THURSDAY, FEBRUARY 7, 1918.

BIOLOGY FROM AMERICA.

(1) *The Organism as a Whole, from a Physico-chemical Viewpoint.* By Dr. Jacques Loeb. Pp. x+379. (New York and London: G. P. Putnam's Sons, 1916.) Price 2.50 dollars.

(2) *Organic Evolution. A Text-book.* By Prof. R. S. Lull. Pp. xviii+729. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 3 dollars.

(3) *Biology.* By Prof. Gary N. Calkins. Second edition, revised and enlarged. Pp. viii+255. (New York: Henry Holt and Co., 1917.)

(1) A BOOK by Dr. Jacques Loeb is always very welcome, for he bases new ideas on new facts, and these are often surprising. The central idea of this book is not new—that organisms are "chemical machines consisting chiefly of colloidal material and possessing the peculiarity of preserving and reproducing themselves"; but many of the facts illustrating this definition are new, and many of them are the rewards of the author's own industry and ingenuity.

What are the distinctive features of a living creature from Dr. Loeb's point of view? First, there is the constant synthesis of specific material from simple compounds of a non-specific character; secondly, there is the division of the cell when it reaches a certain limit; thirdly, there is the whole business of fertilisation and subsequent development. But when these features are carefully examined in the light of modern knowledge their apartness from inanimate phenomena tends to disappear. Is anything more specific than fertilisation, yet a strange spermatozoon may be got to enter an inappropriate ovum if the surface conditions of that ovum be modified by artificially altering the chemical concentration of the medium, and the manifold ways of artificially launching a non-fertilised ovum on the voyage of development are well known.

The generic characteristics of a type seem to depend on the specificity of the proteids in the ovum-cytoplasm; and the unity of the organism in development, and afterwards, depends on the unified organisation of the ovum-cytoplasm, which contains the organism "in the rough." On this the Mendelian factors or genes (probably hormones in the nucleus) may impress varietal or stock characters in the course of development. Very interesting is the author's suggestion that special sex-determining chromosomes may hinder or favour the formation of specific internal secretions which have developmental potency, and, on the other hand, that an environmentally induced change in these internal secretions might even counteract the chromosomal sex-determination. It need scarcely be said that, according to Dr. Loeb, there is nothing in instincts to remove them from a mechanistic category; and we are likewise assured that "the mere laws of chance are adequate to account for the fact of the apparently purposeful adaptations."

Sometimes the author seems to us impetuous, as in his acceptance, in spite of Prof. Castle's work, for instance, of the conclusion that Darwin's small fluctuating variations are not heritable. But whether one agrees or not, the book is always stimulating, and in the majority of cases the author is ready with chapter and verse, *i.e.* with facts and experiments, in support of his contention.

Perhaps the author is not responsible for the statement on the wrapper that "Darwinism had reached the conclusion that the harmonious character of the organism as well as its adaptation to the environment was the result of chance," but he is responsible for the erection of a "bogey" vitalism, the overthrowing of which does not tax his strength. In the genus vitalism there are several species, some of which are already extinct, while others are in process of elimination, but it is not of the essence of methodological vitalism to make an antithesis between the physico-chemical and the vital, between materiality and mind. Dr. Loeb considers the organism as the seat of a concatenated and correlated series of physico-chemical operations. So do all biologists. But to methodological vitalists it seems that the physico-chemical descriptions, invaluable as they are, do not exhaust the reality before us, do not adequately describe the living, growing, developing, varying, struggling, and sometimes companionable organisms that we know. We do not speak of more general grounds for finding it impossible to believe that from a physico-chemical viewpoint one can ever envisage the organism as a whole.

It is not perhaps of great importance, but we must direct attention to the curious statement in the preface that "the book is dedicated to that group of freethinkers, including d'Alembert, Diderot, Holbach, and Voltaire, who first dared to follow the consequences of a mechanical science—incomplete as it then was—to the rules of human conduct, and who thereby laid the foundation of that spirit of tolerance, justice, and gentleness which was the hope of our civilisation until it was buried under the wave of homicidal emotion which has swept through the world." Wave of homicidal emotion, forsooth!

(2) Prof. R. S. Lull has written a useful text-book of organic evolution, compendious but clear, and very generously illustrated. The introductory part deals with what may be called the facts of life—the variety of types, their distribution in time and space, their interrelations, and so on. The treatment of the geological succession is particularly effective. The second part is entitled "The Mechanism [rather a question-begging term] of Evolution," and the treatment is broad-minded and eclectic. The discussion of orthogenesis and kinetogenesis is interesting, and the balance of Nature is picturesquely illustrated. The author then passes to the evidences of evolution, and, after a brief discussion of recapitula-

tion, leaves the beaten track and gives the student a delightful account of adaptations to various modes of life—such as running, burrowing, swimming, climbing, and flying—and of adaptations to various haunts—such as deserts, caves, deep sea, and inside other animals. This section extends over about 200 pages, and it is very instructive. Prof. Lull gets the student to see that every fact of life that admits of genetic interpretation is an "evidence of evolution," and he works successfully with the idea which Osborn called "adaptive radiation," that around many a central or focal type we may group an often-repeated series of similar solutions of the problem of livelihood.

The last section of the book is palæontological. Selecting three great lines—molluscan, arthropod, and vertebrate—Prof. Lull sketches the probable evolution of the highest class of each, namely, cephalopods, insects, and mammals. With the aid of the abundant illustrations the reader gets some feeling of the movement, both progressive and retrogressive, of the evolutionary process. No student can fail to be impressed, for instance, with the case of the nautiloid Lituites, which "went through the orthoceran, cyrtoceran, gyroceran, and nautilian stages, and as it became adolescent left the close coil and reverted to the orthoceran stage."

The part of the book that deals with the evolution of vertebrates seems to us the most distinctive; the author is there dealing with subjects around which most of his own investigations have centred. He is inclined to accept Prof. Chamberlin's hypothesis of the origin of vertebrate animals in flowing land water; he traces back terrestrial forms to a probable derivation from Crossopterygian fishes earlier than the Upper Devonian; Dinosaurs arose from a primitive Cotylosaurian Carboniferous stock; birds from a stock common to them and Ornithischian Dinosaurs; mammals from reptiles like Therapsids; and man from primitive anthropoids. Without ever pretending to finality, Prof. Lull balances various theories, and the student will appreciate the methodical questioning in regard to each important type: What was the probable ancestral stock? When and where did the emergence occur? What were the probable evolutionary factors? Most characteristic of the whole treatment is the correlation of organismal and environmental changes, which, even when tentative, is full of interest and suggestion. "The stream of life pulses irregularly as it flows. There are times of quickening, the expression points of evolution which are almost invariably coincident with some great geologic change. . . . The geologic changes and the pulse of life stand to each other in the relation of cause and effect." In any case, climatic changes and organismal evolution are correlated.

(3) We have already had an opportunity (NATURE, vol. xciv., 1915, p. 504) of expressing our appreciation of the first edition of the fresh and stimulating introduction to biology which Prof. Calkins has worked out. It is an eminently educative book, and the second edition is even better than the first. Galton is still called Dalton, but that is a microscopic fly in the ointment. We mention it, however, since we directed attention to it before. J. A. T.

SCHOOL-LIFE IN THE SEVENTEENTH CENTURY.

About Winchester College. By A. K. Cook. To which is prefixed *De Collegio Wintoniensi*, by R. Mathew. Pp. xvii + 583. (London: Macmillan and Co., Ltd., 1917.) Price 18*s.* net.

THAT a boy should have been moved to write an account of his school, in which he enumerates the warden, masters, chaplains, clerks and organist, the seventy "children," the sixteen "quiristers," their gowns and other garments, the servants and their several offices, the hours of rising, meals, and lessons, and to describe the food, the games and other occupations, is difficult of explanation. That Robert Mathew's 286 hexameter lines should have been preserved is most remarkable. His picture of life at Winchester in 1647—it is a machine drawing rather than a picture—can have had no interest for his contemporaries. They were too familiar with the details which he sets forth with the pedantic accuracy of a valuer's inventory. He had no prevision of their interest to posterity. Documents of this kind are extremely rare. Students of sociology may search in vain such famous chronicles as the Mahawanso, in which a long succession of Buddhist priests recorded, from year to year, the current history of the Sinhalese from the first establishment of their kingdom, for evidence of the ways and occupations of the people. Does the *Times* describe a man's evening dress? The uniform and obvious calls for no description.

To a student of Wykehamical customs, or of the functioning of any other academic body, Mathew's poem is of surpassing interest. It is used by Mr. Cook as a fixed point from which he surveys the college life—backwards to its foundation, forwards to the present time. Since the days when he entered as a schoolboy to his retirement from a mastership, his life has been spent in the college precincts, save for the usual interval at New College, Oxford. The book is indispensable to Wykehamists. To others, who had not the privilege of education in the "best of all schools," it is a delightful pastime to gaze at the moving views of the social life of five passing centuries. However enthusiastic the reader may be for the Newest Education, the reflection will give him pause that boys have, apparently, made progress under a system in which all his axioms were inverted.

Even the physiologist will find himself constrained to admit that the genus Boy is, or was, a more adaptable creature than he supposed. To take a few illustrations out of the many to which one would like to direct attention. "Surgite" was at 5 a.m., summer or winter. Having put on gowns, breeches, and shoes, the "children" sweep their chambers and make their beds; then

they go downstairs and out to the conduit to wash their faces and hands. (The regulations of Eton and Westminster only required them to wash their hands.) There were no baths, and, as at Cambridge and at Glasgow, "going into the water" in the Meads was an offence against propriety which earned a flogging, if not expulsion. Of floggings on all days, but organised on Bloody Friday, it is unnecessary to speak. No food before 9, whether the early morning was spent in school or "on Hills," then bread and beer for breakfast; at 12, for dinner, boiled beef, bread, and beer; 3.30, bevers of bread and beer; 5, supper of mutton, bread, and beer; "further refreshment" before going to bed, and a nipperkin of beer in chambers, to last the night. (It reminds one of F. W. Maitland's discovery, "Doomsday Book and Beyond," that the allowance of a Canon of St Paul's, probably including two servants, was eighteen gallons a week.) Vegetables are not mentioned, and there is no reason for thinking that they were comprised in the diet. "In winter we may, perhaps, be allowed a fire in Hall"—charcoal, in a brazier, beneath the lantern in the roof. There was no other fire in college. And, for mental food, Latin and Greek authors, with, "on Saturdays, for the higher classes, the catechism of Nowell (the learned divine) in Greek, by heart." Mathematics, taught by the writing master, made a timid entry towards the end of the eighteenth century. Physical science was first tolerated (the word is used advisedly) in 1867.

All servants were male, with the exception of one *anus culinae* (old woman in the kitchen) over an, apparently, short period, and the nurse who made her appearance in Sick-House just after Mathew had left. The list is of great interest as pointing the contrast between the economic conditions of the seventeenth century and modern times: one manciple, one bread-butler, one beer-butler, two cooks, one baker, two brewers, one miller, one horsekeeper, one gardener, one porter, two scullions, one cleaner of trenchers, one old woman of the kitchen. As in all other colleges, the society killed their own beef and mutton, ground their own wheat, baked their own bread, grew their own hops, and brewed their own beer. For a society of 105 persons, of whom most of the scholars and all the "quiristers" performed many menial duties for the masters as well as for themselves, the establishment was large and "economically" wasteful. A. H.

ORGANIC CHEMICAL ANALYSIS.

Allen's Commercial Organic Analysis. Fourth edition, entirely re-written. Vol. ix. Edited by W. A. Davis. With index for all the volumes. Pp. xviii+836. (London: J. and A. Churchill, 1917.) Price 30*s.* net.

THE issue of this volume marks the completion of a task begun some ten years ago, when the production of a revised and entirely re-written edition of Allen's well-known work was undertaken. Ten years is a somewhat lengthy period in modern chemical history. A considerable amount of literature dealing with organic analysis has appeared during the last decade, and many new processes have been devised within this period; it was therefore desired to bring the text of the whole work, and especially of the earlier volumes, as nearly "up to date" as was practicable. This has been done in the present volume—the ninth—by means of a series of supplementary articles, written for the most part by the original contributors, and embodying any noteworthy advances in the various branches of organic chemical analysis dealt with in the eight preceding volumes.

Without attempting to indicate by any means all the additional matters, mention may be made of a few out of many interesting points noted on looking through the book.

In the section on "Alcohols" a method is given for the detection and estimation of methyl alcohol in ethyl alcohol, which marks a real advance in the subject. By this method, due originally to Denigès so far as the detection is concerned, the presence of as little as 0·2 per cent. of methyl alcohol in ethyl alcohol can be detected with certainty within twenty minutes, and only twice as much time is required to estimate the proportion of methyl alcohol with sufficient exactness for most purposes.

For the estimation of starch, particularly in foliage leaves and similar material, a method of employing taka-diastase is recommended. Starch is converted by taka-diastase into maltose and dextrose, free from the dextrin produced with ordinary diastase of malt. The resulting sugars are determined by the usual methods.

In the article on "Butter" it is of interest to note that the composition of margarine has undergone great changes during the last few years. Except in the case of margarine intended for pastry and cooking, the use of animal fats is rapidly dwindling; their place has been taken by products obtained from the coconut and palm kernel. A certain percentage of butter fat, however, is often present. The various changes have made the analysis of modern margarine mixtures a very complicated problem. The introduction of hydrogenated ("hardened" or "semi-hardened") fats complicates the matter still further, as the process of hydrogenation largely destroys the identity of the original oil or fat.

An abuse of scientific knowledge is indicated in connection with the production of essential oils. Artificial esters such as terpinyl acetate, glyceryl acetate, and ethyl citrate are prepared for use as adulterants of these oils. The esters, as is doubtless well known to the persons who employ them, have chemical characters such that essential oils adulterated with the esters appear to contain natural esters considerably in excess of the artificial adulterant added. Methods for the detection of such admixtures are indicated in the book.

Since the previous articles on alkaloids were written, a good deal of work on individual alkaloids has been published, but not much which affects alkaloids as a class. The question of the

mode of formation of vegetable alkaloids is still left open, but on the whole it is considered that the work done recently rather supports the view that alkaloids are formed from the decomposition products of proteins. As regards the function of alkaloids in plants, the view most widely accepted now is that they are ultimate products of metabolism, and of no further use to the plant. Among useful new processes of alkaloid analysis may be mentioned the citrate method of estimating quinine (p. 516) and the ferrocyanide process for quantitatively separating strychnine from quinine (p. 518).

The volume contains a two-hundred-page index to the whole work, which is indispensable to analytical laboratories dealing with organic products. The editor is to be congratulated upon the successful completion of his lengthy task.

C. S.

OUR BOOKSHELF.

Om Laegekunst hos Perserne. By A. Christensen. Pp. 103. (Medicinsk-historiske Smaaskrifter, 18.) (Kφbenhavn: Vilhelm Trydes Forlag, 1917.)

THIS small work of one hundred pages constitutes the eighteenth pamphlet of the Medicinsk-historiske Smaaskrifter edited by Vilhelm Maar and published in Denmark. We have reviewed the other volumes in a previous issue, and regret that an announcement in the present pamphlet indicates that the series, for the present at any rate, has reached a conclusion. The subject of Persian medicine has been dealt with by many historians, and Dr. Christensen has brought our knowledge up to date. He divides the matter into four chapters: the Zoroaster period, ancient Islam medicine, the period of Avicenna, and recent Persian medicine. An appendix with a translation of one of the four treatises of the "Tchahar makala" of Nizami-i-Aruzi (twelfth century) completes the account. The medicine of the Avesta, the original document of Zoroaster's religion, is fully dealt with, and the influence of Ahura Mazda, the all-wise spirit, in maintaining health is analysed. The demoniacal concept of disease and its production through the agency of Anro Maiynus —the evil mind—is carefully considered. The fall of the Sassanian empire in the seventh century and its conquest by the Arabs has had a profound influence on the subject of medicine, for it was through the Arabs, notably Rhazes and Avicenna, that the great works of classical antiquity were restored to European learning, enriched with the valuable commentaries of these diligent students of the dark ages. Dr. Christensen's researches constitute a distinct addition to our knowledge of this interesting period.

The "Wellcome" Photographic Exposure Record and Diary. Pp. 256. (London: Burroughs Wellcome and Co., 1918.) Price 1s.

THIS well-known pocket-book has all its usual features, in spite of the exigencies of the times. The main article has been rewritten, and gives concise but sufficient directions for the use of "tabloids" in all the usual photographic operations. It includes development by time and temperature, tank development, factorial development, fixing, intensification and reduction, and printing processes, the use of various development papers, carbon printing, and oil pigment printing, the making of lantern slides, various toning and staining processes, and colour photography by means of autochrome, Dufay and Paget colour plates. The mechanical calculator attached to the cover, with the necessary tables and lists, from which the photographer will select those details that apply in his particular case, has established its trustworthiness and convenience by many years of experience. A useful diary, plenty of space for recording exposures, a copious index, sundry tables, etc., and two illustrations "from the front," or very near it, complete the volume. It is interesting to note that in the classified lists of photographic materials there are given considerably more than two hundred different kinds of plates and films, forty-five kinds of bromide paper, and twenty-nine kinds of lantern plates, although German and Austrian goods are excluded.

LETTERS TO THE EDITOR.

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

The British Scientific Instrument-making Trade.

THE progress of science as the result of experience gained during the present war will call for increased effort on the part of British manufacturers of scientific instruments at the conclusion of hostilities. Moreover, the knowledge gained by our principal enemy by virtue of the British blockade will give her a lead over us in many directions, since she has been forced to bring the brains of her leaders of scientific thought to bear on many problems of vital moment to the life of their country.

From this it would seem as if British scientific instrument makers were called upon to co-operate more closely than has been the case in the past, if they are to meet the competition they will be called upon to face as soon as Germany is in a position to reconstruct her industries when relieved from the burden of war.

The object of the present letter is to suggest the formation of an institution which, while retaining most of the features of existing scientific societies, will provide means for greater effort in collaboration, as regards training, research, and propaganda, with the view of increasing the field for British-made instruments. As was pointed out by the present writer in an article in NATURE of August 16, 1917 (vol. xcix., p. 488), Germany has always realised the value of research as applied to the instrument-making trade, but the same cannot be said for this country. One of the first tasks, then, confronting such an institution, if established, would be the installation of a properly equipped and staffed laboratory, in which investigations could be carried out (1) in the interests of individual members, (2) in the interests of the general body of members. It may be objected that this would mean usurping the functions

Scientific apparatus & instruments

of the national laboratories, but this would scarcely be so, since the institution laboratory would devote its attention more to the creation of new types of apparatus, the outcome of improved methods of teaching, and the perfection of existing types, rather than to the purely theoretical ascertainment of data on which standard apparatus is based. It must not be forgotten that there are many small firms whose means are insufficient to allow of their bearing the somewhat heavy charges levied by the national institutions for extended research work

The discussion of methods of manufacture would constitute another important function of the institution. Certain firms no doubt meet with difficulties which could often be cleared up by free discussion, just as members of other scientific institutions profit by the experience gained by their colleagues. There are very few, if any, treatises on the manufacture of instruments. Most of the existing books on the subject come from Germany, and several of them have never been translated. Thus it will be seen how original papers and discussions could be made into a permanent record.

Such questions as the standardisation of designs and the study and improvement of the designs of other countries could also be very suitably dealt with in an institution intended for the general development of the industry.

As regards the organisation of the proposed institution, this could follow, generally, the lines of existing scientific societies, with extensions to cover the particular activities suggested by individual firms. It is expected, of course, that the first cost would be heavy, and would necessitate the co-operation of the entire instrument-making trade; but surely it is worth while if the ultimate benefits to be conferred upon the trade were made permanent, as they could not fail to be. The question should be dealt with at once, for indications are not lacking that Germany is relaxing no effort to secure, by co-operation and concentration on the part of her leading manufacturing concerns—and probably scientific instrument makers also—the dominant position she held at the outbreak of the war.

E. S. HODGSON.

Coventry, February 5.

THE NATIONAL FOOD POLICY.

THE columns of the daily Press have for many months past furnished adequate evidence of the controversy which is raging in agricultural circles as to the lines upon which national policy should be framed with the view of securing the maximum of efficiency in the production and husbanding of food supplies. That part of the question which relates to animal production may be said to have been brought to a focus in the notable conference of representative agriculturists from all parts of the country which met on Friday last to receive statements on the position from Lord Rhondda and Mr. Prothero.

Mr. Prothero indicated clearly that the dominating factor by which national policy in this matter must be guided is the great shortage of concentrated feeding-stuffs. Basing his conclusions upon estimates of the supplies of such feeding-stuffs which are likely to be available before next harvest, and postulating as self-evident that working horses and milch cows must be adequately, though not extravagantly, provided for in the first instance, Mr. Prothero found that the remaining supplies of concentrated food available for other classes of live-stock were far from sufficient to enable these to be fed in the same numbers or on the same lines as has been customary in past years. Whilst expressing the opinion that ample freedom should be left to the individual farmer to determine how he can utilise inadequate food supplies to the best advantage, Mr. Prothero outlined suggestions as to the kind of ration of concentrated feeding-stuffs which might be regarded as giving a reasonable apportionment to different classes of stock. A considerable reduction in the numbers of certain classes of live-stock was inevitable, but the farmer must endeavour to mitigate this by growing as much food as possible at home for his stock.

The address of Lord Rhondda was punctuated freely with criticism from the audience, especially when outlining the reasons which had led to the existing policy of control of meat and milk supplies. This policy had been rendered necessary owing partly to the undue rise in meat prices even when supplies were relatively plentiful, and partly to the necessity of keeping meat production within moderate limits in view of the restricted supplies of concentrated feeding-stuffs and the more efficient utilisation thereof in other directions.

From the reports of the meeting in the Press it is evident that the conference was not entirely successful, owing to no opportunity being afforded the audience of discussing the many controversial matters raised by the speakers. This view was expressed in a leading article in the *Times* of February 2, the writer then proceeding to criticise adversely certain items of the food policy of the Government, and incidentally to throw doubt upon the competence of the scientific investigator to furnish trustworthy guidance in the matter of the economical utilisation of food supplies. "Scientific calculations about food," said the writer, "are a very untrustworthy guide to practice, because the data on which they are based are quite inadequate to justify the conclusions drawn from them." The reply of the scientific worker came promptly in Tuesday's *Times* from the pen of Prof. E. H. Starling, with the retort that science is "nothing but practical experience accurately noted, recorded, and classified." The data upon which the man of science bases his calculations are furnished entirely by practical experience, and include all such data as are detailed and accurate. The practical man can have no other data which will render his conclusions more trustworthy, and, indeed, in all too many cases the individual practical critic has little regard for data of any description in the formulation of his opinions.

It is surprising to find that the attitude of the writer of the *Times* article on this point is apparently determined by the views expressed in a letter in the same issue contributed by Mr. C. B. Fisher, "a well-known agriculturist of wide experience," who is referred to as writing "in the moderate tone of a man who is master of his subject." It is doubtful whether Mr. Fisher would entirely accept the latter description, but it is clear from

his letter that whatever be his mastery of the practical aspect of the subject, he is not well informed on the scientific aspect as set out in the report of the Royal Society Food Committee. He is particularly scornful of the view that it is more economical to feed cereals direct to human beings than to use them first for the production of pork. By a travesty of the facts as to the common practice of pig-feeding, and an obvious inaccuracy in the numerical example given, he has no difficulty in evolving his *reductio ad absurdum*. The whole matter would have been scarcely worthy of notice but for the public attack upon the position of the scientific investigator in relation to food problems, and a special meed of thanks is due to Prof. Starling for the swiftness and effectiveness of his defence.

For the farmer the position is perfectly plain and must be faced. The supply of feeding-stuffs is very short, and live-stock of some kind must be sacrificed. Above all, there must be no competition between animals and human beings for food which the latter can directly utilise. It is under this latter head that the hand of restriction falls most heavily on the pig. It is undeniable that by pig-feeding much could be done to remove the evil of the butter-queue; but the bread-queue would be infinitely more dangerous, and can only be avoided by a rigid economy in the use of cereals.

THE INVESTIGATION OF INDUSTRIAL FATIGUE.

PROF. STANLEY KENT gives, in the papers mentioned below,[1] a general summary of the results at which he has arrived in his studies of the physiological signs of industrial fatigue and some practical conclusions to be drawn from them. It is pointed out that the state to be tested is more complex than that of simple muscular exhaustion, inasmuch as it is dependent on a state of the nervous system, brought about, not by muscular fatigue alone, but even more by nervous fatigue, combined with worry, bad hygienic conditions in the factory, ill-health, and insufficient food, as well as unsatisfactory home-life.

The tests used were four in number—reaction time, visual acuity, acuity of hearing, and height of blood-pressure. They were selected as being made quickly and easily, while being incapable of control by the examinee. Curves constructed from the results of these tests show a gradual development of fatigue during the day, which recovers to some extent during the night, so that there is a steady increase through the week. The increase due to overtime work is also indicated, and the greater effect of a given amount of overtime towards the end of the week comes out distinctly. Overtime work always causes a greater fatigue than the same amount of work at an early part of the day.

A factor which upsets the regular accumulation of fatigue is that called by Prof. Kent the "Monday effect." This is due to the lassitude and disinclination to work present on Monday morning. The cause of this appears to be the partial forgetting of skill during the period of rest, and is the more obvious the greater the skill acquired. The decrease of output on the Monday morning is not, in fact, a case of fatigue, but of loss of co-ordination.

As a rule, the Sunday rest puts an end to the accumulated fatigue of the week; if not taken, fatigue continues to increase until breakdown occurs; unless, as usually happens, an automatic slackening of work takes place, accompanied with late arrival in the morning and so on. In any case, there is loss of efficiency.

The measurement of fatigue by tests of the kind described leads thus to the same conclusion as that arrived at by Dr. Vernon from investigations of output, namely, that the maximum output is to be obtained in most cases by reducing the hours of labour. An equally important aspect of the matter is that the worker is also given time for culture and relaxation and for becoming a "reasonable being instead of a mere machine."

It will be seen that the fatigue investigated in this research may be described as the feeling of being tired, as distinguished from the exhaustion of the muscles themselves. Now, it is just here that the mischievous effect of alcohol shows itself so clearly. Alcohol abolishes for a time the feeling of fatigue, and thus enables the worker to go on until the fatigue becomes worse than before. He naturally takes more alcohol and so on. The net result is no increase of output—rather the reverse—while the state of the worker himself goes from bad to worse. The effect of alcohol on muscular work was strikingly shown in the march to the relief of Ladysmith, where the "drinkers" fell out as if labelled. Some interesting results with the four tests mentioned are given on p. 16 of the address on "Fatigue and Alcohol." The reaction-time of abstainers was uniformly less than that of those who took alcohol. Moreover, the depressing effect of a day's work was five times as great in the "alcoholics" as in the abstainers. Similar results were obtained with the other tests.

The conclusion is that the only effect to be put to the credit of alcohol is a psychical one, and that this is transitory, leading to repeated doses. The worker knows by experience that the discomfort called fatigue can be diminished by taking alcohol, and he naturally turns to it. The remedy is obvious. The fatigue is determined by the conditions in which men work. Improve the conditions and fatigue and drinking disappear. Let us, therefore, do our best to provide "the elements of a healthy, full, and interesting life in place of a mere existence without interest, without pleasure, and without hope." W. M. BAYLISS.

[1] "Fatigue Induced by Labour." *Bristol Medico-Chirurgical Journal*, July, 1917, vol. xxxv., No. 133.
An Address on "Fatigue and Alcohol." Delivered before the Society for the Study of Inebriety. *Lancet*, July 28, 1917.

GERMANY AND IRON-ORE SUPPLIES.

DURING the past year there have been continual references in the German technical Press and in the papers read before various technical societies to the immense importance of the Briey and Longwy iron-ore basins for German industry both during and after the war. Gradually the mask is being dropped in technical circles, where the facts are, of course, well known, and the hollow pretence that this war was a war of self-defence on the part of Germany is barely referred to, for these circles at any rate know that it is a war of aggression and spoliation. In February last Dr. M. Schlenker, Syndic of the Saarbrücken Chamber of Commerce, showed that the extraction of iron ore in the Briey basin amounted (calculated by iron contents) to 28 per cent. of the total German ore supply, this latter being made up as to 56 per cent. of domestic production and as to 44 per cent. of imported iron ore. He said that it must be described as a special stroke of good fortune that at the very commencement of the war Germany came into possession of the Briey ore basin, as without the French iron ores it would have been *impossible* for the German iron industry to cover its enormous requirements of munitions; on the other hand, France has lost, as the result of the operations of the war, 85 per cent. of its pre-war iron output. Dr. Schlenker takes for granted that Germany will retain possession of its spoil and thus remain "simply invulnerable in its most important sources of strength and power."

The same story was repeated even more emphatically at the meeting of the Union of German Iron and Steel Manufacturers at Berlin in December last, where it was pointed out that the German supplies of iron ore in the portion of Lorraine annexed in 1871 will be practically exhausted in forty to fifty years, and that the German iron industry needs the Briey ironfield in order to assure its continued existence. Here, again, the demand for the retention by Germany of the Briey and Longwy iron deposits is most insistently put forward.

Somewhat similar conclusions are reached by the writer of an article signed "Politicus" in the *Fortnightly Review* for the current month. After showing that throughout the history of the world Germany's aggressive militarism has been a constant danger to the world's civilisation, he discusses in detail the main sources of military power—namely, man-power and supplies of coal and iron. He indicates that to a considerable extent the former depends upon the latter, because industrial districts are always the most densely populated, and "the greatest centres of population occur on and around the great coalfields." The writer also emphasises the importance of the iron-ore question, though he employs statistics as old as 1910, and therefore not quite correct in the light of modern knowledge; this accounts for his statement that "Germany has by far the largest iron deposits in Europe. France comes second." Recent developments in France have somewhat altered the position as it was known in 1910, and it is now recognised that the quantity of iron ore in France is but little less, and probably even greater, than that of Germany. This fact, however, strengthens rather than weakens his conclusions, which are that "Germany intends to retain the coal- and iron-bearing frontier lands upon which she has seized. . . . If Germany should be allowed to retain her conquests she would not only subject to herself millions of non-Germans, but she would absolutely dominate Europe with the coal and iron monopoly which the war would have given her, and she would thus be able to embark upon the final conquest of the world."

If any confirmation of the correctness of these views and of the real intentions of Germany is required, this is furnished by the recent speech of the German Chancellor, who gave a number of reasons why Germany should retain possession of Alsace-Lorraine, but carefully abstained from even hinting at their supreme economic importance to Germany.

H. L.

NOTES.

THE managers of the Royal Institution reported at a general meeting of members held on February 4 that Dr. Mond, under the conveyance and deed of trust of the Davy-Faraday Research Laboratory, covenanted to pay to the institution before the year 1926 the sum of 62,000*l.* as endowment fund. Dr. Mond's trustees have in the most generous way anticipated the obligation by eight years, and have transferred the sum of 66,500*l.* in 5 per cent. War Stock to the trustees, nominated by the managers, of the Davy-Faraday Research Laboratory Endowment Fund. This will add materially to the income available for the purpose of promoting and maintaining the efficiency of the Davy-Faraday Research Laboratory in the advancement of original research in chemical and physical science.

A MEETING was held at the rooms of the Royal Society of Arts on Monday, February 4, at the invitation of the London Section of the Society of Chemical Industry, to consider the formation of a London Section of the British Association of Chemists. There was an attendance of about 300, including members of the Society of Chemical Industry, the Chemical Society, the Institute of Chemistry, the Society of Public Analysts, and the British Association of Chemists. Dr. Ling took the chair, and briefly explained the reasons for convening the meeting. Prof. Brame outlined the history of the British Association of Chemists and the course of the negotiations between that body and the Institute of Chemistry. Mr. Smith, on behalf of the British Association of Chemists, dealt with the need for some registration authority for chemists and the demand by chemists for a professional association which would not only improve the status of chemists, but also bring into the ranks of the chemist a larger number of well-equipped men than is now the case. He emphasised the importance of chemists from a national point of view, and invited the meeting to form a London Section of the association. After remarks by Prof. Donnan and other speakers, a resolution was passed, with few dissentients, for the formation of a London Section, and a provisional committee of eleven was appointed to proceed with the matter. Mr. Pilcher made a spirited defence of the Institute of Chemistry against some criticisms of that body, and stated that the institute was not antagonistic to the new association.

THE following arrangements have been made in connection with the Royal College of Physicians of London:—The Harveian oration will be delivered on October 18 by Dr. P. Kidd, and the Bradshaw lecture in November by Dr. Aldren Turner. Prof. H. R. Kenwood is to be the Milroy lecturer this year, and Dr. J. McVail in 1919.

THE next meeting of the Faraday Society will be held at the Municipal School of Technology, Manchester, on February 14, when there will be a general discussion on electric furnaces. The discussion will be preceded by the reading of the following papers:—Application of electric furnace methods to industrial processes, H. Etchells; electric furnaces for steel refining, J. Bibby; electric furnace control, A. P. M. Fleming and F. E. Hill; and a high-temperature electric resistance furnace, E. A. Coad-Pryor and W. Rosenhain.

THE death is announced of Prof. J. P. Remington, chairman of the Committee of Revision of the United States Pharmacopœia and professor of the theory and practice of pharmacy in the Philadelphia College of Pharmacy. Prof. Remington was the author of numerous papers on pharmacy, many of which were contributed to the American Pharmaceutical Association, and of the "Practice of Pharmacy," the sixth edition of which was recently published by Messrs. J. B. Lippincott Co.

THE death of Mr. M. Beazley, which is recorded in the *Engineer* for February 1, is the third death among Indian engineers announced last week. Mr. Beazley was born in Bath in 1833. He assisted Mr. Cubitt in the piercing of the Shakespeare Tunnel at Dover for the South-Eastern Railway. He proceeded to India in 1859, and was engaged in the construction of a portion of the Central Indian Railway. Afterwards he served for ten years in the Imperial Chinese Customs.

WE note with regret that the *Engineer* for February 1 records the death of Mr. T. Anderson on January 15. Mr. Anderson spent about thirty-three years in India, thirty of which were in the service of the Royal Indian Marine. He was born in Greenock in 1842, and went to India in 1864. After occupying various positions, he became, in 1881, engineer-surveyor to the Port of Bombay, and was made chief engineer in 1885. After the Burmese war he was sent to Mandalay to value the factories of King Theebaw. Mr. Anderson was an associate member of the Institution of Civil Engineers.

WE notice with regret the announcement of the deaths of several distinguished medical men. Surg.-Gen. Sir Adam Scott Reid, who died in London on February 2, at the age of sixty-nine, was for many years in the Indian Medical Service.—Sir George H. Philipson, ex-president of the British Medical Association and representative of the University of Durham on the General Medical Council, died on January 24, in his eighty-third year.—Sir James A. Russell, for some years demonstrator of anatomy in the University of Edinburgh, afterwards inspector of anatomy and vivisection for the whole of Scotland, and an active fellow of the Royal Society of Edinburgh, died on January 22, at seventy-two years of age.

THE death has occurred of Prof. Amos P. Brown, professor of mineralogy and geology in the Towne Scientific School of the University of Pennsylvania, at fifty-two years of age. A resolution passed at a recent meeting of the faculty of the Towne Scientific School, and published in *Science*, states that among the most notable recent investigations in America was the work done by Prof. Brown in the field of crystallography; specifically the investigations in the classes of crystals found in the hæmoglobins of the entire range of the vertebrate animals. In the course of this investigation Prof. Brown prepared, examined, and calculated the functions of thousands of intricate and minute crystals, deducing from them conclusions highly important alike to organic and inorganic science. This work, carried out in collaboration with Prof. Reichert, is referred to as one of the greatest contributions to exact science ever made in America.

MAJ.-GEN. H. P. BABBAGE, who died at Cheltenham on January 29, aged ninety-three, inherited much of the mathematical ability of his distinguished father, Charles Babbage, mathematician and mechanician, whose famous calculating machine, after many vicissitudes, was pronounced by a committee of the British Association to be, "in the present state of the design, not more than a theoretical possibility." Maj.-Gen. Babbage was educated at University College School and at University College. He joined the East India Company's Army in 1843, served in Assam and during the Mutiny, and was then transferred to civil employment, where he gained reputation as a builder of bridges. He was a learned mathematician, and is best known by his account of his father's work and of the principles of calculating machines, besides papers on mechanical notation and occulting lights. After his retirement from Indian service he engaged in municipal work at Bromley and Cheltenham, and did good service as a vigilant critic of the accounts of these corporations.

PROF. A. N. TALBOT, professor of municipal and sanitary engineering, University of Illinois, has been elected president of the American Society of Civil Engineers. The American Society of Civil Engineers is the oldest American engineering society. It has a membership of 8225, an annual budget of 30,000*l*., and assets of 120,000*l*. As a consulting engineer Prof. Talbot has been connected with many large enterprises, such as the Galveston Causeway, the Chicago City Hall, and numerous waterworks and sewage purification problems. Prof. Talbot is a past-president of the Society for the Promotion of Engineering Education and a past-president of the American Society for Testing Materials. The University of Pennsylvania has conferred upon him the honorary degree of Doctor of Science, and the University of Michigan the honorary degree of Doctor of Engineering.

AN interesting example of the audibility of the sound of a distant fog-horn has been communicated to us by Mr. W. T. Evans, of Treharris, Glam. On January 14, from about 6 to 7 a.m., he heard series of four consecutive blasts, each followed by an interval of silence—the distinctive note of the siren at Nash Lighthouse, on the southern coast of Glamorganshire. Treharris is about twenty miles inland, and is separated from the coast by several ranges of hills. Though all the blasts were distinctly audible, they varied in strength, some being as loud and clear as when heard at other times from a distance of four miles. The fog-horn at Nash, according to a statement by the light-house-keeper, was sounding on account of a snow-shower from 6.15 to 7 on the morning in question. A thick mantle of snow lay over the ground at the time, and the air was absolutely calm. The conditions were thus favourable for the transmission of the sound to so great a distance.

MR. H. S. WELLCOME has presented to the War Office, for the use of the British Army Medical Department, a completely equipped motor bacteriological laboratory. The body of the car and its extended weather-proof annexe form a laboratory with a total working space of 219 sq. ft. The equipment includes

microscopes, incubators, balance, autoclave, centrifuge, microtome, ice-chest for water samples, and numbers of accessories, the whole being packed in thirteen canteens, which ensures safety in transit under the roughest conditions. A water tank fitted with pump is fixed on the roof of the car, an electric lighting outfit, with dynamo and accumulators, is fitted, and apparatus for the staff mess and sleeping accommodation for the staff are provided. Much ingenuity has been exercised, so that everything is conveniently grouped and easily accessible, and can be packed or unpacked in about two hours. The formal presentation of the laboratory was made a few days ago to Col. Stanistreet, the representative of the War Office.

THE *Times* of February 1 contains an account of an improvement by Dr. S. A. Kapadia in the Lawton method of preserving perishable foodstuffs. In that system the produce was kept under anaerobic conditions, so that putrefactive and other changes were arrested, but the objection to it was that the gas used contained carbon monoxide, forming an explosive mixture in the preserving chamber. The gas used by Dr. Kapadia consists of nitrogen and carbon dioxide, with only a trace of oxygen. Australian apples which had been kept for five weeks in this atmosphere were found to be in as good condition as at first, and the rottenness from some of the specimens had not spread to the neighbouring sound fruit. Raspberries, a fruit very difficult to preserve fresh, after a fortnight of the same treatment were as fresh as when the experiment started, and, moreover, they retained this freshness for four days after removal from the preserving chamber, thus allowing time for the fruit to be marketed. After salted fish had been kept in the preserving chamber for six weeks it appeared to an expert to be in exactly the same condition as when introduced. Similarly, eggs which had been preserved for twenty weeks in the same way could be afterwards boiled without the shell cracking, as if new-laid.

ON account of the warmth and dampness of the air in mines, the timber which is used for props, sleepers, etc., underground is very liable to decay, set up by fungi. Pitwood as a rule lasts a very short time, and has to be speedily replaced. Before the war this class of timber was very cheap, and nothing was done in Britain to lengthen its duration by preservative treatment, although it was known that economies in this direction had been effected in France owing to the experiments that had been undertaken by M. Fayol in the collieries of Commentry, and by Prof. E. Henry in the mines near Nancy. The U.S. Forest Service had also treated a large number of timbers by various methods, and placed them in the coal mines at Pottsville, in Pennsylvania, with convincing results of the efficiency of creosote and zinc chloride as preservatives. Several mining companies in the United States have been using treated timber, and have found it economical. It is most important at the present time to lengthen the life of pitwood in our mines and collieries, as this will result in a lessened demand for seaborne timber. With this end in view, the Department of Scientific and Industrial Research has issued Bulletin No. 1, Memorandum on the Preservation of Timber in Coal Mines, by Prof. Percy Groom. Practical remedial measures against the spread of the spores of the destructive fungi in the galleries are clearly described. The fructifications can be readily removed and burned, provided careful inspection of the timbers is made periodically by an intelligent workman. The mycelia accessible on the surface of the pitwood can be washed off by an antiseptic solution and removed. All the fresh timber put down in the mines should be treated beforehand with creosote or zinc chloride, applied by brushing or impregnated by immersion or pressure methods. When the wood has to last only a relatively short time, other substances may be used, as common salt, magnesium sulphate, and certain mine waters.

A REPORT just issued of the Meteorological Committee for the year ended March 31, 1917, the sixty-second year of the Meteorological Office, shows that considerable activity is maintained in meteorology. Sir Napier Shaw is director, and no change has taken place in the Meteorological Committee constituted under the authority of the Lords Commissioners of H.M. Treasury. The observatories and the stations for the daily weather service have been kept regularly in operation. There has been an unprecedented increase in the work of the forecast division and the instruments division. Many calls have been received for new publications and new editions of existing publications from various sub-departments of the Admiralty, War Office, Air Board, Ministry of Munitions, Board of Trade, and Colonial Office. To meet the increased requirements in the office and to supplement the absence of many members of the staff on military service, use has been made of members of the staff who have reached or passed the age of superannuation in the office. "Summer-time" has entailed some addition to the work, and as the diurnal variations of the weather are so essentially controlled by the sun, the office obtained permission under the Act to retain Greenwich time for the hours of its observations, but this by no means freed the office from much complexity. An interesting inquiry is mentioned, at the instance of Dr. Walker, Director-General of Indian Observatories, into the statistical relation between the weather in the middle of the North Atlantic Ocean and subsequent weather of north-western Europe. Especial mention should be made of an important new work, "Réseau Mondial," for which data have been prepared, which give a compendious review of the meteorology of the globe. This work is a great advance in international meteorology, and the report states that the work is fairly completed for the years 1911, 1912, and 1913.

THE Bihar and Orissa Research Society continues to do excellent work on the antiquities of the province. In the Journal of the society for September last (vol. iii., part 3) Mr. C. W. Anderson describes a find of prehistoric stone implements in the Singhbhum district. The first discovery of such remains dates from 1868. Generally speaking, the trap implements may be classed as Mesolithic, intermediate between the Neolithic and Palæolithic periods. This definition would bring them in line with Prof. Sollas's Azilian stage, if the assumption be made that there was an uninterrupted sequence of industries. But this is by no means a necessary assumption, and such implements as can be compared with European collections rather point to an origin contemporary in the stage of culture, if not in age, with the Magdalenian. If the view recently expressed be correct, that the language of the Kolarian tribes in India may be connected with those of races in the Malayan Peninsula and the Andaman Islands, the present discovery may lead to further interesting identifications.

THE importance of Syria and Palestine as fields for the investigation of prehistoric antiquities is fully illustrated in an important paper by Le Fre Néophytus, entitled "La Préhistoire en Syrie-Palestine," published in *L'Anthropologie*, vol. xxviii., parts 4–5, for July–October, 1917. The practice of human sacrifice in the form of immolation of new-born children in funereal jars is fully established. The historical survey of

explorations describes a large number of prehistoric animals the remains of which have been discovered. The Palæolithic period is represented at several sites in the neighbourhood of Bethlehem and Jerusalem, and the periods known as Mesvinian, Mousterian, Aurignacian, Solutrian, and Magdalenian are all more or less fully illustrated by discoveries. The Neolithic age is abundantly represented by examples from Mount Carmel, the banks of the Jordan, and the neighbourhood of the Dead Sea. The writer remarks that though the prehistoric age in Syria and Palestine has not been so fully investigated as in Europe, the materials for its study are abundant, and students of the history of ancient man will share with him in the hope that when peace has been re-established the study of the remains in this important region will be undertaken with still greater hopes of success.

DR. R. F. SCHARFF, in the *Irish Naturalist* (December, 1917), gives a long and useful history of the now extinct Irish "greyhound-pig," which survived until recently in the more isolated parts of Ireland. This he is inclined to believe is not a descendant of the wild boar which roamed over the island, but was introduced possibly so far back as the Bronze age. It would seem to be nearly related to the ancient "turf-pig" of the Swiss Lake dwellings and the Lake dwellings of Glastonbury, in Somerset. From this last fact it would seem more probable that the Irish pig was introduced from England rather than from the Continent, as Dr. Scharff is inclined to believe. A great deal of information has been brought together in this short paper, which is further illustrated by photographs.

ISLAND faunas afford us valuable data as to the effects of isolation in regard to the evolution of species. Hence we are glad to note the summary of a study of the birds of the Anamba Islands by Mr. Harry C. Oberholser which appears in the Bulletin of the Smithsonian Institution (No. 98). The material described was collected some years ago by Dr. W. L. Abbott, and includes fifteen subspecies peculiar to these islands. As might be expected, they are all of small species of the Passerine type. It is shown that, so far as their avifauna is concerned, these islands are most closely related to the Malay Peninsula, less so, but about equally, to Sumatra and Borneo, and only slightly to Indo-China.

A VERY remarkable shrew, *Scutisorex congicus,* is described by Mr. J. A. Allen in the Bulletin of the American Museum of Natural History (vol. xxxvii., 1917). This animal, when originally described by Mr. Oldfield Thomas from a skin and skull from Uganda, seemed to differ from the typical shrews chiefly in its long, thick fur and the great development of the cranial ridges. But a number of specimens have been recently obtained by the American Museum of Natural History Congo Expedition, and among these are several skeletons and specimens in alcohol. The dissection of these has revealed a quite extraordinary condition of the vertebral column, unknown in any other mammal. Briefly, all the vertebræ, from the seventh thoracic to the last lumbar, have the latero-ventral borders so enormously produced that this part of the vertebral column, seen from below, is deeply trough-shaped. Nothing that is known of the habits of this creature affords any explanation of so singular a modification. But it certainly imparts tremendous strength to the backbone. This is well known to the natives, who take "great delight in showing to the easily fascinated crowd its extraordinary resistance to weight and pressure . . . a full-grown man weighing some 160 lb. steps barefooted upon the shrew. Steadily trying to balance himself upon one leg, he continues to vociferate several minutes. The poor creature seems certainly doomed. But as soon as his tormentor steps off, the shrew, after a few shuddering movements, tries to escape, none the worse for this mad experience." Having regard to the fact that fully adult animals do not exceed 243 mm. in length, its weight-carrying possibilities are truly wonderful. The natives hold this animal in great esteem. They are convinced that its charred body, or even its heart, when prepared by their medicine-men, transmits truly invincible qualities. Such precious relics are always worn by those engaging in warfare, or setting out on any equally dangerous enterprise, such as hunting elephants.

THE December number of *Terrestrial Magnetism and Atmospheric Electricity* contains an article by Mr. J. P. Ault on the meteorological observations taken by the *Carnegie* during her voyage around the Antarctic continent in the spring of 1916. With a few exceptions, the observations were taken between latitudes 50° and 60° S., from Lyttelton, New Zealand, to South Georgia, Kerguelen, and Lyttelton. The temperature of the sea, the pressure, temperature, and humidity of the air, the direction and speed of the wind, and the position of the ship are given for noon each day. The weather was uniformly bad, the humidity 80 to 90 per cent., the sea and air temperatures only a few degrees above freezing point, and the wind high. With decreasing barometric pressure the wind almost invariably shifted from north to west, became a gale, and as the pressure again increased, shifted to the south-west and blew hard. A comparison of the *Carnegie* observations with those made by the Shackleton expedition during the same period should prove of considerable interest.

THE *Chemical Trade Journal* for December 29 contains an interesting article on the perchlorate method of estimating potassium. By the work described the following facts are established:—(1) The perchlorates of sodium, barium, calcium, and magnesium are readily soluble in alcohol containing 0·2 per cent. of perchloric acid, in which potassium perchlorate is almost insoluble. (2) The chlorides of the above metals are completely transformed into perchlorates by evaporating their solutions with excess of perchloric acid. (3) The loss effected by washing one gram of potassium chlorate with 100 c.c. of alcohol containing 0·2 per cent. of perchloric acid and then with 2 c.c. of alcohol amounts to 0·36 per cent. (4) Barium hydroxide is preferable to barium chloride for the preliminary precipitation of sulphates, and, when such large quantities as 0·8 to 1·0 gram of perchlorate are dealt with, it is advisable to use the solid hydroxide. The procedure recommended is as follows:—The solution of the potassium salt is treated with excess of solid barium hydroxide, and the barium sulphate filtered and washed under pressure on an asbestos filter. The filtrate and washings are evaporated with a 50 per cent. excess of perchloric acid in a glass basin until white fumes are evolved, then 25 c.c. of water are added, and the product evaporated to dryness. The residue is taken up with 20 c.c. of alcohol containing 0·2 per cent. of perchloric acid, the potassium perchlorate transferred to an asbestos filter, washed with 80 c.c. of the dilute alcoholic solution of perchloric acid, and then with 2 c.c. of pure alcohol. The filter is dried, weighed, washed with boiling water, dried, and again weighed, the difference in the two weights giving the amount of perchlorate. It does not seem to have occurred to the writer to use a Gooch crucible, and thus reduce the weighings to one, nor does he seem to

be aware of the work of W. A. Davis (NATURE, 1912, vol. xc., p. 441), who established most of the above facts, and in addition showed that the loss of potassium perchlorate can be entirely obviated by washing with alcohol saturated with this salt.

MR. ROBINSON SMITH, in an article on efficiency in the *Quarterly Review*, states that the two forces in America that in recent years have done most to put the American house in order, and of which next to nothing is known in Europe, are efficiency and prohibition. Efficiency, or scientific management, as it was termed by its founder, was introduced by Mr. F. W. Taylor, and its methods certainly lead to large increases in the output per worker. Mr. Taylor got his data by timing men at work with a stop-watch, and by seeing whether the men could do more work if they omitted certain movements or rested periodically; hence the term "motion-study." The following illustrates the process applied to a gang of men lifting pig-iron from a ground-pile, walking up an inclined plank, and dropping it into a car at the rate of 12½ long tons per day. "Taylor's first step was to single out one of these men —of the ox-type of man—and on this first day and all day long he was told by the man who stood over him with a watch: 'Now pick up a pig and walk'; 'Now sit down and rest,' and at half-past five in the afternoon the man had loaded 47½ tons of pig-iron on to the car." The author of the article expresses regret at the cold reception which has been given to Mr. Taylor's ideas in Britain, and uses many arguments in its favour. Probably the prejudices which bar the way at present would be modified considerably if workmen were convinced that better wages and shorter working hours would permanently follow the introduction of Mr. Taylor's methods.

SOME recent developments in balancing apparatus are described in a paper read by Mr. N. W. Akimoff before the American Society of Mechanical Engineers and reprinted in *Engineering* for February 1. Mr. Akimoff's original machine consisted in principle in mounting the body which required dynamic balance on a beam hinged at one end and supported on a spring at the other. A "balancing cage" was also mounted on the beam and rotated in unison with the body. By moving masses on the balancing cage, the effect of the rocking couple on the body was neutralised, and from a knowledge of the amount and position of these masses was obtained the information necessary to correct the want of balance in the body. In Mr. Akimoff's latest machine the effects of both static and dynamic want of balance can be readily neutralised by means of a clamp fixed to the body, and having a mass which can be adjusted in radius from the axis of rotation. The clamp can be moved axially and also adjusted for angular position. The effect of static want of balance is first eliminated, and the rocking couple is then got rid of. The machine is ingenious, and appears to be effective in solving a rather troublesome problem.

THE water supply of the city of Brisbane is the subject of an article in the issue of the *Engineer* for January 25, and the following particulars are of interest. The supply is derived chiefly from the Brisbane River. The pumping plant, which is located about twenty miles from the city, and above the tidal region, consists of three triple-expansion, condensing engines, each capable of pumping six million gallons per twenty-four hours. The population supplied is about 158,000, and the average daily consumption forty-six gallons per head. There is an important storage reservoir at Cabbage Tree Creek, a tributary of the Brisbane River, formed by a dam of cyclopean concrete, 740 ft. long (including the by-wash), 125 ft. high, 95 ft. thick at the base, and 10 ft. wide at the top. The surface area of the enclosed lake is 700 acres, and the quantity of water impounded 5,800,000,000 gallons. The rainfall of the district is intermittent; there are long periods of drought alternating with heavy downfalls, which result in floods. The longest recorded period of drought was in 1915, when the Brisbane River was dry for eight weeks. Allowing for evaporation, the available quantity of water, when the reservoir is full, affords 12,000,000 gallons daily for 300 days, and as the present consumption is only seven and three-quarter million gallons per day, there is ample margin for considerably more than a year's supply without the aid of a single drop of rainfall. The dam was ceremonially opened in December, 1916, the work having cost about 172,000*l.*

THE latest catalogue of second-hand books (No. 172) just issued by Messrs. W. Heffer and Sons, Ltd., Cambridge, should be of much interest to readers of NATURE, seeing that it deals mainly with books relating to science. It contains sections devoted to astronomy and meteorology, botany (including forestry and herbal), chemistry, folklore and mythology, geology, mineralogy and palæontology, mathematics, physics and engineering, physiology, anatomy and medicine, and zoology, biology and Nature-study. Copies of the catalogue are obtainable upon application.

OUR ASTRONOMICAL COLUMN.

LUMINOSITIES AND PARALLAXES OF 500 STARS.—The spectroscopic method of determining the absolute magnitudes, and thence the luminosities and parallaxes, of stars has been further improved in detail by Messrs. W. Adams and A. H. Joy, and applied to 500 stars (*Astrophysical Journal*, vol. xlvi., p. 313). For stars of the same spectral type, the enhanced lines and the hydrogen lines are relatively strong in those of high luminosity, and weak in those of low luminosity, while the low-temperature lines behave in a manner directly opposite. For 360 of the stars, measured parallaxes are available for comparison, and the average difference between these and the spectroscopic parallaxes, taken without regard to sign, is 0·026″. The spectral types now within the capacity of the spectroscopic method range from A8 to M. One of the most striking conclusions from this important investigation is that the distinction between "giant" and "dwarf" stars is clearly shown for types M, K, and G, with a slight indication of such separation even in the case of F stars. In the case of the M type the list includes thirty stars brighter than absolute magnitude 3·9, and twelve stars fainter than absolute magnitude 9·5, with none of intermediate brightness. It is considered almost certain, in the case of types M and K at least, that these results cannot be ascribed to the selection of the stars. The catalogue is conveniently arranged, and includes position, proper motion, and visual magnitude, besides other data.

SOLAR HYDROGEN BOMBS.—A remarkable solar phenomenon of short duration has been investigated photographically and visually by Mr. F. Ellerman at the Mt. Wilson Observatory (*Astrophysical Journal*, vol. xlvi., p. 298). It consists of the sudden appearance of a very brilliant narrow band extending for several angstroms on each side of Hα, which persists as a dark line with little change in width. The duration is only from one to three minutes on the average, and rarely from five to ten minutes. The average width of the bright band is about 8 A., but in an extreme case the band extended over 30 A. These "bombs"

are most likely to appear around and among active spot-groups, especially groups which are developing and have many component members. At times they follow one another like the balls of a Roman candle, at intervals varying from ten to twenty minutes. Two essential conditions for their observation are good seeing and a large solar image. The appearance suggests something of the nature of an explosion, in which nothing but hydrogen seems to be involved. The level at which the explosions occur would seem to lie below the reversing layer, as the Fraunhofer lines, including those of hydrogen, do not seem to be affected. The phenomenon is quite distinct from the ordinary eruptive reversals of $H\alpha$, in which the continuity of the dark line is interrupted.

"ANNUAIRE DU BUREAU DES LONGITUDES."—In addition to the valuable astronomical tables and explanatory matter which ordinarily appear in this well-known official publication, the volume for 1918 includes a number of articles of special interest. Among these is the first part of an extensive study of sundials by M. Bigourdan; the Egyptian calendar, by the same author; the sun and terrestrial magnetism, by M. Hamy; and the life and work of Gaston Darboux, by M. Emile Picard. It should be noted that the tabular matter is not exclusively astronomical, but also includes authoritative data which make the volume a valuable source of reference on questions relating to meteorology, terrestrial magnetism, physics, and chemistry. The *Annuaire* is published at two francs by Messrs. Gauthier-Villars et Cie.

THIRD MELBOURNE STAR CATALOGUE.—The third Melbourne General Catalogue of 3068 stars, for the equinox 1890, has recently been issued. It is based upon observations made at the Melbourne Observatory during the period 1884 to 1894, under the direction of Mr. R. J. Ellery, and has been prepared for publication by the present Government Astronomer, Mr. P. Baracchi. The catalogue includes fundamental stars used for the determination of clock-error and azimuth, guide-stars in connection with the astrographic work, and various stars observed for special purposes at the request of other astronomers. The second catalogue, of 1211 stars, was published in 1889.

THE ENDOWMENT OF UNIVERSITY AND TECHNICAL EDUCATION.

MR. H. A. L. FISHER, President of the Board of Education, speaking at Birmingham on January 31, referred to the support afforded to higher education in the United States and Germany in comparison with that in England. He is reported by the *Times* to have said that "he had been looking into the endowments from private sources which have been going to the American universities on one hand, and to the English universities on the other, in recent years. In the period from 1906 to 1917 the American universities received an average of more than four millions annually from private sources, whereas our universities were lucky if they received 200,000*l.* in one year. Concerning the amount of State help to the universities in Prussia on one hand, and in England and Wales on the other, whereas the Prussian universities receive rather more than a million pounds a year, our universities and technical institutes receive 378,000*l.* from the rates and taxes combined. The comparison is even more unfair to England than it appears at first sight, because the Prussian figures exclude the endowments of the technical institutions and sums paid by the State to assist the training of teachers."

We are glad that Mr. Fisher has directed attention to the need for more liberal provision for university and higher technical education in this country, as indicated by the support offered in other countries. The most complete survey of State-aid and private endowments for scientific and educational purposes is that given annually in the report of the British Science Guild; and in connection with Mr. Fisher's remarks it is of interest to extract the following facts from such reports published in recent years:—

(1) The grand total of gifts to education in the United States during the forty-four years 1871–1914 was 116,883,600*l.* The average annual amount of new benefactions during the four years 1911–14 was six million pounds, excluding grants by the United States, different States, and municipalities; in the United Kingdom, the average is less than one-twentieth this amount.

(2) The total receipts of universities in the United States in the year 1910–11 amounted to nearly nineteen million pounds, and the benefactions to five millions. In the same financial year, the total incomes of those universities and university colleges in Great Britain which are in receipt of State grants was little more than one-seventh of the amount of gifts to education in the States, and was less than one-thirtieth of the incomes of the universities there.

(3) The income from endowments in the case of the universities and university colleges receiving Treasury grants is about 85,000*l.* for England and 4000*l.* for Wales; or, say, 90,000*l.* for Great Britain. Five universities in the United States have each a much greater income from private endowment funds alone than the total endowment income of State-aided universities and university colleges in Great Britain. They are:—Harvard University, 239,500*l.*; Columbia University, 199,700*l.*; Leland Stanford Junior University, 177,400*l.*; University of Chicago, 164,700*l.*; and Yale University, 140,900*l.*

(4) Our Treasury grants in aid of expenses of universities and university colleges amount to about 300,000*l.* The Treasury grants of the United States Government to universities and colleges amount to 1,175,000*l.*, and the State or city grants for current expenses to 2,940,000*l.*, or more than 4,000,000*l.* in all. The contributions of several single States in the United States, from State or city funds, for current expenses of universities and other institutions of higher education approach the total amount of the grant made for like purposes in Great Britain.

(5) In Germany, State subsidies provide the main part of the incomes of the universities. The annual expenditure for the universities from State funds amounts in round figures to 1,800,000*l.* In 1913 the expenditure of the University of Berlin alone was 242,000*l.*; and of this amount 200,000*l.*, or about 83 per cent., was derived from State funds.

(6) The total number of full-time day students in the universities of the United Kingdom is about 21,000, in comparison with 55,000 in German universities. In our technical institutions, the number of day students in attendance is about 2000, in comparison with 16,000 in the technical high schools of Germany. The seventy-two universities, colleges, and technical schools in the United States, on the accepted list of the Carnegie Foundation for the Advancement of Teaching, had, in 1910, 89,000 students.

It is evident that we have much leeway to make up in order to increase the number of highly trained men required to enable us to come into line with the United States and Germany as regards the provision for the scientific development of our industries. There is no more important problem of reconstruction than that of extending our facilities for higher education, yet almost nothing has been done to enable our universities and technical institutions to provide for the extensions which are needed for national security in the future.

Education—England

As we have now a really democratic President of the Board of Education, who has a genuine zeal for education and a fervent desire that all who are capable of benefiting from it shall have the means of enjoying its advantages, we may hope that steps will be taken to place our universities and technical institutions upon a satisfactory financial footing. In an address delivered in September last to the Associated Educational Societies of Manchester, on "Educational Reform," recently issued in pamphlet form, Mr. Fisher surveyed the whole field of education, and directed attention to the great increase in the number of universities now existing in England and Wales, comprising twelve, including the ancient universities of Oxford and Cambridge. Mr. Fisher characterised these as in the forefront of European learning, and said they need not fear comparison with the most famous universities of the Continent in respect either of the quality of their contributions to the advance of knowledge or of the adequacy and power of their teaching. The ten more modern universities, which are largely subsidised by the State, have not yet received an equipment at all adequate to modern needs, and are nowhere supported by so large a body of students as they deserve. Attention was directed to a comparison between Lancashire and Scotland, with a similar population. In the former there are two universities, in the latter five, with, in the case of Scotland, a body of undergraduates five times as numerous as that of the Universities of Manchester and Liverpool combined.

The place and function of the secondary school in its relation to the university were also discussed by Mr. Fisher. While the number of such schools has greatly increased, there being nearly 1000 in receipt of education grants, there is in many areas very inadequate provision, to the great detriment of the children residing therein. There are too many early leavers and too low a percentage of pupils who reach matriculation standard. Much needs to be done before the secondary schools can reach a proper level. Better salaries must be offered to the teachers and an adequate scale of pensions arranged. More encouragement must be offered to induce a higher standard of work, and so enable the universities to reach a higher plane of teaching. More and better provision is needed in the way of maintenance scholarships enabling capable, though poor, children to travel along the broad highway unimpeded from the elementary school to the university. Whilst the work of the elementary school has much improved of late it can never do its full work until the leaving age is made compulsory up to fourteen at least, and provision then made for a liberal, continued education within working hours for those entering industry up to eighteen years of age.

One point which has been overlooked in recent discussions is that of the need for improvement of the scales of salaries of teachers in universities and technical institutions if competent instructors are to be maintained. A meeting of teachers engaged in the technical institutes, junior technical and trades schools of London and the neighbouring counties was held on Saturday last to consider this question. Special emphasis was laid by several speakers on the fact that men and women of attainments similar to those of teachers in technical institutions can obtain much higher salaries in industry or in secondary schools than are paid in the technical institutions. A resolution declaring that the present rates of salaries paid to both day and evening teachers in technical institutions are totally inadequate, and urging the education authorities to take immediate steps to establish satisfactory scales of salaries for all teachers, was carried unanimously. A further resolution requesting the Government to allocate special grants, similar to those given in the case of secondary and elementary schools, for improving the salaries of teachers in technical institutions was also adopted. It was agreed that the London Branch of the Association of Teachers in Technical Institutions, by whom the meeting was organised, should request the County Councils of London and the Home Counties to receive deputations for the purpose of placing the views of the meeting before them.

MAGNETIC SURVEY OF NEW ZEALAND.[1]

IN the observational work recorded in the publication referred to below Dr. Farr had much assistance from Mr. Skey, who succeeded him as director of the Christchurch Magnetic Observatory when Dr. Farr became professor of physics at Canterbury College, while Mr. D. B. MacLeod took an active part in the discussion of results. The observational work extended over the years 1899 to 1909, in the course of which 334 stations were occupied, including forty-four in the Southern Islands, Chathams, and West Coast Sounds. The instruments, a unifilar magnetometer and dip circle—the former once used by the North American Boundary Commission, and by the Jackson-Harmsworth Polar Expedition—were lent by the old Kew Committee of the Royal Society.

Particulars are given of the position of each station, the date or dates of observation, the values of the declination, dip, east and north components, horizontal, vertical, and total forces. Owing to the long period covered by the observations, considerable importance attaches to the secular change corrections necessary to reduce the data to a common epoch. These were based on the magnetograph data obtained at Christchurch from 1901 onwards, and on observations at repeat stations. Following the example afforded by Rücker and Thorpe's survey of the British Isles, New Zealand was divided into ten overlapping districts. These were bounded by parallels of latitude, the limits of three successive ones being, for instance, 38° and 40° S., 39° and 41° S., and 40° and 42° S. Assuming the change in any element within any one district a linear function of the latitude and longitude, the rates of change with latitude and longitude were deduced in the first instance by the method of least squares. A process of smoothing was then applied, to secure continuity in passing from one district to the next.

The general nature of the results is best seen by consulting the maps. The great length of New Zealand from north to south necessitates two maps for each element, one for the North Island, the other for the South Island. The latter, it should be noticed, is described as the "Middle Island" in the charts principally devoted to the North Island, a memory of the time when the small island, now known as Stewart Island, was called the South Island. In the case of the declination, starting at the extreme north of the North Island, we have the isogonal of 14° 0′ E., sloping from N.W. to S.E. Near the south of the North Island, and north of the South Island, the isogonal of 15° 50′ runs nearly due east and west, while to the extreme south of the South Island the isogonal of 17° 10′ slopes from N.E. to S.W. The isoclinals and lines of equal horizontal force, on the other hand, have a nearly parallel trend from extreme north to south. The dip ranges from under 60° S. to over 71° S., and the horizontal force from 0·275 C.G.S. in the extreme north to 0·200 C.G.S. in Stewart Island.

Other maps deal with the northerly, east, and vertical components, and the total force. The two last

[1] "A Magnetic Survey of the Dominion of New Zealand and Some of the Outlying Islands for the Epoch June 30, 1903." By Dr. C. Coleridge Farr. Pp. 64+2, with 18 maps. (Wellington: John Mackay, Government Printer, 1916.)

show the local disturbing forces, which are discussed in pp. 28–31. Amongst the largest disturbances are those in Stewart Island and near Invercargill and Dunedin. Prof. Marshall contributes in pp. 63–64 some remarks on the geological character of the disturbed regions. His conclusion is that "while in each case of magnetic irregularity it is possible to point to some unusual geological feature, these are in no instance the most marked feature of that kind in the country, and those localities where such feature is most pronounced show no unusual magnetic characters." As Dr. Farr says himself, there is room for considerable further observational work in the disturbed districts.

Two supplementary pages give particulars of observations made in March and April, 1916, at ten of Dr. Farr's stations by Mr. W. C. Parkinson, once of Greenwich and Eskdalemuir Observatories, now observing for the Carnegie Institution of Washington. These serve a useful purpose in showing the changes that have occurred since the epoch of the survey.

Transport is still a serious difficulty in parts of New Zealand, and the work had to be carried on in the spare time which his other important duties left at Dr. Farr's disposal. He is to be congratulated on having brought to a satisfactory conclusion an arduous piece of work, which adds substantially to our knowledge of terrestrial magnetism in the southern hemisphere. It is satisfactory to notice that the work had the active support of the New Zealand Government, and that the printing was done, and satisfactorily done, at the Government Press. C. CHREE.

PARASITES OF CROPS AND CATTLE.

VERY striking data as to the extent of the loss of crops occasioned by diseases of parasitic origin are contained in the paper on economic mycology read by Prof. M. C. Potter at the Newcastle meeting of the British Association (1916), and since published in the Journal of the Royal Horticultural Society (vol. xlii., parts ii. and iii.). In the year 1891 the loss to the German Empire upon the total cereal crops was estimated at more than 20 millions sterling, an amount nearly equal to one-third of the total value of the crop. In the same season (1890–91) the loss due to rust of wheat in Australia was estimated at $2\frac{1}{2}$ millions. The case of potatoes is even more notorious. In Germany the loss due to disease of the potato crop amounted in one year to 30 millions, and in our own country it is computed that, on the average, the crop is reduced by disease by at least one-third. It is estimated that in Northumberland and Durham about half the crop of swedes and turnips is destroyed in average years by parasite attacks. Losses of timber also are very serious, and probably amount to one-third of the whole. Other crops, such as tea, rubber, hops, and every kind of fruit, greenhouse, and garden crops, all pay a heavy toll to fungus diseases. A plea is entered for greater encouragement by botanists to the prosecution of research in phyto-pathology and for the wider treatment of the fungi in ordinary botanical courses, especially from the point of view of their work in Nature. The scope of the problems awaiting solution in this field is abundantly illustrated, and appreciation is expressed of the increased attention and support given to it in recent years by Government departments and other institutions, although further provision is still urgently necessary.

A report on investigations into the cause of worm nodules (*Onchocerca gibsoni*) in cattle by Messrs. C. G. Dickinson and G. F. Hill has been issued as a Bulletin (C. 9341) by the Government of the Commonwealth of Australia. Two series of experiments were carried out in the Northern Territory with calves from nodule-free districts of Victoria. Calves grazing on high, dry ground along with infected cattle became infected within eight months of arrival, whereas similar nodule-free calves did not become infected during the same period when enclosed in an open pen with concrete floor within 30 yards of a paddock within which affected cattle were depastured, although exposed to the attacks of winged and apterous Arthropoda. The results, while not revealing an intermediary host of the parasite causing Onchocerciasis in cattle, have definitely excluded certain species that were regarded as possible vectors, namely, *Lyperosia exigua, Stomoxys calcitrans, Tabanus mastersi, T. nigritarsis, Boophilus australis,* and any purely aquatic forms other than those possibly found in the bore-water. Various common species of mosquito, it is thought, may also be excluded. Wild swamp buffaloes were not affected, whereas wild Zebu cattle and domestic cattle grazing on the same country are invariably affected.

LIGHT AND VISION.[1]

THE old Greek philosophers who did so much thinking and so little experimenting had queer ideas about light and vision. Empedokles, who died about 420 B.C., considered it necessary to record the fact that darkness is not a real thing, but privation of light; and that the moon shines with reflected light, but he thought that the sun is the primary fire of the light of the sky reflected in a crystalline spheroid. Democritus, who died about 370 B.C., held that vision was to be explained by emanations or exceedingly thin husks or films which were continually being detached or thrown off from the surface of bodies, and that they penetrated into the sense-organs through fine passages or pores. We admit this in the case of taste and of smell. These ghost-like forms or images were called *eidola* (εἴδωλα), whence we have the word idol (a very different kind of image from those considered in optical books), and were supposed to be ever passing from the object to the moist and receptive surface of the eye straight into the mind. Aristotle, who died about 325 B.C., seems to have objected to some of the earlier theories. He scarcely alludes to light and vision in "De Physica," but there is some reason to suppose that a treatise by him on optics has been lost. More than two centuries later Lucretius, the scientific poet, discussed the theory at great length in the fourth book of "De Natura Rerum." He used the expression *simulacra quasi membranae,* resemblances like films, peeled off from the upper surface of things, flying hither and thither on one side and the other through the air. *Simulacra* was also used for ghosts, and he goes on to explain how they terrify us in sleep. He also attempted to explain the action of curved mirrors, of the distance of the image behind a mirror, and why the theory does not work in the dark.

The schoolmen in the Middle Ages tried to follow Aristotle as closely as they could, but matter and form probably did not mean to them what they meant to Aristotle or to us. The *eidolon* was still used, but the expression had lost its materialistic signification. At the end of the sixteenth century men began to shake off dogmas of authority, to think for themselves, and to follow inductive lines of reasoning.

We may perhaps flatter ourselves that in our branch of applied optics we are not trammelled by fundamental theory, and that if the corpuscular hypothesis of light came back again into fashion next week to replace the undulatory theory, as the electron has pushed aside the

[1] From the presidential address delivered before the Illuminating Engineering Society on December 18, 1917, by A. P. Trotter.

elastic ether hypothesis which satisfied us in Maxwell's days, we should carry on with no change in our methods.

Silvanus Thompson, in his inaugural presidential address on the founding of our society, referred to the youthfulness of that branch of engineering which we practise. It recalled, he said, illuminations on the proclamation of peace after the Crimean War. "Bengal lights and rockets. How the vision of them stands out in memory! But our society has as little to do with fireworks as with fireflies. As little—and as much—for, after all, both of them are assuredly of some interest to the illuminating engineer."

He knew that the secret of the firefly is still hidden from us, but that if we knew it, if we knew how to produce the rapid vibrations which give the stimulus called light, without producing all the slow ones as well, as when we sound a high note with a finger instead of pressing all the keyboard at once, the mechanical equivalent of light would be as important as the mechanical equivalent of heat, and we should be able to produce light without heat. The quantity of energy which appears as useful light is about 2 per cent. of the energy radiated from an electric glow-lamp; in the firefly it is about 96 or 97 per cent. In other words, if we could produce a highly efficient lamp, the light-generating output of a dynamo would be fifty times greater than now, and 45 lb. of coal would do what a ton does to-day. The cost of lighting will not be reduced in anything like the same proportion. The cost of fuel is about one-tenth of the selling price of the light. The ordinary London householder pays 3*d*. to 6*d*. for his domestic lighting, which entailed a consumption of about 0·44*d*. of coal at pre-war prices.

While so many engineers and scientific men have been eager to do something for the war, and so few have succeeded in finding any appreciation of their services, our society must be content to have been allowed to carry out more than one investigation for which it was well fitted. Silvanus Thompson said that fireworks, as well as fireflies, were of some interest to the illuminating engineer. The star-shell, flares, and parachute lights which play so important a part in the war are but fireworks. The chemist has used his skill to choose the most suitable compositions, and ingenuity has been expended in putting them up and in priming them; but in estimating the results, no further progress had been made beyond the stage of Lambert—the eye alone was the judge. Fortunately the right men in the right department were approached. It was recognised that photometric tests would be useful. Our society offered to find men who would suggest methods and give their time, if necessary, to carry out the work. A committee was accordingly formed; it conferred with the experts, who cordially placed their data and requirements before the members; a special photometer was at once discussed, designed, and made. At the present time nothing more can be said than that the instrument has fulfilled all expectations; it needs no manipulation whatever during observations, measurements may be taken over large ranges, and the behaviour of unsteady or flickering lights can be recorded. The observations on a large number of samples, both of service patterns and of experimental kinds, were made by the committee during night meetings, and were reduced to candle-power-seconds per gram of composition, and it is hoped that the results have been useful.

Some five and twenty years ago it seemed likely that luminous paint would have many useful applications, but the results were disappointing. The preparation of one of the best kinds was kept secret, and it was never properly placed on the market. Night operations of war have directed attention to this subject, and the old method of exciting zinc sulphide or other materials by light has given place to continuous stimulation by α rays of radium compounds. Dials of watches and compasses are well known, and luminous gun-sights are no secret, but there are other applications which cannot be described at present. On these a committee of our members has been working. Tiny tubes are used which are smaller and give less light than a glow-worm, but in their preparation careful photometric measurements of considerable difficulty have been made and valuable information has resulted from the research.

More work is wanted, or at all events more accessible literature is needed, on the physiology of vision. The dioptrics of the eye are well understood; its normal, abnormal, and pathological characteristics are the basis of ophthalmic science. The theory of colour vision is still, perhaps, unsettled, though no one worker will admit it. The subject to which I wish to refer is a purely quantitative one, and is the relation of light flux to visual perception. The range of the luminous stimulus to which the eye can respond is enormous. When we grope our way on so dark a night that objects are only just visible, the illumination is about one-ten-thousandth of a foot-candle, or equal to that received from a candle at a distance of 100 ft. In summer sunshine we often have 5000 foot-candles, and in clearer atmospheres than ours 10,000 foot-candles are reached. The brightness of a furnace is even higher, and furnacemen judge the temperature by the colour.

By some marvellous organic control the eye so reacts that it is capable of estimating difference of tone and colour over a range of several thousand millions. The contraction of the pupil has very little to do with this regulation. It merely seems to take advantage of a greater stimulation to reduce spherical aberration. Over a large part of the enormous range Fechner's relation between stimulus difference and sensation difference holds good. There must be some intricate and delicate provision, perhaps, of a chemical change in the receptive portion of the eye, the retina, depending on saturation or exhaustion of material; or some inhibition of the transmissive portion, the optic nerve, or some compensatory reaction or opposing activity or fatigue in what Huxley called the sensificatory portion, the brain. The automatic adjustment of control which permits so sensitive an organ to accommodate itself to such great changes in the external stimulus has its counterpart in other organs and functional mechanisms of the body, such as those which are concerned in breathing. If physiologists could tell us something about this quantitative control, it would help us in several ways.

SCIENCE AND THE COLD-STORAGE INDUSTRY.[1]

THE value of perishable produce imported into this country, subject more or less to refrigeration, was, before the war, about 130,000,000*l*. per annum. It is abundantly evident that the most natural means of preserving foodstuffs, viz. by methods of low temperatures, have gained the confidence of our merchants, and the cold-storage industry to-day is a striking example of the successful combination of science, commerce, and industry. The history of the cold-storage movement reveals four outstanding features:—

(1) It is difficult to imagine a more striking example than the cold-storage industry affords of the success of the spirit of enterprise and love of adventure which have always characterised British commerce.

[1] From a paper read before the Royal Society of Arts on December 19, 1917, by Prof. J. Wemyss Anderson.

(2) Refrigerating engineers have been in no sense less typical, inasmuch as the methods employed are scientifically sound, the machines of the leading manufacturers are thoroughly trustworthy, and the necessary low temperatures for the transport and storage of food have been made a sound commercial proposition.

(3) Refrigeration has played a most important part in the development of some of our Colonies—particularly Australia and New Zealand.

(4) While the applied science of the engineer has done much for the advance of cold storage, pure science has in this country done little or nothing for the commercial preservation of foodstuffs.

The principal foodstuffs at present cold-stored can be roughly divided into three classes :—

(1) Produce the life-history of which is finished, such as all classes of meats, poultry, rabbits, and fish.

(2) Produce the life-history of which is not finished, such as fruit and eggs.

(3) Milk and produce from milk—cream, butter, and cheese.

It has been found that with good rearing of sound stock, combined with scientific methods of slaughter, and a thorough system of veterinary inspection and hygienic after-care, beef can be kept in the chilled (soft or unfrozen) state for five or six weeks. This time permits of a voyage from North or South America, together with the time necessary for collecting the cargo at one end and its distribution at the other—in this country. This time allowance cuts out all possibilities of a chilled beef trade with Australia or New Zealand with low temperatures only.

Then, with all classes of meats, poultry, and rabbits, certain troubles manifest themselves from time to time —such as mould. Often the troubles are epidemic and caused by ignorance or carelessness prior to shipping, while often only a small percentage of an overseas consignment is affected and the source of trouble cannot be found by the trader.

Fish has been preserved in many ways, but it is safe to say that refrigeration is destined to outrival, in bulk, all other methods. Research work is urgently needed in this direction, both with respect to meeting periods of glut and for general preservation and transport. The main questions to be determined are :—

(1) What kinds of fish will stand preservation the best?

(2) What are good methods, and, if possible, the best with each kind of fish?

(3) Which seasons of the year are the best adapted for each form of preservation?

(4) What are the food values and general effect for each method of preservation on the principal kinds of fish?

When the best methods have been determined, there still remains the problem of educating the public taste. In the British Isles the problem is mainly how to get the fish to the markets in a fresh state. Cold-storage methods will help this, but wider researches are required for the fishermen who go far to sea, and also for fish imported in a frozen state from our Colonies.

The preservation of both fruit and eggs, if properly understood, would mean a great saving of wealth to the country, and also better health. It seems very doubtful if new-laid eggs will ever again be sold in any part of the country at 6*d*. a dozen. With respect to fruit, refrigeration has enabled this country to enjoy a perpetual autumn; but the methods that enable Australian fruit to be eaten in a sound condition in this country are not applied to home-grown fruit. Why? The fruit merchants of this country have had to depend on the pure science of countries other than our own to help them to keep material the life-history of which is not finished. Fruit and vegetables offer an immense field for research.

Milk and its products open up a still greater field. Sterilisation as usually adopted hopelessly destroys its structure, and, no doubt, correspondingly destroys its food value. Common-sense deductions point to mechanical milking into covered vessels, the whole to be cooled down to 3° or 4° C. as soon as possible after the milking operation, and then kept away from the air until the time of consumption. Milk so treated and kept cold will keep quite sound, with ordinary commercial handling, for more than a week—theoretically, it should last for months.

The main questions may now well be asked : What has stood in the way of scientific development in the past, and what are the suggestions for the future?

With respect to low-temperature work, the answer to the first question can be readily divided into two main reasons :—

(1) The want of a bond or link between pure science and industry.

The present time is most opportune, and if the man of science will only realise that laboratory results are not by any means conclusive, he will find the man of commerce will help him in researches of a practical nature; the net result will be more commerce and a higher and better scientific knowledge.

(2) The man of science has not had facilities in his laboratory for low-temperature work. Many researches stop short at the melting point of ice or a little below.

Every seat of scientific learning should have a refrigerating apparatus as part of its equipment. No research of any kind where temperature is a function can be considered complete that does not go down to the lowest limit reasonably attainable, yet how many institutions are there where such investigations are possible? The lack of such facilities, in the light of recent advances all over the world, will constitute a serious disadvantage to our men of science, and the question must be taken up by every scientific body in the kingdom.

The author suggests :—

(1) That institutes of research and schools of refrigeration should be instituted in London and Liverpool. (This suggestion has been approved by the Cold Storage and Ice Association.) These institutes would be attached to learned institutions, and would act as centres for research work and the higher instruction of graduates (or others duly qualified) in medicine, science, engineering, and veterinary science from home and Colonial universities. They would also keep definitely in touch with Government departments and associations interested in low-temperature work.

(2) That every seat of scientific learning should provide facilities for low-temperature study and research.

(3) That every engineering school of university rank should provide facilities for refrigerating engineering study and mechanical research.

(4) That the principal technical colleges and schools under the Board of Education should be provided with facilities for instruction in mechanical refrigeration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The first election to a biological scholarship under the bequest of the late Mr. Christopher Welch, of Wadham College, will take place in July next. The scholarship is of the annual value of 100*l*., and is tenable for four years. Candidates must be undergraduate members of the University; they may offer either botany, animal physiology, or zoology, and

must give notice of the subject selected to the registrar of the University not later than March 1. They may submit to the examiners any original work previously done by them.

The Committee for Anthropology reports that nine fresh students entered their names on the register during 1917, as against eight in 1916. Miss M. Czaplicka has delivered a course of lectures on ethnology, with special reference to her Siberian researches. She has been assisted in the preparation of the scientific results of her expedition by a grant from the committee. Lady Tylor has offered the valuable scientific library of the late Prof. Sir E. B. Tylor to the Radcliffe Library on condition that such books as are not needed to supplement that collection shall be placed at the disposal of the Committee for Anthropology.

THE Department of Agriculture and Technical Instruction for Ireland has issued the time-table of technical-school examinations which it will hold on various dates during May next. The Department's scheme of technical-school examinations is designed to follow courses of instruction extending over four years in the following branches of technical knowledge:—Commerce, building trades, applied chemistry, electrical engineering, mechanical engineering, domestic economy, and art. There are, in general, two examinations in each course in each of the four years, and the examinations in each course must be taken in a prescribed order.

IT was agreed in the House of Commons on February 1, in a discussion of the Lords' amendments to the Representation of the People Bill, that the University of Wales should be separately represented in Parliament. When the Bill was in the House of Lords, Lord Peel, the spokesman for the Government, accepted an amendment to give to the University of Wales, instead of being one of a group of universities returning two members, a member to itself, and he appealed to the Home Secretary to assent to this being done. The request made on behalf of the University has now been granted. The position of university representation is, therefore, that Oxford and Cambridge retain two members each; London has one; Wales one; a single constituency is formed by the group composed of Durham, Manchester, Liverpool, Leeds, Sheffield, Birmingham, and Bristol, and the Scottish universities form one constituency returning three members.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1916–17 has now been published by Mr. John Murray at the price of 6*d*. net. The total number of candidates examined in technology in the United Kingdom in 1917 was exactly 1000 fewer than in 1916, viz. 7508 as against 8508. The candidates entering for examinations in England and Wales in 1917 numbered 85 per cent. of those in the preceding year, and in Scotland 91·5 per cent. In Ireland, on the contrary, there was an increase of 25 per cent. on the figures for 1916. In spite of this general decrease in Great Britain there was an appreciable increase in the number of students attending classes in certain chemical subjects, such as alkali manufacture, coal-tar distillation, painters' oils and colours, oils and fats, cotton dyeing, leather dyeing, and dressing of skins. After a consideration of the proposed new regulations issued by the Board of Education for continuation, technical, and art courses in England and Wales, the Technology Committee of the institute contemplates no change in its system of examinations, which is to be continued on the same lines as heretofore. The programme of the current session's work includes no new subjects of examination, but a special *viva voce* and practical examination is announced in connection with the highest tests in cotton weaving.

IN *Mind* (New Series, No. 105) Mr. P. J. Hughesdon discusses the relation between art and science. He argues that, at a time when education reform is being called for but still debated on the basis of an inadequate, and in part false, antithesis of the classics *versus* science, a satisfactory scheme of education must, whatever adaptations to tradition, etc., may be advisable, start with a correct view of the relation between the various aspects of truth or spheres of knowledge. He discusses the causes which have obscured the true relation of art and science, causes which, by exaggerating the particular domain of each, have deepened the gulf between them, chief among which is the erroneous view that art is concerned primarily with feeling and science with thought. The writer maintains that art and science provide complementary and correspondent conceptions of reality; in both the freely conceiving mind is active, but the organon of art is intuition or imagination, through which the nexus in the context of reality is divined implicitly and under the aspect of fitness or harmony, while that of science is reasoning, through which the nexus is recognised explicitly and abstractly under the aspect of ground, or reason, the essence of art lying in individualised representation, that of science in generalised explanation. The article is interesting, and furnishes some valuable points of view to those interested in the more fundamental problems underlying art and science.

THE *Journal of the Board of Agriculture* for December last contains an account by Mr. A. W. Ashby of some interesting features of agricultural educational work in connection with the State College of Agriculture, University of Wisconsin. It is an essential condition of graduation in agriculture at the University that the student must have previously secured at least two years' experience in farming. In order to ensure facilities for such experience to be obtained under good conditions a system of examining farms and awarding certificates of good management was established some years ago, and has proved very successful. In addition, university honours have been awarded to farmers who have rendered distinctive service to their profession or to their localities. During the past six years twenty-one farmers have been honoured in this way, of whom only three could claim academic training. A further feature which is described is the annual farm management contest, in which, despite the small financial inducement offered, competition is always keen. The awards are based upon a definite scale of "points," and it is specially interesting to note that no less than 20 per cent. of the total is allotted to "home life," a decidedly novel item in such score-cards. The importance of this factor is apparent to the student of rural conditions, even in this country, but in a country of widely scattered homesteads, where each must of necessity function as a largely self-contained social centre, the amenities of existence must bulk largely in ensuring the permanence of labour supplies, upon which a steadily prosperous agriculture must depend.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 24.—Sir J. J. Thomson, president, in the chair.—Prof. A. N. **Whitehead**: Graphical solution for high-angle fire.—Spencer **Pickering**: Flocculation. The subsidence of suspended matter on the addition of a flocculant to a mixture of kaolin and water is accompanied by an increase of 100 to 200 per cent. in the specific volume of the sediment deposited.

This increase, as well as the disappearance of Brownian motion, proves that flocculation is due to an increase in the size of the particles. With acids as flocculants, definite combination between them and the kaolin occurs, the acid being almost completely removed from the solution up to the point when flocculation is complete, beyond which no more is removed. The acids being in a highly hydrated condition accounts for the increase in volume of the kaolin particles on uniting with them. With alkalis the phenomena are the same, but combination is complete only in the presence of excess of alkali; hence the concentration at which flocculation occurs is much higher. In very weak alkaline solutions where there is but little actual combination, the subsidence of the particles is retarded by the attraction of the alkali present.—Dr. J. **Aitken**: Revolving fluid in the atmosphere. The paper deals with the objections to the cyclonic theory of circulation recently advanced by Sir Napier Shaw. These objections are founded on the fact that the charts of isobars and winds of the weather maps nowhere show a circulation such as would be given by a combination of the motions of rotation and translation. It is pointed out that these objections are based on suppositions which do not find support in Nature. If the cyclone were a closed system, the winds would be such as Sir Napier says they ought to be, but as the cyclone is an open one and draws in air at its lower end, and as this incoming air is only on its way to become part of the system, it cannot be treated as having the revolution and translation of the cyclone. If the combination of these two motions is to be found anywhere, it will probably be in the higher winds, and even there they will be affected by the general circulation in the system.—Hon. R. J. **Strutt**: Ultra-violet transparency of the lower atmosphere and its relative poverty in ozone. (1) The lower atmosphere is found to be comparatively transparent to ultra-violet light. The λ 2536 can be detected on the spectrum of a mercury lamp four miles distant. (2) The solar spectrum, even when observed from high altitudes when the equivalent thickness of air overhead (reduced to N.T.P.) is less than four miles, is limited by atmospheric absorption to λ 2922. Air near the ground-level is therefore much more transparent to ultra-violet light than the upper air. (3) Since the limitation of the solar spectrum is almost certainly due to ozone, it follows that there must be much more ozone in the upper air than in the lower. (4) Scattering by small particles acts in the same way as ozone to absorb ultra-violet radiation from a distant source, and this action makes quantitative estimation difficult. Even if the observed enfeeblement of λ 2536 were entirely due to ozone, 0·27 mm. of pure ozone in four miles of air would suffice to produce it. Taking scattering into account, the quantity is probably much less, and there is no evidence from this investigation that any ozone is present in the lower air.—Prof. A. **Fowler**: The presence in the solar spectrum of the water-vapour band λ 3064. The band at λ 3064, which is usually attributed to water-vapour, is quite strongly represented in the solar spectrum, and accounts for at least 150 lines which were previously unidentified.—Prof. A. **Fowler** and C. C. L. **Gregory**: The ultra-violet band of ammonia and its occurrence in the solar spectrum. The ammonia band having its greatest intensity at λ 3360 has been photographed with high resolving power, and the positions of 260 component lines have been determined. In the principal maximum, and in a secondary maximum at λ 3371, the band lines are very closely crowded and form series of the usual type. On the less refrangible side the principal lines form three series which coalesce and fade out at λ 3450, and there is a similar set of three series on the more refrangible side which coalesce and disappear at λ 3287. These two groups, however, are not symmetrical, and they differ considerably from the more usual type of series. It is shown that the ammonia band lines are consistently represented in the solar spectrum and account for about 140 faint lines which were previously unidentified. The remaining band lines are either too weak to appear in the sun or are obscured by lines of metallic origin. The brightest part of the ammonia band accounts for the greater part of Group P of the solar spectrum.

Geological Society, January 23.—Dr. Alfred Harker, president, in the chair.—Prof. W. J. **Sollas**: A flaked flint from the Red Crag. The remarkable specimen forming the subject of the paper was obtained by Mr. Reid Moir from the base of the Red Crag exposed in the brick-pit worked by Messrs. Bolton and Co. near Ipswich. It is a fragment of a nodule of chalk-flint, irregularly rhombic in outline, with a nearly flat base and a rounded upper surface which retains the whitish weathered crust of the original nodule. The base was formed by a natural fracture which exposes the fresh flint bordered by its weathered crust. Both upper and under surfaces of the specimen are scored with scratches which are mainly straight, but in some cases curvilinear. Two adjacent sides have been flaked by a force acting from below upwards, in a manner that recalls Aurignacian or Neolithic workmanship. The two edges in which the flaked faces meet the base are marked by irregular minute and secondary chipping, such as might be produced by use. On the hypothesis that the flint has been flaked by design, these edges should correspond with the "surface d'utilisation" of M. Rutôt, and one would expect to find on the opposite edges of the flint the "surface d'accommodation," as, in fact, is the case. The origin of the flaking is discussed, and the author, while admitting that the fashioning of the flint is not inconsistent with intelligent design, concludes that the evidence is not sufficient to establish this beyond dispute.

MANCHESTER.

Literary and Philosophical Society, January 22.—Prof. S. J. Hickson, vice-president, in the chair.—J. W. **Jackson**: The association of facetted pebbles with Glacial deposits. The object of the paper was to place on record several recent discoveries of facetted and wind-etched pebbles in localities near Manchester and in the Wirral peninsula, and to discuss the association of such pebbles with Glacial deposits. The pebbles are of Glacial origin, and all show the characteristic features of wind-erosion. The most noteworthy feature, however, is the large number of split and fractured pebbles, all of which exhibit the action of sand-blast on the fractured surfaces, in addition to other parts of the pebble. All stages towards the formation of typical "Dreikanter" are exhibited. The splitting appears to have been independent of rock composition, as both igneous and sedimentary rocks are represented in the series; in the latter they are mainly split along joint-planes. The mode of occurrence shows that the pebbles were acted on by sand-blast after the deposition of the Glacial beds on which they lay, and in this respect they agree with similar pebbles found in North Germany and in North America. It is suggested that the splitting is due to frost action, and that it is somewhat earlier than the wind-erosion.—The late E. **Halkyard** (paper edited and revised by E. Heron-Allen and A. Earland): The fossil Foraminifera of the Blue Marl, Côte des Basques, Biarritz. The Blue Marl of Biarritz forms a cliff stretching for nearly three-quarters of a mile N.N.E.

to S.S.W., and attains a height of about 135 ft. The height is maintained for about two-thirds of its length and dies away at the valley of Chabi. The paper contains an account of the genera and species of Foraminifera found by Mr. Halkyard in this blue marl, and is illustrated by eight plates of figures.

DUBLIN.

Royal Dublin Society, January 22.—Dr. G. H. Pethybridge in the chair.—Dr. A. G. G. **Leonard** and P. **Whelan**: The quantitative spectra of lithium, rubidium, cæsium, and gold. The utility of spectrum analysis has been greatly enhanced by a knowledge of the persistency of the spectrum lines in the spark spectra of dilute solutions of the metals. The present paper is a continuation of the quantitative study of these spectra, and includes the results obtained for the metals lithium, rubidium, cæsium, and gold.—Capt. E. G. **Fenton**: Studies in the physiography and glacial geology of southern Patagonia. This paper, which is the result of several years of personal observation on the pampas from the coast region at the mouth of the Gallegos River to the Andes, describes the way in which the generally level country has been cut into by the streams, and the formation of successive terraces by repeated flooding and erosion. The distribution of large ice-borne boulders enables the limits of a large ice-sheet of Glacial times to be determined, and the author shows that there were at least two epochs of ice-extension from the Andes. An epoch of dry south-westerly winds gave rise to a remarkable series of sand-cut grooves in the lava-blocks and lava-surfaces of the plateaus. The bajos, which are spoon-shaped excavations in the pampas, with a steep cliff at their heads, are attributed to waterfall action during the melting of the margin of the ice-sheet. The succession of events is pointed out, and the corresponding climatic changes are discussed.

PARIS.

Academy of Sciences, January 14.—M. Paul Painlevé in the chair.—E. **Ariès**: The co-volumes considered as functions of the temperature in the Clausius equation of state.—G. **Julia**: The repetition of rational fractions.—M. **d'Ocagne**: Skew surfaces circumscribed to a given surface along a given curve.—R. **Soreau**: The origin and the meaning of the word "abaque."—MM. **Lubrano** and **Maître**: The determination of the latitude of the Observatory of Marseilles by observations made with the prism astrolabe. The mean of the determinations, reduced to the latitude of the meridian circle, is 43° 18′ 16·35″, a value identical within 0·01″ with the mean figure obtained with the meridian circle.—A. **Colson**: The cause of the anomalies presented by the dissociation of amylene bromohydrate, and its consequences. The reaction between amylene and hydrobromic acid at 184° C. was found by Lemoine not to obey the law of mass action, and this has been confirmed by the author. It is shown that this anomaly is due to the partial change of the bromopentane originally formed into an isomer.—P. **Chevenard**: An anomaly in the elasticity of carbon steel correlative to the reversible transformation of cementite. The elastic anomaly of steel, due to transformation of the cementite, is proportional to the percentage of carbon.—E. **Léger**: The action of hydrobromic acid upon cinchonine and its isomers: cinchoniline, cinchonigine, and apocinchonine. Hydrobromic acid produces phenomena of isomerisation with these alkaloids.—C. R. **Lopez-Neyra**: A new Cyrnea of the partridge. The name *Cyrnea seuratii* is proposed for the new species, and a detailed comparison is made of it and *Cyrnea eurycerca*.—C. **Vaney** and A. **Allemand-Martin**: Contribution to the study of the larva of *Hippospongia equira* from the coasts of Tunis.—F. **Diénert**, A. **Guillard**, and Mme. A. **Leguen**: The search for the Eberth bacillus and the B-paratyphoid bacillus in waters. A detailed account of the modified method now in use, the first medium being a broth containing malachite-green. The two bacilli above-named can be detected by this method in 50 c.c. of Seine water taken at Paris.—P. **Masson**: Abnormal epidermisation after bathing with hypochlorites. A warning as to possible dangers attending the prolonged use of hypochlorites for disinfecting wounds. Epidermal lesions sometimes appear which are characteristic of pre-cancerous states, and which it is necessary to excise.

SYDNEY.

Royal Society of New South Wales, December 5, 1917.—R. T. **Baker**: The occurrence of crystals in some Australian woods. Crystals of calcium oxalate were found to be of rather frequent occurrence amongst some microscopical sections of Australian timbers when being examined for anatomical data. Timbers of twenty-two natural orders were examined, and of these crystals were found in fourteen, being the first record of such in Australian timbers. The crystals were simple, being found in both the wood and ray parenchyma, a single one in each cell, with one exception.—J. H. **Maiden**: Notes on Eucalyptus (with a description of a new species). No. 5. The paper consists of supplementary notes on a number of species, many of them Western Australian. Most of the species are somewhat rare, and their life-history and morphology but little known. The proposed new species is a remarkable form which throws light on the affinities of *Eucalyptus erythronema*.—Prof. J. **Read** and Miss M. M. **Williams**: A novel application of bromine water in synthetic organic chemistry. The method bears directly upon several processes of technical importance, including the manufacture of novocaine (a well-known synthetic substitute for the natural drug cocaine) and other substances of physiological interest; it may also be applied in preparing phenyl acetaldehyde, a hyacinth perfume; and it is of interest in connection with the chemistry of the Australian natural essential oils.

Linnean Society of New South Wales, September 26, 1917.—Dr. H. G. Chapman, president, in the chair.—R. J. **Tillyard**: Some dragonflies from Australia and Tasmania.—A. A. **Hamilton**: Notes on the genus Lepidium.—W. F. **Blakeley**: A new species of Acacia.—R. **Etheridge** and J. **Mitchell**: The Silurian trilobites of New South Wales, with references to those of other parts of Australia. Part vi.: The Calymeneidæ, Cheiruridæ, Harpeidæ, Bronteidæ, with an appendix.

October 31, 1917.—Dr. H. G. Chapman in the chair.—F. H. **Taylor**: Australian Tabanidæ, part iii.—R. J. **Tillyard**: Odonata, Planipennia, and Trichoptera from Lord Howe and Norfolk Islands.—E. **Cheel**: Notes on the common nightshade (*Solanum nigrum*, Linn.) and some closely related forms or species which have been confused with it.—A. M. **Lea**: Descriptions of new species of Australian Coleoptera, part xiii.

November 28, 1917.—Dr. H. G. Chapman in the chair.—R. J. **Tillyard**: The morphology of the caudal gills of the larvæ of Zygopterid dragonflies. Parts iii.–iv. (Ontogeny and Phylogeny).—G. I. **Playfair**: Rhizopods of Sydney and Lismore.—R. J. **Tillyard**: Mesozoic insects of Queensland. No. 2: The fossil dragonfly *Aeschnidopsis* (*Aeschna*) *flindersiensis*, Woodward, from the Rolling Downs (Cretaceous) series.—R. J. **Tillyard**: Permian and Triassic insects from New South Wales in the collection of Mr. J. Mitchell.—Miss V. A. **Irwin-Smith**: The Chætosomatidæ, with descrip-

tions of a new genus and four new species from the coast of New South Wales.—H. J. **Carter**: Some new Heteromera and a new Stigmodera (Coleoptera) from tropical Australia.—Prof. W. N. **Benson**: The geology and petrology of the Great Serpentine Belt of New South Wales. Appendix to part vi.—Dr. H. S. H. **Wardlaw**: The variability of cows' milk. Samples of afternoon milk from 109 healthy cows kept under similar conditions, but of various ages, breeds, and stages of lactation, were examined. Certain physical properties, the composition, and quantities secreted in eight hours were determined. The variabilities of the results fall into four distinct groups. The percentages of results lying within five of the mean, and the percentage-deviation from the mean within which practically all the results lay, were:—(1) Freezing point and density, 100, 5; (2) electrical conductivity and concentration of soluble matter (chiefly lactose), 50, 25; (3) concentration of matter not in solution (chiefly fat and protein), 20, 50; (4) quantities secreted in eight hours, 10, 100. Only three samples contained less than 3·2 per cent. of fat, while more than 40 per cent. of the samples contained less than 8·5 per cent. of solids not fat.—Miss E. C. **Pinkerton**: The composition of expired alveolar air. Estimations of the percentage of oxygen and carbon dioxide in the successive portions of air rapidly expelled from the lungs show that the concentration of carbon dioxide diminishes by not more than 0·22 per cent. in the final 600 c.c. respired, and that the concentration of oxygen increases by not more than 0·36 per cent. in the same portion of the breath. The change in concentration is independent of the depth of respiration, but depends on the speed with which the air is expired; the more slowly the air is breathed out the greater the change in concentration of the gases of the final portion. The results obtained lead to the inference that the alveolar air in the pulmonary atria, at the end of an expiration, contains a lower concentration of oxygen and a higher concentration of carbon dioxide than the air last expelled from the mouth in the rapid expiration.

BOOKS RECEIVED.

The Principles and Practice of Pruning. By M. G. Kains. Pp. xxv+420. (New York: Orange Judd Co.) 2 dollars net.

Comment Economiser le Chauffage Domestique et Culinaire. By R. Legendre and A. Thevenin. Pp. 123. (Paris: Masson et Cie.) 1.25 francs.

The Rural Teacher and his Work in Community Leadership, in School Administration, and in Mastery of the School Subjects. By H. W. Foght. Pp. xii+359. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 7*s.* 6*d.* net.

Manual of Milk Products. By Prof. W. A. Stocking. Pp. xxvii+578. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s.* 6*d.* net.

La Statique des Fluides, la Liquéfaction des Gaz et l'Industrie du Froid. By E. H. Armagat and L. Décombe. Première et Deuxième Partie. Pp. vi+265. (Paris and Liège: Ch. Béranger.) 18 francs.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 7.

ROYAL SOCIETY, at 4.30.—The Photo-Electric Action of X-rays: Prof. O. W. Richardson.—The Parent of Actinium: Prof. F. Soddy and J. A. Cranston.—Some Problems in the Theory of Radiation: Prof. A. Schuster.—The Absorption of the Radiation Emitted by a Palladium Anticathode in Rhodium, Palladium, and Silver: E. A. Owen.

ROYAL INSTITUTION, at 3.—Illusions of the Atmosphere: The Travelling Vortex and the Cyclonic Depression: Sir Napier Shaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Ninth Kelvin Lecture: Kelvin as a Teacher: Prof. M. Maclean.

LINNEAN SOCIETY, at 5.—Two Bibliographical Rarities of the Society's Library: (*a*) Cupani, F., "Panphyton siculum," 1713; (*b*) Du Gort, J. and P., "L'Histoire et Pourtrait des Plantes," Lyon, 1561: The General Secretary.—Plant Distribution from the Standpoint of an Idealist: H. P. Guppy.

CHEMICAL SOCIETY, at 8.—Atomic and Molecular Numbers: H. S. Allen.—Studies of the Carbonates. IV. The Hydrolysis of Sodium Bicarbonate and the Ionisation Constants of Phenolphthalein: C. A. Seyler and E. H. Tripp.—Some Inorganic Stannichlorides: J. G. F. Druce.—A Re-investigation of the Cellulose-dextrose Relationship: Miss M. Cunningham.—Esparto-cellulose and the Problem of Constitution: C. F. Cross and E. J. Bevan.

FRIDAY, FEBRUARY 8.

ROYAL INSTITUTION, at 5.30.—Science and Ethics: Principal E. H. Griffiths.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

SATURDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 3.—The Ethics of the War: P. H. Loyson.

MONDAY, FEBRUARY 11.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The London Society's Map with its Proposals for the Improvement of London: Sir Aston Webb.

SOCIETY OF ENGINEERS, at 5.30.—Presidential Address: W. B. Esson.

TUESDAY, FEBRUARY 12.

ROYAL INSTITUTION, at 3.—The Problems of British Anthropology: Prof. A. Keith.

WEDNESDAY, FEBRUARY 13.

BRITISH ASSOCIATION GEOPHYSICAL DISCUSSIONS (Royal Astronomical Society), at 5.—The Influence of Barometric Pressure on Mean Sea-level: Sir C. F. Close.—Precise Levelling: Major Henrici.

ROYAL SOCIETY OF ARTS, at 4.30.—The Relations between Capital and Labour—Reasonable Hours, Co-partnership, and Efficiency: Lord Leverhulme.

THURSDAY, FEBRUARY 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Artificial Production of Echinoderm Larvæ with Two Water-vascular Systems, and also of Larvæ Devoid of a Water-vascular System: Prof. E. W. MacBride.—The Quantitative Differences in the Water-conductivity of the Wood in Trees and Shrubs: Prof. J. B. Farmer.—The Efficiency of Muscular Work: Capt. M. Greenwood.

ROYAL SOCIETY OF ARTS, at 4.30.—The Hide Trade and Tanning Industry of India: Sir Henry Ledgard.

FRIDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 5.30.—The Mechanism of the Heart: Prof. E. H. Starling.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.—Traction on Bad Roads or Land: L. A. Legros.—Utility of Motor Tractors for Tillage Purposes: A. Amos.

SATURDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

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