebtedness to the National Trust.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. G. Graham: Glycæmia and Glycosuria (Goulstonian Lecture).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss M. C. Buysman: The Value of the Drama in the Training of the Child's Emotions.

CHEMICAL SOCIETY, at 8.

FRIDAY, MARCH 4.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Problems of Seismology: opened by Prof. H. Lamb, followed by Dr. G. W. Walker, R. D. Oldham, and J. J. Shaw. Chairman: Prof. H. H. Turner.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at Faraday House), at 6.30.—A. Rosen: Telephonic Transmission through Submarine Cables.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—W. A. Tait: Severn Crossings and Tidal Power.

SATURDAY, MARCH 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Electricity and Matter.

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