NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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

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Applications (in duplicate), giving particulars of age, qualifications, and experience, accompanied by copies of testimonials (also in duplicate), should be lodged with the SECRETARY, Office of the High Commissioner for the Union of South Africa, 32 Victoria Street, London, S.W. 1, not later than August 7, 1920.

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2. ASSISTANT LECTURER in MATHEMATICS, who should have special qualifications in applied mathematics.
3. TWO ASSISTANT LECTURERS and DEMONSTRATORS in GEOLOGY.
4. ASSISTANT LECTURER and DEMONSTRATOR in ENGINEERING.

Further particulars regarding the above posts may be obtained from the undersigned, by whom applications, with testimonials (which need not be printed), must be received on or before August 7, 1920.

D. J. A. BROWN, Registrar.

University College,
Cardiff,
July 19, 1920.

MINISTRY of AGRICULTURE, EGYPT.

The Ministry of Agriculture, Egypt, invites applications for the APPOINTMENT of an ARBORICULTURIST for the study and care of the street trees in Cairo. Candidates are expected to be in possession of a Degree in Science and must have had experience in tropical or sub-tropical climates.

The post carries an initial salary of £E480 per annum plus bonus, which consists of an increase of 20% to salary and in addition a war gratuity of 60% on the salary so improved, provided that the increase from the war gratuity does not exceed £E192 per annum, and that the total increase from both sources of increment does not exceed £E300 per annum. The Pound Egyptian is worth about sixpence more than the Pound Sterling.

Applications, together with statements of qualifications and references, which will be received up to August 15, 1920, should be endorsed "Arboriculturist, Egyptian Ministry of Agriculture," and addressed to Sir ARTHUR WEBB, K.C.M.G., Queen Anne's Chambers, Broadway, Westminster, from whom all particulars regarding conditions of service, etc., can be obtained.

THE ROYAL TECHNICAL COLLEGE, GLASGOW.

The Governors invite applications for the CHAIR of INORGANIC and ANALYTICAL CHEMISTRY. Salary £800. Applications should be sent not later than August 7 to the DIRECTOR, the Royal Technical College, Glasgow, from whom further particulars may be obtained.

THE UNIVERSITY OF LIVERPOOL.

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Applications are invited for this post. Salary £300, rising by annual increments of £50 per annum to £400. Tenure one year, renewable on two occasions, at the close of which period a further tenure or promotion to higher grade will be considered. Candidates must possess an Honours Degree of a University, and be specially qualified in Palæontology. Further particulars may be obtained from the undersigned, to whom applications must be sent on or before July 27.

EDWARD CAREY, Registrar.

BEDFORD COLLEGE FOR WOMEN.

(UNIVERSITY OF LONDON.)

REGENT'S PARK, N.W.1.

The Council of Bedford College invite applications for the post of DEMONSTRATOR in PHYSIOLOGY. Candidates must have taken an Honours degree or its equivalent in Physiology. The appointment is open to men and women equally. Applications must be received not later than August 28. Further information can be obtained from the SECRETARY, Bedford College, Regent's Park, N.W.1.

July, 1920.

KENT EDUCATION COMMITTEE.

COUNTY SCHOOL FOR BOYS, DOVER.

Applications are invited for the following vacancy:—

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E. SALTER DAVIES,
Director of Education.

July 20, 1920.

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For the Session beginning October 1, an ASSISTANT PROFESSOR in PHYSICS is wanted to take charge of the Elementary Laboratory. Salary $2500.

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State qualifications, and send two references, to the DIRECTOR OF PHYSICS, McGill University, Montreal.

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SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY.

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WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE.

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Minimum commencing salary £300. Increments in accordance with scale (maximum £500).

Particulars may be had from the PRINCIPAL, to whom applications should be sent as early as possible and not later than August 9.

UNIVERSITY OF LEEDS.

DEPARTMENT OF BOTANY.

The Council will shortly proceed to the appointment of an ASSISTANT LECTURER in BOTANY. Salary £300 a year. Applications to be received before August 1 by the SECRETARY the University, Leeds, from whom further particulars may be obtained.

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CITY OF BIRMINGHAM EDUCATION COMMITTEE.

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Education Office,
Council House,
Birmingham.

P. D. INNES,
Chief Education Officer.

July 20, 1920.

UNIVERSITY OF BIRMINGHAM.

ASSISTANT LECTURESHIPS IN MATHEMATICS.

The Council invites applications for two vacant ASSISTANT LECTURESHIPS in MATHEMATICS. Stipend £300 per annum.

Applications, accompanied by three or four testimonials, should be sent to the undersigned not later than Monday, August 9, 1920.

The Candidates elected will be required to enter upon the duties on October 4, 1920.

Further particulars may be obtained from

GEO. H. MORLEY, Secretary.

For other Official Advertisements see page ccii *and page* ii *of Supplement.*

THURSDAY, JULY 22, 1920.

Editorial and Publishing Offices:
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Aerial Navigation and Meteorology.

METEOROLOGY has been international ever since it became a science. From the first congress of directors of meteorological institutes at Vienna in 1873, meteorologists have been engaged in standardising methods of observation and exposure of instruments, and in devising codes for the transmission of observations by telegraph in order to compress as much valuable information as possible in the small space available for transmission at moderate cost. So the introduction of upper-air data, though strongly recommended by those who wanted to substitute calculation for "rule of thumb," had to fight its way against other useful and more easily accessible information of the older kind. The last international code, fixed at Rome in 1913 after long correspondence and discussion, kept the morning message at four groups of five figures, and allotted only one figure to upper-air data—direction of high cloud—in addition to the customary figure for weather or state of the sky. For the benefit of aerial navigation, the results of pilot-balloon ascents were telegraphed by many European observatories to the central station at Lindenberg. Funds for the telegraphic distribution of these data and of those of soundings of the atmosphere by means of kites or cable balloons were usually lacking.

The great war has changed all this; aerial navigation demanded quick and detailed information, especially about low cloud, visibility, and wind velocity in free air. Many reporting stations were erected and connected to central offices by telephone or wireless. Meteorologists sprang up from the ground, the observational hours were multiplied, and no one considered the cost.

The result lies before us in the form of Annexe G of the Convention for the Regulation of Aerial Navigation,[1] the object of which is to substitute legal regulation for free international co-operation. The prominent features are:—

(1) Regulation of the collection and dissemination of meteorological information—introduction of four observational hours instead of two or three; of short-period (three to four hours) and route forecasts (six hours) on one hand, and of long-period forecasts (two or three days) on the other, besides the normal forecasts (twenty to thirty hours).

(2) Extension of the number of groups in the reports from individual stations to a central office from four to six for all stations, and from four to any number between twelve and forty-four for stations observing upper-air wind, temperature, and humidity.

(3) Introduction of new codes for the new information and several of the customary data.

Annexe G has been discussed at a meeting in London of members of the pre-war International Meteorological Committee, and again at the Conference of Directors of Meteorological Institutes at Paris in October, 1919; but definite resolutions were postponed. We have reason to think, however, that the following remarks express the opinion of a large majority of Continental meteorologists and several of their British colleagues.

There is practically no difference of opinion about the necessity of reorganisation and centralisation of the collection and dissemination of meteorological information. Standard observational hours, quick transmission of the reports to the national centre, exchange of collective reports between centres with a maximum distance of 1500 km. within an hour and a half of the observation, followed by selections from these reports sent out over world-wide ranges by a few high-power wireless stations within three hours of the observation, is a good, but not altogether new, scheme. Its complete realisation will be hampered only by the unsatisfactory state of communication by telegraph or telephone in some countries. The proposed simultaneous transmission of several of the national collective reports may cause the receiving stations to miss part of them; successive transmission may take more time than the convention grants; but these are only technical details: the principle is all right. Differentiation of forecasts also is necessary, but it has to be adapted to local circumstances.

1 "Air Ministry. Convention portant Réglementation de la Navigation Aérienne (13 Octobre, 1919). Convention for the Regulation of Aerial Navigation (October 13, 1919)." Pp. 48. (London: H.M. Stationery Office, 1920.) Cmd. 670. Price 1s. net.

Appendix III. mentions, in addition to the observations of physical quantities like wind, pressure, temperature, and humidity, no fewer than seven kinds of weather phenomena (fog, clouds, precipitation, visibility, etc.), and only as additional and facultative do we find wind, temperature, and humidity in the upper air, in spite of the fact that knowledge of the latter data is essential for a real prediction of weather phenomena, whereas the most minute description of present weather does not form a guarantee against sudden changes. Some years ago it might have been urged that sufficiently recent upper-air data were not available—we have shown, however, in Holland that the aeroplane is an excellent substitute for the kite or the cable balloon in almost any weather, and hence this excuse is no longer permissible. In this respect Appendix III. almost looks like a step backwards.

Certainly the multitude of codes introduced by European meteorological institutes since the war is a nuisance, but it may be taken as a symptom of the general dislike of the codes prescribed in Appendix IV. These include units, like the millibar, unfamiliar to the majority of Continental meteorologists (unless in purely scientific work), and change codes for the transmission of the usual elements without any real gain for practical purposes, and they do not use sufficient economy with the room available in the telegrams. A few specimens may illustrate this. Wind direction is given in two figures as usual, but in a scale of 1 to 72 instead of 1 to 32; this means that an accuracy of 5° is claimed. Every meteorologist knows that such accuracy is imaginary—the exposure of the anemometer, the turbulence of the winds, etc., cause larger variations with space and time. No fewer than four figures are allotted to past and present weather. The result is that the observer is puzzled as to the number he is to choose out of 50 or 100, five or six numbers applying equally well, or he gets into the habit of reporting some favourite phenomenon —the very slightest degree of haze, for instance. The multitude of phenomena reported makes one lose sight of the distribution of any particular class.

In our view, Appendix IV. is a mistake, and ought to be deleted as soon as possible; it may prevent some States from joining the convention, Article 34 of which allows a minority of one-fourth or even less to prevent any modification of the annexes. General rules ought to be given in the convention, details being left to a competent body like the "Comité Météorologique International," reconstituted at Paris in October, 1919, which certainly is fully aware of the need for reforms, and will choose the best way to ensure general approval.

In the meantime, reforms are not being postponed; the majority of the Continental countries have already their wireless collective reports, and others will soon follow—special route reports for flying purposes are being exchanged, for example, between England, France, Belgium, and Holland. Meteorologists are thankful for the stimulus which aerial navigation has given to their weather services; they admire the desire for organisation and centralisation apparent in the convention; but they cannot overlook the fact that meteorology has other important applications. Theoretically it might be argued that these may look after themselves; practically it is impossible to maintain an independent system of information, say for agricultural purposes. In following up the historical line, the Comité International will try to serve *all* purposes equally well.

E. VAN EVERDINGEN.

Child Physiology.

The Principles of Ante-Natal and Post-Natal Child Physiology: Pure and Applied. By W. M. Feldman. Pp. xxvii+694+6 plates. (London: Longmans, Green, and Co., 1920.) Price 30*s.* net.

DR. FELDMAN'S work is a notable addition to the books which deal with physiology. As in them, so in this volume, the reader is impressed by the great change which the past decade has wrought in the content of physiological science, and especially in the predominance of physics, of mathematics, and of chemistry which is so noticeable. Here and there one comes upon pages occupied almost entirely with mathematical formulæ. Dr. Feldman's book has all these characters; but it has also another feature, which is novel: it brings to the study of the physiology of the child (up to puberty) a consideration of the conditions of life which exist before birth, and an evaluation of the effect which the process of birth itself has upon these conditions. It has in this respect and for this reason what one might term a fructifying novelty. It sweeps into the scope of child physiology not only the vital processes of fœtal life, which differ merely in details from those which prevail after birth, but also those of embryonic life, which are so manifestly unlike physiology that we commonly call them "embryology," as if they were something apart; and it travels still further back towards the origins of

things and brings in the physiology of the germ or heredity, which it requires an effort of the mind to associate with physiology at all. With so novel an outlook and so enlarged a sphere, it is impossible that everything should be exact and beyond argument; much must remain for a time uncertain, and theories will abound, and do abound, within the cover of this book. For example, the statement that the normal new-born infant is in a condition resembling acidosis is not by any means secure against attack, as a research by Sehom, made so recently as 1919, shows.

Dr. Feldman does not claim to carry over into pathology the ideas which this widened outlook of physiology suggests, and yet indirectly disease and the abnormal are recognised as lying just below the horizon in almost every part. Thus the peculiarities of the fœtal circulation underlie every statement which one can make regarding congenital heart disease. And the converse is also true, for the fact that the fœtal heart beats before and even at birth in a fœtus possessing neither brain nor spinal cord throws light upon the physiology of cardiac action before birth, and suggests that its rhythm is myogenic, and not neurogenic, in origin. Interesting notions spring up on every page, and the reader can scarcely escape the stimulation to think out for himself their application to all sorts of phenomena. One is well accustomed to apply physiology to the clarification of the diseases of adult tissues and organs; but a certain degree of novelty attaches to the effort to look at the pathological occurrences in the new-born infant in the light supplied by the special conditions of ante-natal physiology. For example, the umbilicus is, so to say, the "one portal" by which all things (food supplies, oxygen for respiration, and the germs of disease and toxic substances) reach the unborn infant—it lives through its umbilicus, and it may die by its umbilicus—and after birth, whilst it is no longer nourished by the navel, it may yet for a time be infected through it, as in cases of septic mischief round the root of the cord stump. Most text-books speak with an uncertain sound regarding the diseases peculiar to the new-born infant—the neonatal maladies, as they are called; it will ere long be found that much which is inexplicable in their characters and causation is made plain by the study of ante-natal physiology as it is affected by the impact of birth-traumatism.

The book is abundantly illustrated and admirably arranged, and the author is particularly happy in his choice of the quotations with which he ushers in each chapter. For instance, what a range of thought along novel lines is brought before the reader's mind by Samuel Butler's paradoxical truth with which the work begins: "Birth . . . is commonly considered as the point at which we begin to live. More truly it is the point at which we leave off knowing how to live." One is tempted to turn away from the thought as, in a sense, mental somersaulting; but if one resists this inclination and looks fairly and wholly at it, one sees that Nature's ante-natal provision for the weil-being of the unborn child is as near perfection as can be imagined. The fœtus, so to say, knows how to live. Birth comes as the jolt due to the changing of the gearing, and it is some time before the new-born infant, with all the aid that doctor, nurse, and mother can give him, can be said to be in harmony with his environment.

We should like to follow out other lines of thought suggested by this volume, such as His's dictum: "The ultimate aim of embryology is the mathematical derivation of the adult from the distribution of growth in the germ"; but enough has been said to send the interested reader to the book itself, where he will find fertile fields for the intellect to water and in due season to reap.

J. W. B.

Forest Research.

The Fungal Diseases of the Common Larch. By W. E. Hiley. Pp. xi+204. (Oxford: At the Clarendon Press, 1919.) Price 12*s.* 6*d.* net.

THIS volume is the most important contribution to the scientific literature of forestry that has been made for some years. Mr. Hiley was well advised to select the larch as the subject of his first investigation as Research Officer in the School of Forestry in Oxford, for it is in many respects the most important species of tree that is cultivated in this country. Moreover, it is a tree the health of which has given much concern to foresters and others for many years past.

After an introductory chapter on the general relationships of host and parasite, and on the morphology of the larch, Mr. Hiley proceeds to deal with the larch disease, or larch canker in the specific sense of the term. This is due to the attack of a Discomycetous fungus, which is usually known in this country under the name of *Dasyscypha calycina*. The author does well to remind us that M. J. Berkeley was the first to recognise the fungal character of this disease, although the work of Willkomm and of Robert Hartig is more frequently cited. Hartig, followed by Massee, believed that infection could take place only through a wound, and it must be said that there is much observational and experimental evi-

dence in support of this contention. Probably the most interesting section of Mr. Hiley's volume is that in which he supports and elaborates the view that in the great majority of cases the stem of a larch is infected by the mycelium of *D. calycina* which is living saprophytically on the dead branches. This theory is not new, but it has never before been subjected to so critical an examination. It is a matter of common observation that a branch springs from the centre of a canker, and it had generally been assumed that death of the branch followed invasion of the stem. But Mr. Hiley now produces evidence which seems to prove beyond reasonable doubt that the branch has always died before the canker has originated, and, in fact, that the dead branch, serving as food for the fungus living saprophytically, has been the vehicle of infection. Such infection always takes place between the end of one growing season and the beginning of the next, consequently the last wood ring in the centre of a canker spot on a stem is always completely formed.

Another parasite of the larch which receives exhaustive treatment in the volume is *Fomes annosus,* the common cause of heart-rot. Unlike *D. calycina,* it is equally common on other conifers, and in the aggregate does a great deal of damage. The same may be said about *Armillaria mellea,* perhaps the most destructive single fungus species with which the forester has to contend.

The more important leaf and seedling parasites are also reviewed, the volume finishing with an interesting general summary and with a useful bibliography. More than seventy illustrations add greatly to the value of the treatise, which is indispensable alike to the mycologist and the forester.

The Absorption of Light by Organic Compounds.

Etudes de Photochimie. By Dr. Victor Henri. Pp. vii+218. (Paris: Gauthier-Villars et Cie, 1919.)

THIS monograph is the first instalment of a series in which are to be presented the results of several years of work of the author and his collaborators. From 1908 to the outbreak of war Dr. Henri devoted his attention to the experimental study of various chemical aspects of the interaction between radiation and matter, dealing chiefly with the absorption of light in the infra-red and ultra-violet regions, with dispersion in the ultra-violet, with chemical reactions brought about by light, and with certain technical and biological aspects of the subject. In 1915 he went to Russia to help in scientific work in connection with the war, and towards the end of 1917 began to work up the mass of data accumulated in preceding years. Very few of his results had been published separately—papers by Bielecki, Boll, and Wurmser will, however, be familiar to workers in this field.

The present volume essentially contains the results of the author's work on absorption and dispersion, and is of considerable interest. Employing a photographic method, carefully checked, and using a powerful source of ultra-violet light, worked out by himself and giving a continuous spectrum, he was able to measure *quantitatively* the exact form of the absorption curve in the ultra-violet for about 240 organic compounds. As he points out, this represents a very considerable advance, previous work being confined to the mere investigation of the positions of the bands. To these measurements are added a series of determinations of dispersion in the ultra-violet, employing a specially designed apparatus, and a number of absorption measurements in the infra-red. The application of formulæ developed by Helmholtz and Ketteler, Drude, Lorentz, etc., has enabled him to draw conclusions as to the nature of the oscillators responsible for the absorption of light of different wave-lengths, the damping (usually very great) to which such oscillators are subjected, etc.

The more important results are as follows: (*a*) The oscillators absorbing in the infra-red are of molecular size, are atoms or fractions of atoms in the mean ultra-violet, and electrons in the extreme ultra-violet. (*b*) These different oscillator systems are closely bound up with one another, and there exist simple numerical relations between the infra-red frequency due to a chromophore and the ultra-violet frequencies in molecules containing such a chromophore. This, of course, was previously discovered by Baly, to whose work adequate reference is not made by the author. (*c*) By the application of simple rules, the absorption spectrum of a compound can be calculated with considerable accuracy from its constitution and the characteristic infra-red frequencies of the chromophores, two simple constants for each infra-red absorption band being necessary. (*d*) The structure of a molecule is essentially *mobile*. The existence of ultra-violet absorption bands is an index of a labile and reactive state. This, again, is in agreement with Baly's views.

Other more speculative conclusions are perhaps less justified. The experimental work appears to be of a high order, and the other volumes promised will be looked for with interest.

Our Bookshelf.

Bibliography of Industrial Efficiency and Factory Management. (Books, Magazine Articles, etc.) With many Annotations and Indexes of Authors and of Subjects. By H. G. T. Cannons. (Efficiency Books.) Pp. viii+167. (London: George Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., 1920.) Price 10*s.* 6*d.* net.

CAN this country pay the interest on the money borrowed during the war without reducing large sections of the community to poverty? The answer to this question appears to be that only by increasing the annual production by at least as much as corresponds to the necessary increase in taxation can we provide enough for everybody. Industrial efficiency is thus seen to be of vital importance. Employers and employed alike should therefore welcome any book which helps to improve methods of production. It will be generally agreed that our manufacturers have still much to learn in this direction.

Mr. Cannons is to be congratulated on having collected no fewer than 3500 references in this bibliography. It would appear that more attention has been given to the subject in the United States than in Great Britain. For example, in a list of thirty-two periodicals dealing more or less specifically with industrial efficiency and factory management, we notice that twenty-three are published in America.

The bibliography is divided into sixty-four subsections. The titles of a few of these will serve to indicate the scope of the book: "Academic study and teaching," "Principles of industrial efficiency," "Factory and workshop management," "Scientific management applied to special branches of industry," "Fatigue study," "Hours of labour," "Personal factor in scientific management," and "Safety methods."

We wish Mr. Cannons had done more to indicate which among the articles referred to are more likely to be worth careful study. Some help in this direction is, however, given in brief notes of the contents of many of the books and papers indexed.

Aliments Sucrés. Sucres—Miels—Sirops—Confitures—Sucreries—Sucs et Réglisse. Par Dr. E. Roux et Dr. C.-F. Muttelet. Pp. vi+474. Paris and Liége: Ch. Béranger, 1914. Price 12 francs.

THE manual of Drs. Roux and Muttelet on the analysis of foodstuffs of which sugar is an important constituent is naturally of somewhat restricted interest. The first part deals with the general optical and chemical methods of determining sugars and various other substances, such as dyes and antiseptics, used in confectionery. In the second part these methods are applied to the examination of commercial products such as honey, sugar, syrups, and preserves. The French laws and regulations dealing with the subject are given at some length together with extracts from those of other countries.

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.*]

British and Foreign Scientific Apparatus.

IT may, perhaps, be useful if I attempt to sum up the conclusions that seem to me to be justified from the somewhat divergent views that have been expressed by those who have written upon this question.

It is satisfactory to find that the makers are keenly desirous of meeting the requirements of the scientific worker. I think I am correct in saying that the majority of these prefer to obtain British rather than foreign goods, even at a somewhat higher price, provided that the quality is sufficiently good. It is here that the difficulty shows itself. It is significant that most of the makers who have written on the matter belong to the optical industry, and it is in this case that the state of affairs appears to be the least to be complained about, except, perhaps, in the smaller accessory apparatus, such as the object-marker referred to by Mr. Dunkerly (NATURE, June 3, p. 425). It is chiefly with regard to glass, porcelain, and chemicals that experience has been unfortunate. There has undoubtedly been improvement, but the impression given is that the makers as a whole have not altogether grasped the necessity of putting some of their best men to the work, and that there has been some carelessness in sending out goods of inferior quality. I have been told of flasks the necks of which drop off on the draining rack. It is natural that the users should be critical, especially when a large expense in time and money may be incurred by the breakage of a beaker in the final stage of a process.

The exhibitions arranged by the British Science Guild in 1918 and 1919 showed that excellent apparatus can be produced, and the difficulty is presumably in the main a matter of price. Glass and porcelain of quite satisfactory quality are being made in this country, and due credit should be given to the makers. The Worcester porcelain works, for example, supply excellent crucibles. At the same time, consumers meet with the experience that a large order cannot be relied upon to be of uniform quality. It is unfortunate, though perhaps unavoidable, that unsatisfactory apparatus was put on the market in the early stages of the supply of British glass, and it was to enable a greater perfection to be attained that I made the suggestion of a subvention (NATURE, May 6, p. 293). It is to be remembered that this is being done through the research associations of the Department of Scientific and Industrial Research, and it is in the direction of more scientific investigations that progress is to be looked for. In this connection, I may direct attention to the statement in the leading article of NATURE for June 24 that the profit of some three or four German dye-making firms in 1919 was more than 3,000,000*l.*, as compared with only 172,000*l.* by the British Dyestuffs Corporation.

The manufacturers want prohibition of import of foreign apparatus, at all events for a time, with the granting of special licences to import. I think it will be generally agreed that this would not meet the case, owing to the difficulty and delay that would necessarily be involved. They do not wish for a tariff, and the only alternative seems to be a grant in some form. When British goods have attained the neces-

sary quality and are then put on the market, it appears that there will not be any great risk of foreign competition in the matter of price. Indeed, according to several correspondents, there is little to be feared at the present time. But opinions are not in agreement.

There should be no objection to "manufacturers' associations," provided that their object is to obtain the advantage of more economical methods of manufacture, as by uniformity of standards and large-scale production, rather than the maintenance of high prices.

The cost of all research work, whether paid for by Government grants or otherwise, is greatly increased by inferior apparatus. At the present prices of materials, a single biochemical preparation may cost 4*l*. or 5*l*. or more. This may be lost by breakage at the final stage. The question naturally arises whether economy would not be effected by allowing free import, even at the cost of subventions to British makers.

With reference to Mr. Watson Baker's statement (NATURE, June 24, p. 518) that there are 12,000 German binoculars in London, I confess that I had chiefly in mind the use of apparatus in teaching and research. The sale for general use certainly raises a difficulty. As to losses incurred by work done for Government Departments during the war, so far as my information goes payment for these did not err on the side of economy. Liability for excess-profit duty surely implies that the profit has been made.

The statement by Mr. C. Baker (NATURE, May 20, p. 356) that capitalists will not put money into the business raises another question. It may well be that British makers do not find it profitable to undertake the supply of fine chemicals and special apparatus used only in small amount, even apart from foreign competition. If so, why not give up the trade to those who make a profit on the sale?

The desire of the British industry for prohibition of import appears to rest chiefly on the fear of competition by Germany. I am not one of those who imagine that because an instrument is of German origin it is necessarily superior to all others. Indeed, I have heard of instruments verified at Charlottenburg being found inaccurate. It would certainly be less obstructive than total prohibition if the restriction applied to German goods only. But there are other considerations to be remembered here, such as the importance of giving an opportunity to that country to restore its credit. However this may be, the large profits of their chemical industries referred to above raise some doubt as to the real cause of the present unsatisfactory conditions in Germany.

The point raised by Mr. Dunkerly that American microscopes and lenses are being sold here, although the rate of exchange is against us, suggests that the source of the trouble is not the low value of the German mark. This view is confirmed by other correspondents. If it is correct, there would be no real gain in a mere prohibition of import. Improvements in modes of manufacture are needed, and we come back again to the necessity for more scientific research.

I note that the British Optical Instrument Manufacturers' Association (NATURE, May 20, p. 355) considers that a tariff might have the result of removing the inducement to improve quality, but I foresee so many difficulties in the way of convincing a Government official that a particular piece of apparatus could not be obtained in England that I am unable to accept the suggestion of import by permit as a satisfactory alternative. If, however, it were possible for every scientific worker to obtain without difficulty a general permit for the import of any apparatus at any time the situation would be different.

There seems to be much doubt as to whether it is really possible to obtain foreign apparatus at a price much lower than the British. Should this be the case, the payment of a subsidy might be considered where there is actual underselling. The test would then become one of quality.

The importance of the subject may, I think, serve as an excuse for this lengthy letter. Scientific workers have every desire to assist the development of the industry, but they feel that they are not justified in wasting time and money where it could be avoided. And if this correspondence has brought out the fact that satisfaction has not yet been given in the matter of quality, especially in the case of certain goods, it will have been of some value. It is possible that users have not sufficiently made known their difficulties to the makers, and have been sometimes content with the purchase of foreign material when further inquiry and discussion might have enabled British goods to be forthcoming.

W. M. BAYLISS.

University College, London.

The Separation of the Isotopes of Chlorine.

MR. D. L. CHAPMAN'S argument appears essentially to be similar to that already developed from a quite different point of view by Lindemann (*Phil. Mag.*, 1919, vol. xxxvii., p. 523; vol. xxxviii., p. 173), that because isotopes are (theoretically) separable by physical means, they must also be chemically separable according to thermo-dynamical reasoning. The fact that the particular mode of separation by semi-permeable membranes (assumption (3), NATURE, July 15, p. 611) is highly fanciful need not obscure the nature of the argument. Lindemann's conclusion that, though isotopes cannot be identical chemically, the difference may be reduced to an unmeasurable one of the second order of magnitude by suitable assumptions as to the "Nullpunktenergie," seems to indicate the more hopeful line of advance. The chemical non-separability of isotopes, of which there is an accumulated mass of experimental evidence, seems to call for consequent adjustments in thermo-dynamic theory rather than the reverse.

The following considerations may throw light on the matter. I have stated (NATURE, June 24, p. 516) that, on the assumption of the chemical identity of the isotopes, the distribution given by probability considerations of the two kinds of atoms among the three kinds of molecules is

$$Cl_2 : Cl'_2 : Cl.Cl' : : n^2 : (1-n)^2 : 2n(1-n) \quad . \quad \text{(i)}$$

where n and $(1-n)$ are the fractional proportions of the Cl and Cl′ atoms respectively. This leads to the equilibrium condition

$$[Cl_2][Cl'_2] = \tfrac{1}{4}[Cl.Cl']^2 \quad . \quad . \quad . \quad . \quad \text{(ii)}$$

Now if one applies in the conventional manner this result to the reversible reaction

$$Cl_2 + Cl'_2 \rightleftharpoons 2Cl.Cl',$$

denoting by k_1 and k_2 the coefficients of velocity of the direct and the inverse reactions, one gets

$$k_1 n^2 (1-n)^2 = k_2 \{2n(1-n)\}^2$$

or

$$k_1 = 4k_2.$$

This, to say the least, is unexpected, because if coefficients of velocity of reaction have any physical significance at all, one would expect them to be the same for substances assumed to be chemically identical. The result is clearly due to a loose method of

choosing the concentrations, for if we re-write the reversible reaction

$$Cl_2+Cl'_2 \rightleftharpoons Cl.Cl'+Cl.Cl'$$

it transpires that we have chosen for the concentration of the resultants, because they are the same, the sum of their individual concentrations, although for the reactants, which also are chemically the same, the individual concentrations have been taken. It is clear that it is the individual concentrations in both cases that have to be taken, and therefore that one-half of the Cl.Cl′ concentration is involved. Then $k_1=k_2$. So with any reaction of this type involving two molecules, apart from the question of isotopes altogether, the 4 that always appears in the conventional text-book examples is merely a consequence of a loose and physically unjustifiable mode of representing the concentrations. Writers of future text-books might ponder a little over this. If the same change in the choice of the concentrations is made in the thermodynamical argument, the difference of entropies, $R \log_e 4$, reduces apparently to $R \log_e 1=0$.

I have now made some progress in the application of probability considerations to the kinetics of the reaction. The distribution already given (i) has reference merely to the manner in which the two kinds of atoms will arrange themselves among the three kinds of molecules, assuming promiscuous combination between the two kinds, the two kinds being identical. But the particular distribution obtained does, I find, depend upon the kind of recombination assumed. As regards the dissociation of the molecules into atoms prior to their recombination, the matter appears straightforward, at least so far as I have got. Thus whether one supposes that in a certain time a certain fraction of collisions, the same on the average for each kind of molecular collision, is fruitful in dissociating the two molecules into four atoms, or one regards the dissociation as monomolecular, as presumably it would be if light were the dissociating agent, one arrives at the same result, that if x, y, and z denote fractional proportions of Cl_2,Cl'_2 and Cl.Cl′ molecules respectively $(x+y+z=1)$, the relative rate of disappearance of each by dissociation is similarly denoted. By equating this rate of disappearance to the rate of formation for the three kinds of molecules, one gets the equilibrium distribution. The distribution given by (i) is got in this way, whether (1) all the atoms of the two kinds recombine promiscuously or (2) the four atoms formed in a single fruitful collision recombine again only among themselves. If a similar limitation be applied to a monomolecular dissociation, obviously the reaction cannot affect the distribution at all, which remains unchanged whatever the initial distribution. But I also found by inadvertently applying the law of promiscuous recombination separately to each of the nine cases that have to be taken into account on the collision view—since there are three types of molecules which may collide with any one of the three types—instead of to the sums of each of the two kinds of atoms produced, that a very extraordinary equilibrium distribution resulted, given by

$$Cl_2 : Cl'_2 : Cl.Cl' : : \tfrac{1}{3}n(1+2n) : \tfrac{1}{3}(3-2n)(1-n) : \tfrac{4}{3}n(1-n),$$

which leads to the curious concentration equation

$$[Cl_2][Cl'_2]=\tfrac{1}{4}\{[Cl.Cl']^2+[Cl.Cl']\}.$$

This in the case $n=0{\cdot}5$ happens to reduce to Mr. Chapman's relation (i) (NATURE, June 17, p. 487).

The case, of course, has no physical meaning, but it may serve to show that the equilibrium distribution is sensitive to the particular assumptions made as to the type of reaction which occurs. I do not imagine I have exhausted the physical possibilities, but, so far as I can see, my distribution relation (i) covers the physically conceivable cases, and therefore the half, not the whole, concentration of the substance undergoing a bimolecular reaction with itself ought to enter into the equilibrium equation.

FREDERICK SODDY.

Science in Medical Education.

THE discussion at the British Medical Association on July 1 on the place of preliminary science in the medical curriculum seemed to indicate practical unanimity on some points, such as the need for a higher minimum standard of general education, the raising of the minimum age for the registration of medical students to seventeen years, and the necessity for the maintenance of a high standard of instruction in physics, chemistry, and biology. There was no indication of the desire on the part of any one of the speakers to reduce the present standard of requirements in any one of these three fundamental sciences, and several suggestions were put forward for extending the courses of each of them into the later years of medical study.

Particularly welcome to many of the science teachers who were present were the remarks of Dr. Brackenbury, who insisted that a high standard of scientific education was just as necessary for the general practitioner as it is in the case of any specialist, and that consequently, in so far as the preliminary science courses are concerned, there should be no division of the courses into a higher and lower standard for different classes of medical students.

On the question of the relegation of the science courses to the school period of the student's education there were some minor points of difference of opinion, and there is need for further consideration of this matter and for the development of a common plan of action. If by raising the age of registration to seventeen years the school period is increased by an average of one year, there will be time for some school instruction in the fundamental sciences after the student has passed a matriculation examination without science, and there can be no doubt that if this time is profitably used, so that the student gains some knowledge of the elementary facts and principles of the sciences, the courses in the first year of study at the universities can be so modified in form as to bring home to the student much more forcibly than the courses do at present the relation of pure to applied science in medicine. The very prevalent idea that a great deal of time is wasted in the first year at the university in learning science that has no application to medicine arises entirely from the fact that the majority of the students come to the university so ignorant of elementary science and so untrained in scientific thought that the time of the university teachers is wasted in teaching the most elementary principles that could and should be taught at school. It seemed, however, to be the general opinion of those who were present at the meeting that the teaching of chemistry, physics, and biology should not cease at the end of the school period, but be extended into the first year of university study in a form which would be more general as regards principles, and more specialised as regards its application to the medical sciences. The suggestion made by Prof. Lorrain Smith and other speakers, that the teaching of science should be extended into the later years of the medical curriculum so that the links that bind the pure sciences to the medical sciences should be continuously presented to the medical student, does

not seem to me really practical unless the time required for a medical qualification is increased.

The time-table of the later years of medical study is already so overcrowded, there is such urgent demand for more time for pathology, for instruction and practice in the wards, for the study of special medical subjects, and for some course of instruction in psychology, that it is difficult to see how any more lectures on pure science subjects can be squeezed in. It seems to me that the special need of medical education at the present time is a carefully thought out scheme of post-graduate studies, in which the teachers of chemistry, physics, and biology would take part, in all the large medical schools of the country.

Manchester. SYDNEY J. HICKSON.

The Mechanics of the Glacial Anticyclone Illustrated by Experiment.

IN various publications issued during the past decade[1] the present writer has treated the peculiar air circulation which obtains above a continental glacier. A number of well-known writers, among them Sir John Murray and Buchan, had early pointed out that essentially anticyclonic conditions obtained over the Antarctic region as a region, but without reference to any connection with the continental glacier; while the late Admiral Peary was the first to note the dominance of centrifugal surface-currents over the Greenland continental glacier,[2] which important observation was the starting point of the writer's studies.

In all my writings upon the glacial anticyclone I have been at much pains to explain that the domed surface of the ice is essential to the development both of the anticyclone and of the alternating calms and blizzards which record its strophic action. In my "Characteristics of Existing Glaciers" it is stated (p. 149): "It is due to the peculiar shield-like form of this ice-mass that the heavier cooled bottom layer [of air] is able to slide off radially as would a film of oil from a model of similar form. The centrifugal nature of this motion tends to produce a vacuum above the central area of the ice-mass, and the air must be drawn down from the upper layers of the atmosphere in order to supply the void. It is here that is located the 'eye' of the anticyclone." Again (p. 266): "This anticyclonic circulation of the air is not determined in any sense by latitudes, but is the consequence of air refrigeration through contact with the elevated snow-ice dome, thus causing air to slide off in all directions along the steepest gradients."

In my monograph published in the Proceedings of the American Philosophical Society it is stated (p. 188): "It is because the inland-ice masses have a domed surface that they permit the air which is cooled by contact to flow outward centrifugally, and so develop at an ever-accelerating rate a vortex of exceptional strength."

It is, of course, fully realised that a domed surface is not the only one which theoretically might be conceived to produce such an anticyclone, but it is the only one of which we have examples in Nature bringing about such results. Any sort of pyramid would suffice; the essential thing is that the surface should have its convexity upwards rather than downwards. Either over a concave surface or about a flat one the refrigerating engine cannot operate.

With the view of demonstrating the relation of the air circulation above a continental glacier to the ice-dome, I have prepared some simple devices for experimentation. In the first experiment water was used as the fluid medium to represent air in an apparatus (Fig. 1) which consists of a glass tank 12 in. by 6 in. by 6 in., containing at the bottom a copper vessel of semi-elliptical cross-section to represent a portion of the domed surface of the glacier. This copper vessel may be filled from below and quite independent of the tank itself. When used for the experiment the tank itself is filled with distilled water at room-temperature, rendered slightly alkaline by addition of sodium hydroxide. Phenolphthalein is then sprinkled over the surface of the water in the tank. It soon develops a dark-red cloudiness which remains near the surface. When ice-water is introduced into the copper dome the adjacent layer of water is cooled by contact and slides off to either side, thus drawing down the coloured water from the surface so as to simulate the vortex and the outflow of a glacial anticyclone. If Victoria green is used to replace phenolphthalein as a dye, its crystals must be supported by a container having a bottom of fine-meshed screen, but in this case ordinary tap-water may be employed, since it is not necessary to render the water alkaline.

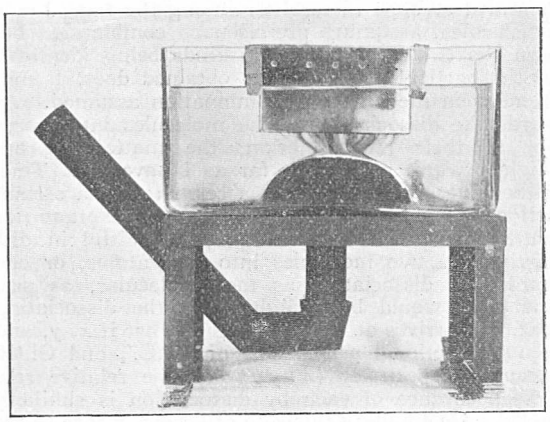


FIG. 1.—A glacial anticyclone simulated in water currents (with use of Victoria green as a colouring dye).

A similar experiment may be carried out using air as the circulating medium and smoke as the visible substance which betrays the currents. It is, however, less suited to photographic representation of the circulation, and the device only is therefore represented in Fig. 2. The device consists of a glass jar open at the top, such as is in common use for goldfish; within this jar is a metal dome to represent the domed surface of the glacier. This dome when filled with ice-water at once develops strong anticyclonic circulation of the air in the jar, and the circulation can be made visible if a burning cigarette is supported on a platform near the top of the jar and near its central axis. The jar is covered by a metal plate, the central portion of which is separate and attached to the funnel through which the ice-water is admitted to the dome and on the stem of which is the platform that supports the cigarette. The funnel may almost equally well be dispensed with, and the dome, already filled with ice-water, introduced into the jar with the hand.

[1] "The Ice Masses on and about the Antarctic Continent," *Zeitsch. f. Gletscherk.*, vol. v., 1910, pp. 107–20. "Characteristics of the Inland-ice of the Arctic Regions," Proc. Am. Philos. Soc., vol. xlix., 1910, pp. 96–109. "Characteristics of Existing Glaciers" (Macmillan, 1911), chaps. ix. and xvi. and Afterword. "The Pleistocene Glaciation of North America Viewed in the Light of our Knowledge of Existing Continental Glaciers," Bull. Am. Geogr. Soc., vol. xliii., 1911, pp. 641–59. "Earth Features and their Meaning" (Macmillan, 1912), pp. 283–86. "The Ferrel Doctrine of Polar Calms and its Disproof in Recent Observations," Proc. Second Pan-American Scientific Congress. vol. ii., Sec. II., Washington, 1917, pp. 179–89.

[2] *Geographical Journal*, vol. xi., 1898, pp. 233–34.

We are here dealing with the constrained motions of falling bodies corresponding to those sliding on inclined planes all joined at their highest points. Such sliding motions are subject to the acceleration of gravity, and hence are slow in starting, but later attain high velocities. Since the falling body is air which is displacing warmer, and hence lighter, air-layers, in the case of the glacier its motions are further modified as a result of adiabatic changes, and, since large quantities of moisture are involved, by important transformations of sensible and latent heat. The source of this moisture is believed to be largely the ice-needles of the cirri.

The tendency to produce centrifugal surface-air circulation above the glacier (anticyclonic movement) is promoted by quiet conditions of the atmosphere, since the measure of contact cooling of the surface layer of air over the ice is a direct function of time. The halting of this circulation or the induction of any reverse centripetal movement of the surface air (cyclonic movement) is an inverse function of the time, since it is a direct function of the *distance* the air currents descend vertically during their outward

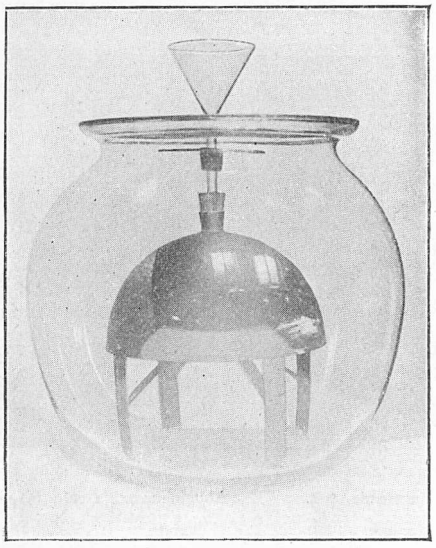


FIG. 2.—Device used to produce anticyclonic circulation in air above a cold dome.

movement. Each of these movements is, however, modified by the transformations of sensible and latent heats of fusion and evaporation of the water brought in in the form of the ice-needles of the cirri.

The beginning of the glacial blizzard, slow by reason of the flattish surface of the ice dome and the acceleration of gravity, is also retarded by the necessity of fusing and vaporising the ice-needles high up in the vortex of the forming anticyclone, which causes *abstraction* of heat and local displacements of air; whereas heat is *evolved* near the end of the blizzard, when fresh snow is precipitated near the glacier surface. Both these transformations of sensible and latent heat will operate so as to add their effect rather than to counteract that due to cooling or to adiabatic effect. They thus tend to cause blizzards to develop gradually and to end suddenly. The halt—the end of the stroke of the refrigerating glacial engine—comes about as soon as the rapid descent of the air carried out by the blizzard has, through its adiabatic effect, quite overcome the surface cooling due largely to the earlier calm. The length of the blizzard, if it precipitates fresh snow, should therefore be adjusted in a measure to the expanse of the glacier surface over which the currents of air must slide before gaining the two miles of descent on the dome, in addition to that which takes place in the "eye" of the anticyclone.

WM. H. HOBBS.

Ann Arbor, Michigan, U.S.A., June 17.

The Diamagnetism of Hydrogen.

THE fact quoted by Dr. Oxley in his letter to NATURE of July 8, that the diamagnetism of hydrogen becomes less as the temperature is raised, seems to be in favour of a kinetic hypothesis of the diamagnetism of that gas rather than against it.

If a magnet starting from rest is made to oscillate it remains paramagnetic until the oscillations on either side of the position of rest become 130°, after which it behaves as a diamagnetic body, the diamagnetism increasing until rotations begin. But once in rotation the diamagnetism *diminishes* as the rotational energy increases; and when this energy is very great the magnet is nearly indifferent to a magnetic field, and it appears to be non-magnetic. If it is allowable to treat temperature as a measure of this energy, then this result means that the diamagnetism should become less as the temperature is raised, and this is what has been observed.

Since the paramagnetism of a rotating magnet is found only for oscillations of less than 130°, the kinetic energy must be comparatively small, and in the case of hydrogen a change from diamagnetism to paramagnetism can be expected to take place only when the temperature is very near to the absolute zero.

Apart from the kinetic hypothesis, the fact that there is any change at all of the diamagnetism of hydrogen with temperature is opposed to the accepted view which regards true diamagnetism as independent of temperature.

J. R. ASHWORTH.

July 14.

Occurrence of Ozone in the Atmosphere.

WITH reference to the lecture of Lord Rayleigh published in NATURE of July 8 on "The Blue Sky and the Optical Properties of Air," the conflicting results obtained by chemical methods in the estimation of atmospheric ozone are recalled. I beg to direct attention to my paper on "The Occurrence of Ozone in the Upper Atmosphere" (Proc. Roy. Soc., 1914, A, vol. xc., p. 204), in which it is shown that a reagent of potassium iodide solution can be made to provide a basis for the distinction of ozone and oxides of nitrogen at high dilutions and enable the approximate estimation of the former. By this method it is shown that, in accordance with the conclusions of Lord Rayleigh, ozone is present in the upper atmosphere, the amount present at an altitude of 10,000 ft. being *of the order of* 5×10^{-6} parts per unit volume. Measurements made with sounding-balloons up to altitudes of 20 km. also showed the presence of definite amounts of ozone, but no detectable increase between 4 km. and 20 km. The view was put forward that this amount of ozone must be taken into account in considering the optical properties of the sky.

An extension of these measurements was made with greater precision at the Mosso Laboratory on Monte Rosa at an altitude of 15,000 ft., where an average proportion of about 1×10^{-6} parts per volume of ozone was found.

J. N. PRING.

The Victoria University of Manchester,
July 14.

Crystal Structure.[1]

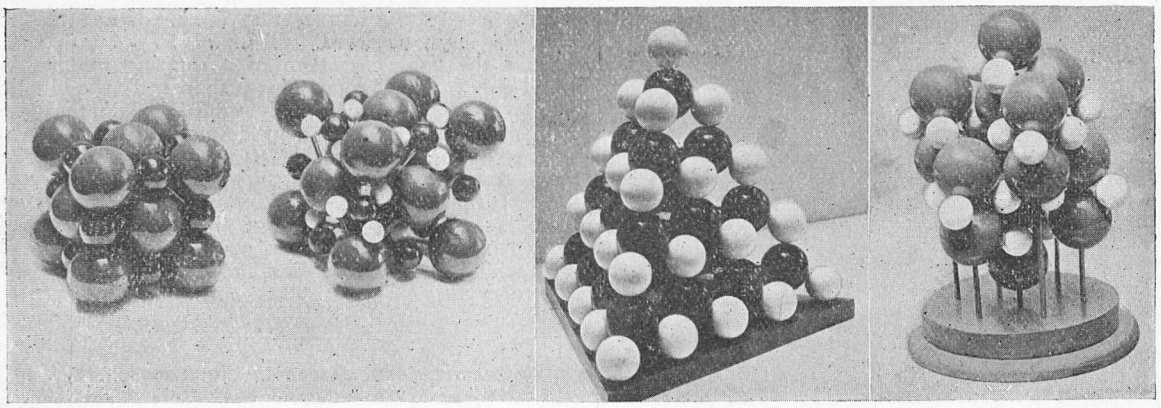
By PROF. W. L. BRAGG.

THE arrangement of the atoms in many of the simpler crystalline forms has now been determined by X-ray analysis. In 1912 Laue published his classical research on the diffraction of X-rays by crystals, and the investigations thus initiated have immensely increased our knowledge of the nature of X-rays, of crystal structure, and of the structure of the atom. Several methods of analysing crystal structure have been used. Laue passed a composite beam of X-rays, consisting of radiations of all wave-lengths over a continuous range, through a thin plate of crystal, and he recorded the diffracted beams by allowing them to fall on a photographic plate. The results he obtained were too complex to admit of ready interpretation, and a simpler method was realised in the X-ray spectrometer devised by W. H. Bragg, in which monochromatic X-rays are reflected from individual crystal faces. In the course of a series of experiments in which the author took part, the structures of a number of crystals such as rock-salt, the diamond, fluor, zincblende, pyrites, and calcite were determined. New fields were opened up by the method of analysis initiated by Debye and Scherrer, in which a beam of monochromatic X-rays is passed through a mass of finely powdered crystalline material, and the resulting "haloes" recorded photographically. Hull has extended this work to a number of substances unobtainable as large single crystals such as must be used in the X-ray spectrometer. By these methods a wide range of crystal forms has been surveyed.

Some crystalline structures possess symmetry of a high order, examples being potassium chloride and zincblende, models of which are shown in Fig. 1. In such cases as these every atom occupies a symmetrical position in the crystal structure. In potassium chloride each potassium atom is symmetrically surrounded by six chlorine atoms, each chlorine atom by six potassium atoms. The atoms cannot be displaced from their positions without destroying the symmetry of the crystal structure; they are therefore fixed by symmetry alone. Such a crystal is analysed very simply. We have only to choose between various alternative arrangements, each quite determinate, in seeking an explanation of the observed diffraction effects.

When the symmetry does not fix the exact positions of the atoms, the analysis is more difficult. In such cases atoms may occupy any position along some axis or in some plane of the crystal structure, and yet be in accord with the symmetry provided the other atoms of the same kind are given corresponding positions. In the structure of the ruby, Al_2O_3 (Fig. 1), the unit of which the structure is composed consists of a pair of aluminium atoms surrounded symmetrically by three oxygen atoms. The distance apart of the aluminium atoms along the axis joining their centres, and the distance of the oxygen atom from this axis, are both indeterminate in so far as the crystalline symmetry is concerned, and their exact values must be deduced by the X-ray analysis. It is these indeterminate parameters which make a crystalline structure complex.

The problem is simplified by regarding the atoms in a crystal as a set of spheres packed tightly together. This manner of regarding the structure was proposed in 1907 by Barlow and Pope, who assigned to the sphere representing an atom a volume proportional to its valency, and by packing these spheres together as closely as possible they obtained structures which accounted for crystal forms. We now know the structure of the crystals dealt with by Barlow and Pope,



Potassium chloride, KCl. Calcium carbonate, calcite, $CaCO_3$. Zinc sulphide, zincblende, ZnS. Aluminium oxide, ruby, Al_2O_3.

FIG. 1

[1] Discourse delivered at the Royal Institution on Friday, May 28.

and we know that it is in many cases not that predicted by the "valency volume" law. The law can be modified, however, so as to apply to the majority of crystals so far analysed. It may be shown that we can assign a definite diameter to the sphere representing the atom, a diameter characteristic of the element in question. Some atoms appear to occupy a small domain in a crystal structure, others a larger space. By finding the distances between the atomic centres in a number of crystals the diameters represented in Fig. 2 have been calculated. This figure summarises an empirical relation, which states that the distance between neighbouring atomic centres in a crystal structure is equal to the sum of two constants, characteristic of the atoms concerned. We can therefore picture the crystal structure as a set of spheres packed tightly together, just as Barlow and Pope did; but in this case the dimensions of the spheres are those in Fig. 2, not those given by the valency volume law.

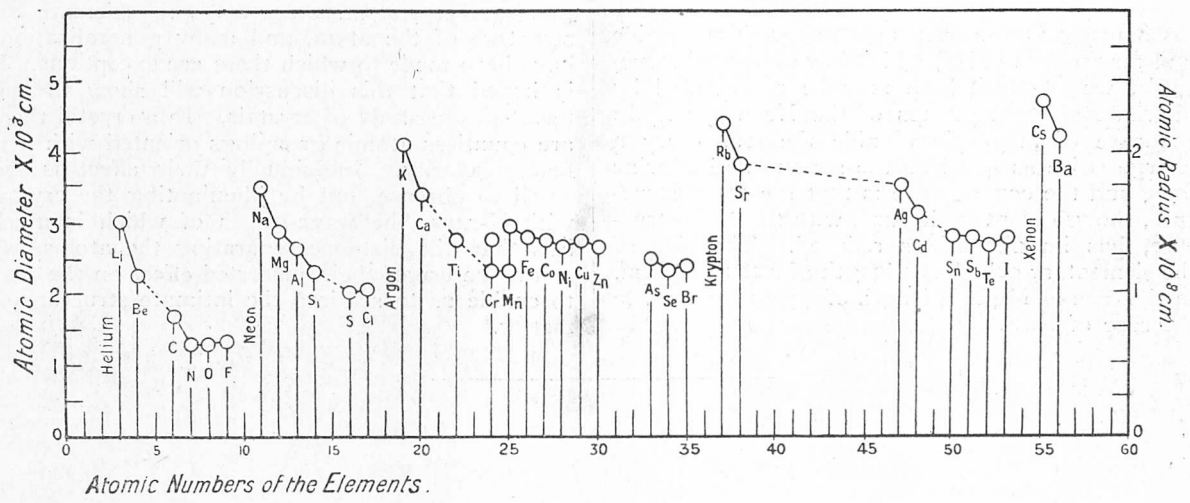


FIG. 2.

The atoms in a crystal are thus packed together as if they were inelastic spheres in contact. This is merely a way of visualising the structure, and must not be interpreted too literally. A ready explanation of the form of the graph in Fig. 2 is afforded by that conception of atomic structure which Stark, Born, Landé, Lewis, and others have helped to build up, and which has recently been so brilliantly summarised in a series of papers by Langmuir. Many independent lines of investigation have led to the conception of the atom as a positive nucleus surrounded by an electron system, in which the electrons are fixed at, or oscillate about, certain definite positions in the atomic structure. This is a view which forms a contrast to the Bohr atomic model, where the electron orbits enclose the atomic nucleus. In the "fixed electron" atom the electrons are arranged in a series of shells surrounding the nucleus, the numbers which complete the successive shells being 2, 8, 8, 18, 18, and 32. Certain arrangements, those of the inert gases, are those in which the outer shell has its full complement of electrons. Such forms are very stable; they are characterised by a weak external field. The chemical properties of the other elements represent their tendency to revert to a more stable electron system.

The crystal of potassium chloride, on this point of view, consists of alternate potassium and chlorine ions. The potassium atom is surrounded by nineteen electrons when electrically neutral. Eighteen of these electrons complete the three electron shells, represented, for instance, by the very stable arrangement of argon. The remaining electron has no place in the stable system, and there is therefore a tendency for the atom to part with it and become a positively charged potassium ion, the nucleus with nineteen elementary charges being surrounded by eighteen electrons. Chlorine similarly tends to gain an electron. The KCl structure may therefore be regarded as an assemblage of argon shells, with resultant positive and negative charges, which are held together by their charges, and kept apart by some force of repulsion which we must suppose to exist between the outer electron systems. The result is the structure in Fig. 1 where every ion is surrounded symmetrically by the greatest possible number—six—of ions of the opposite sign.

In the case of two electro-negative elements which are chemically combined, both atoms have a smaller number of electrons than corresponds to stability of the outer shell. Stability is attained by their holding pairs of electrons in common. In this way Langmuir has succeeded in the most striking manner in explaining the complicated valency of such elements as nitrogen and phosphorus.

The structure of calcite (Fig. 1) is an example of both types of chemical combination. The calcium atom, represented by the large sphere, is

an ion with a double positive charge, the CO_3 group an ion with a double negative charge. These ions group themselves in the same way in the calcite and potassium chloride structures, as the models show, except that the form of the CO_3 group distorts the cube into a rhombohedron. The electro-negative atoms of carbon and oxygen hold electrons in common, and form a closely knitted group, and from their distance apart we can form an estimate of the dimensions of the outer electron shell; it is the lower limit to which the diameters tend at the end of each period in Fig. 2.

In this an explanation is found of the large diameters assigned to the electro-positive elements, and the small diameters assigned to the electro-negative elements, in Fig. 2. The electro-positive atoms never share electrons with their neighbours; they are therefore isolated in the crystal structure, and appear to occupy a large domain. The electro-negative elements, bound together by common electrons, have to be represented by small spheres.

Comparing two crystals such as sodium fluoride and magnesium oxide, which have identical structures, we see that both may be represented by alternate electron groups of the Neon type. In the case of magnesium oxide the ions carry a charge twice as great as the sodium and fluorine ions, and the consequence is that the MgO structure, though identical in form with the NaF structure, has its dimensions reduced. The side of the elementary cube has a length of 4.22×10^{-8} cm. in the case of MgO, a length of 4.78×10^{-8} cm. in the case of NaF.

In diamond every carbon atom is surrounded symmetrically by four other carbon atoms arranged at the corners of a tetrahedron. The carbon atom has four electrons in its outer shell, and, in order to complete the number eight required for stability, it shares a pair of electrons with each neighbouring atom. The whole crystal is thus one continuous molecule, and the great hardness and density receive a simple explanation.

A crystal of an electro-positive element cannot be bound together by common electrons. Here we must suppose that the crystal consists of ions and electrons, the ions representing the stable electron systems, and the electrons being present in sufficient numbers to make the whole assemblage electrically neutral. From the fact that all crystals of electro-positive elements are conductors of electricity we deduce that the electrons have no fixed place in the system; they move under the influence of an electromotive force.

It has been possible only to indicate the manner in which crystal structure helps to elucidate the structure of the atom, and many generalisations have been made to which there are exceptions. It is hoped that this discussion will show the interest of the study of crystals. In a crystal there are countless atomic groupings oriented with perfect regularity. Individually their effect is too small to observe, but by illuminating the crystal with X-rays, the wave-length of which is much less than the distance separating the atoms, we can make use of their concerted effect on the rays to enable us to see into the intimate structure of matter.

Researches on Growth of Plants.[1]

By SIR JAGADIS CHUNDER BOSE, F.R.S.

II.

The General Principle Determining Tropic Movements.

THE movements in plants under the stimuli of the environment—the twining of tendrils, the effect of temperature variation, the action of light inducing movements sometimes towards and at other times away from the stimulus, the diametrically opposite responses of the shoot and the root to the same stimulus of gravity, the night and day positions of organs of plants—present such diversities that it must have appeared hopeless to endeavour to discover any fundamental reaction applicable in all cases. It has, therefore, been customary to assume different sensibilities especially evolved for the advantage of the plant. But teleological argument and the use of descriptive phrases, like positive and negative tropism, offer no real explanation of the phenomena. I propose to describe experimental results from which it will be possible to discover an underlying law which determines the various tropic movements in plants.

Direct Effect of Stimulus.—In the motile pulvinus of Mimosa the excitation caused by stimulus causes a sudden diminution of turgor and contraction of the cells. With regard to this fall of turgor it is not definitely known whether excitation causes a sudden diminution in the osmotic strength of cell sap or increase in the permeability of the ectoplast. The state of excitation in a vegetable tissue may, however, be detected, as I have shown elsewhere, by the following indications: (1) diminution of turgor; (2) contraction and fall of leaf of Mimosa; (3) electromotive change of galvanometric negativity; (4) variation of electric resistance; and (5) retardation of the rate of growth.

Continuity of Physiological Reaction in Growing and Non-growing Organs.

In investigations on the effect of all modes of stimulation, mechanical, electrical, or radia-

[1] Continued from p. 617.

tional, I find that they check growth or bring about an "incipient" contraction; when the intensity of stimulus is increased, the effect culminates in an actual contraction—a result exactly parallel to the contraction of the pulvinus under direct stimulus. This would explain the similarity of tropic movements in pulvinated and growing organs.

Indirect Effect of Stimulus.—A novel result was discovered under indirect stimulation—that is to say, when the stimulus was applied at some distance from the responding area, *i.e.* the pulvinus or the growing region. This caused an increase of turgor, an expansion, an enhancement of the rate of growth, and an erectile movement of the leaf of Mimosa, and an electromotive variation of galvanometric positivity. This effect is specially exhibited in tissues which are semi-conductors of excitation.[2] The contrasted effects of direct and indirect stimulus are given in the following tabular statement:—

TABLE I.—*Direct and Indirect Effects of Stimulus.*

Direct	Indirect
Diminution of turgor, contraction.	Increase of turgor, expansion.
Fall of leaf of Mimosa.	Erection of the leaf.
Diminution of the rate of growth.	Enhancement of the rate of growth.
Galvanometric negativity.	Galvanometric positivity.

In Fig. 4 is given a record which shows in the same specimen (1) the acceleration of growth under indirect, and (2) a retardation of growth under direct, stimulation.

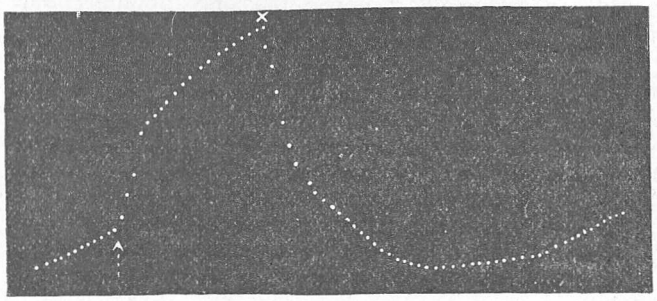


FIG. 4.—Effect of indirect and direct stimulation on growth: (↑) shows application of indirect stimulus with consequent acceleration of growth; application of direct stimulus at (×) induces contraction and subsequent retardation of growth.

We thus arrive at the law of effects of direct and indirect stimulus:—

Direct stimulus induces contraction; indirect stimulus causes the opposite effect of expansion.

The same law applies when stimulus acts on

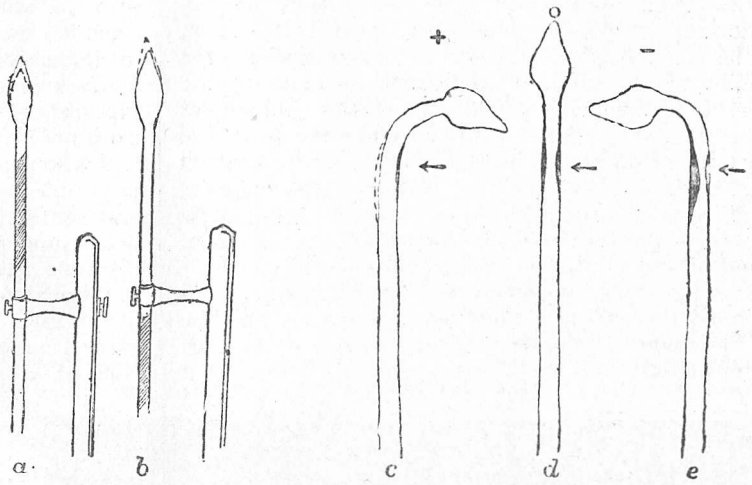


FIG. 5.—Effects of direct and indirect stimulus: *a*, Stimulus applied directly at the growing region inducing retardation of growth or contraction as represented by dotted line (stimulated area in this and in following represented as shaded); *b*, stimulus applied indirectly (at some distance from growing region) gives rise to acceleration of growth and expansion; *c*, stimulus applied at right side of organ causes contraction of that side and expansion of the opposite side, thus giving rise to positive curvature towards stimulus; *d*, excitation transmitted to the opposite side causes neutralisation; *e*, excitation caused by intense stimulation is transmitted across and thus reverses the normal curvature to negative, *i.e.* away from stimulus.

one side of the organ. When stimulus of any kind acts on the right side (Fig. 5*c*) the directly stimulated right side contracts, and the indirectly stimulated opposite, or left side, expands, the result being a *positive* tropic-curvature towards the stimulus. This explains the twining of tendrils and positive heliotropism.

Negative Heliotropism.—When the light is very strong and long continued, the over-excited plant-organs may begin to turn away. How is this effected? My experiments show that the strong excitation percolates into and traverses the organ and provokes contraction on the further side, thus neutralising their former bending (Fig. 5*d*). The organ now places itself at right angles to the light, and this particular reaction has been termed dia-heliotropism. In certain cases the transverse conductivity of the organ is considerable. The result of this is an enhanced excitation and contraction of the further side, while the contraction of the near side is reduced on account of fatigue caused by over-excitation. The organ thus bends away from light or exhibits so-called negative heliotropism (Fig. 5*e*). These effects are accentuated when one side of the organ is more excitable than the other. Thus under the continued action of light the response record shows first a movement towards light, then neutralisation, and finally a movement away from light. In this way a continuity of reaction is demonstrated proving that the assumption of specific positive and negative heliotropic sensibility is unjustified.

That the application of stimulus on the near

[2] "Plant Response," p. 524.

side of the organ induces at first an increase of turgor on the distal side and that this first effect may be neutralised and reversed by transverse conduction of excitation are seen strikingly exhibited in the accompanying record (Fig. 6), where a narrow beam of light was applied at a point of the stem diametrically opposite to the motile leaf which was to serve as the indicator of the induced variation of turgor under the unilateral action of light. That this indirect stimulation caused an enhancement of turgor of the opposite side was soon demonstrated by the erectile movement of the leaf. When the stimulus is moderate and of short duration, the response is only erectile or positive. But when the stimulation is continued the excitatory impulse is conducted to the distal side, giving rise to diminution of turgor, contraction, and the fall of the leaf.

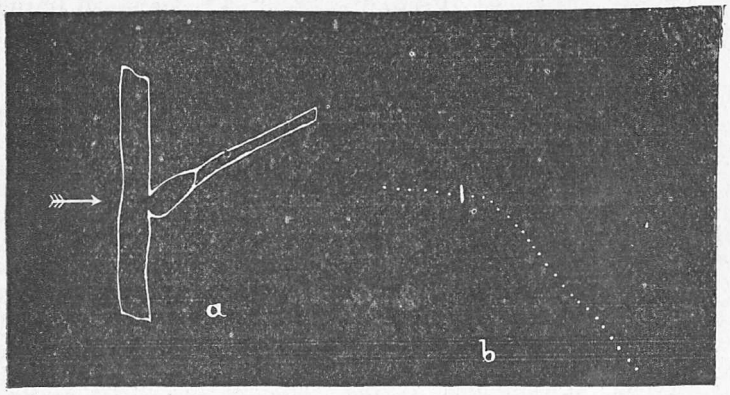


FIG. 6.—Increased turgor due to indirect stimulation inducing erection of Mimosa leaf: *a*, diagram of experiment; *b*, erectile response (shown by down-curve) followed by rapid fall (up-curve) due to transverse conduction of excitation.

TABLE II.—*Showing Responsive Effects Common to Pulvini and Growing Organs under Unilateral Stimulation.*

Effect of direct stimulation on proximal side	Effect of indirect stimulation on distal side
Diminution of turgor.	Increase of turgor.
Contraction and concavity.	Expansion and convexity.
Galvanometric negativity.	Galvanometric positivity.

When stimulus is strong or long-continued, the excitatory effect is conducted to the distal side, neutralising or reversing the first response.

Space does not allow my entering into the question of Nyctitropism, which will be found fully explained in the "Life Movements in Plants," vol. ii.

Geotropism.—No phenomenon of tropic response appears to be so inexplicable as the opposite effects of stimulus of gravity on the root and the shoot. As regards the mechanism of the upcurving of a horizontally laid shoot, it may be due either to the expansion of the lower side or to an active contraction of the other. In order to decide the question I devised the method of geo-electric response whereby the state of excitation (which is attended by contraction) is independently detected by the induced electromotive change of galvanometric negativity. Displacement of the shoot from the vertical to the horizontal position is found to be immediately followed by the clearest electric indication that the upper is the excited side. The electrical response is found to increase as the sine of the angle of inclination. This excitation of the upper side involves its contraction and the resulting geotropic curvature upwards.

Localisation of Geo-perceptive Layer by Means of the Electric Probe.—The new investigation was carried out by means of my electric probe, which consists of an exceedingly fine platinum wire enclosed in a capillary glass tube, the probe being thus electrically insulated except at the extreme tip. When the probe, suitably connected with a galvanometer, is slowly thrust into the stem, so that it enters one side and comes out at the other, the galvanometer deflection shows by its indication the state of irritation of every layer of cells throughout the organ. When the stem is held in a vertical position the probe during its passage shows little or no electric sign of irritation. But when the stem is displaced from the vertical to the horizontal position, the geotropically sensitive layer now perceives the stimulus and becomes the focus of irritation, and the probe on reaching this point gives the maximum deflection of galvanometric negativity. This electric indication of irritation disappears as soon as the geotropic stimulus is removed by restoration of the stem to a vertical position. I was thus able to map out the contour lines of physiological excitation inside a living organ. The geo-perceptive layer was thus localised at the endodermis.

In geotropic response the only anomaly that remained was in regard to the response of the root being opposite to that of the shoot. Every cut portion of the growing region of the shoot responds to the stimulus of gravity by bending upwards. The growing region of the shoot is therefore both sensitive to stimulus and responsive to it. *Hence geotropic stimulation of the shoot is direct.* But this is not the case with the root; here it is the tip of the root which perceives the stimulus, the geotropic bending taking place at some distance from the tip. From the results of electric investigation I find that the root tip becomes directly stimulated, while the responding growing region some distance from it becomes indirectly stimulated. *Hence geotropic stimulus acts indirectly in the responding region of the root.* I have shown that the effects of direct and indirect stimulus on growth are antithetic; it

therefore follows that the responses of shoot and root to the direct and indirect stimulus must be of opposite signs.

The diverse movements of plants are thus explained from the establishment of the general law that direct stimulus induces a contraction and indirect stimulus an expansion.

I have shown, further, the extraordinary similarity of physiological reaction in the plant and animal (Friday evening discourse, Royal Institution, May 29, 1914). The responsive phenomena in plants must thus form an integral part of various problems relating to irritability of all living tissues, and without such study the investigation must in future remain incomplete.

Popular Natural History.[1]

(1) THE best popularisers, after all, are the masters—if they care to try; and Fabre's "Story Book of Science" is a fine illustration. It is very perfect—full of interesting material, vividly written, stimulating both observation and reflection. He tells of ants, aphides, long-lived plants and animals, procession caterpillars, bees, spiders, shells, cotton, paper, silk, clouds, thunder, rain, the sea, and more besides—all as if it were a pleasure to him to talk, and just the very easiest thing in the world. The book must have been fashioned long ago, but so wisely that there is little that requires changing; it was meant for the children of more than a generation ago, and it would be a joy of a reading-book in schools to-day; it was written in French, and it reads as if it had been composed in English. The translator, Mr. A. T. De Mattos, has done his work with great skill. We confess that we should not call Hemerobius a dragon-fly, and there must be something wrong in speaking of the "sharp bones" in the silk-moth's cornea, which Fabre described as a rasper for filing at the silk threads of the cocoon. But these are pin-pricks; the book is past praising, and its pages are very pleasant to read—pleasant both to the inner and the outer eye. We should be having a Fabre centenary soon.

(2) A translation of Fabre's "Story Book of Birds and Beasts" is very welcome. The subjects are for the most part familiar, but the handling of them is masterly in its simplicity, grip, and vividness. Fabre had a way of taking the reader into his confidence, and making a sort of partner of him in his observations. But it is a game that only a big man can play with success. We are introduced to the cock and the hen, the egg and the chicken, the duck and the goose and the pigeon, the cat and the dog, the sheep and the cow, the horse and the donkey, and we get interested in them as if they were novelties. It is high art. The stories should be used in schools.

The book is not without blemishes, of which we venture to give some samples. We do not know what to call the first part of a hen's stomach, but we are sure that it cannot be called "the succenturiate ventricle." The story of the making of the shell of the egg is misleading, and it is not true to say that the hen *must* have carbonate of lime in her food. We are rather staggered by some humming-birds "as small as our large wasps." The account given of "pigeon's milk" is erroneous. It should have been noted that the passenger pigeon, in regard to which Audubon's account is quoted, has now ceased to exist. For the translator's work we have great admiration; but it might have shown wisdom as well as piety to have got an editorial expert to look into points such as we have illustrated. There is no sense in perpetuating mistakes.

(3) Dr. Francis Ward's book is in great part an attempt to take the point of view of the animal under water.

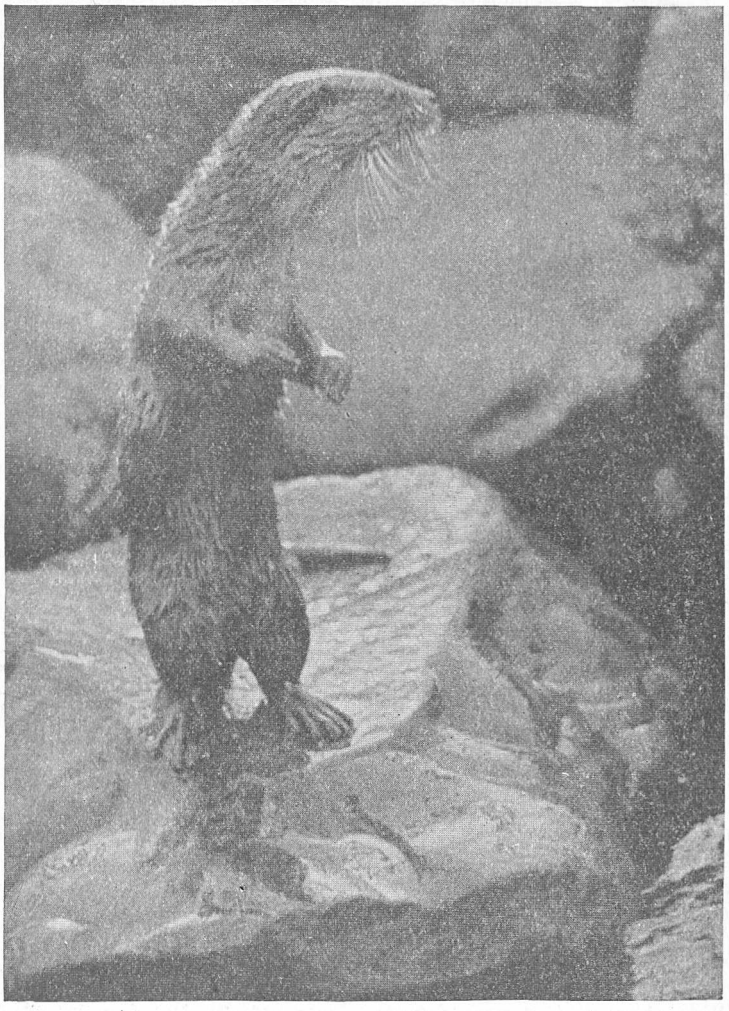
Seen from below, the surface of the water would appear as an extensive mirror, with the river-bed reflected upon it. Immediately above the observer the reflecting surface is broken by a circular hole or "window." Through the surface of the water, in the area of this "window," the sky and objects immediately overhead have their usual appearance, but in addition surrounding objects above the water level are also seen through the "window" as dwarfed and distorted images, suspended, as it were, in the air above the circumference of the circular hole. A ring of iridescent colours separates the "window" from the surrounding reflecting surface.

Many of Dr. Ward's observations have a direct bearing on the concealment of aquatic animals, and deserve careful attention from naturalists. Let us illustrate. The size of the "window" varies with the depth of the under-water observer; when birds and fishes on the surface slip out of the "window" they cease to be conspicuous (to their enemies below) as silhouettes against the sky. Protection under water may be afforded, as in the case of brown trout, by reflection of the surrounding coloration. White animals, such as a white sea-anemone, take up a position where the revealing top light is cut off. Black-plumaged birds, like the water-hen, become mirrors under the water owing to reflection from the air-bubbles retained in their plumage.

After explaining the sub-aquatic conditions as

[1] (1) "The Story Book of Science." By J. H. Fabre. Pp. 299. (London: Hodder and Stoughton, n.d.) Price 7*s*. 6*d*. net.
(2) "The Story Book of Birds and Beasts." By J. H. Fabre. Pp. 315. (London: Hodder and Stoughton, n.d.) Price 7*s*. 6*d*. net.
(3) "Animal Life under Water." By Dr. Francis Ward. Pp. x+178+plates. (London: Cassell and Co., Ltd., 1919.) Price 7*s*. 6*d*. net.
(4) "Birds in Town and Village." By W. H. Hudson. Pp. ix+274. Illustrated. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., 1919.) Price 10*s*. 6*d*. net.
(5) "The Book of a Naturalist." By W. H. Hudson. Pp. viii+360. (London: Hodder and Stoughton, n.d.) Price 12*s*. net.
(6) "Wonders of Insect Life: Details of the Habits and Structure of Insects." Illustrated by the Camera and the Microscope. By J. H. Crabtree. Pp. viii+211+32 plates. (London: George Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 6*s*. net.
(7) "Just Look! or, How the Children Studied Nature." By L. Beatrice Thompson. Pp. viii+204+58 plates. (London: Gay and Hancock, Ltd., n.d.) Price 5*s*. net.

regards illumination, the author discusses the life and behaviour of a number of types. In connection with diving birds, he suggests that the "flashes" of reflected light from the moving body may attract fishes. Under the water the back of the Great Northern Diver "simulates a shoal of small shining fish." The inordinate appetite of diving birds is emphasised; thus a small cormorant took from Dr. Ward at one time twenty-seven herrings of average size. It seems to us that the author does not sufficiently appreciate the good these birds do from the fisherman's point of view in destroying species which devour food-fishes. There are two sides to most indictments of birds.



The otter alarmed. From "Animal Life under Water."

In addition to the contributions to the theory of concealment of water animals from enemies or from booty, the book contains many very interesting natural history sketches—of the seal, the heron, the kingfisher, various kinds of gulls, and, best of all, the otter. Indeed, the story of the otter strikes us as the finest part of the book. We are not sure that a popular book, especially one with a definite and very interesting problem to discuss—animal life under water—is the place for weighing the beneficial and injurious effects of the activities of particular birds. That should be done in a severely scientific and critical way. Dr. Ward describes, for instance, the contents of the stomachs of thirty black-headed gulls, which show that these birds were "certainly not helping the farmer." But it is easy to get expert records of thirty cases which show the reverse. The question is to which side the balance inclines in a particular area and through the year. This entertaining and breezy book is copiously illustrated with very interesting photographs. We appreciate these, but we may hint at the injudiciousness of putting even a diagrammatic penguin into a scene on a Highland loch.

(4) Mr. Hudson's "Birds in Town and Village" is based on "Birds in a Village" (1893), his first book about bird life, but much of it is new. It is a continual delight—a succession of fine pictures—and it is very gratifying that the beautiful text should be so successfully illustrated. Mr. E. J. Detmold's coloured drawings are altogether charming. The time is past for speaking of the author's style, his irresistible enthusiasm, his intimate knowledge of birds, and his passion for them. If more people read his books there would soon be no need for a Plumage (Prohibition) Bill.

"The robin is greatly distinguished in a sober-plumaged company by the vivid tint on his breast. He is like the autumn leaf that catches a ray of sunlight on its surface, and shines conspicuously among russet leaves." "The kingfisher, speeding like an arrow over a field of buttercups so close that they were touching, seemed, with the sunshine full on it, to be entirely of a shining, splendid *green*. . . . Flying so low above the flowery level that the swiftly vibrating wings must have touched the yellow petals, he was like a waif from some far tropical land. The bird was tropical, but I doubt if there exists within the tropics anything to compare with a field of buttercups—such large and unbroken surfaces of the most brilliant colour in nature." But we might as well quote the whole book. The delightful "Birds of a Village," which forms about half the book, is echoed at the end in a story of the birds in a Cornish village, and between the two there are essays on exotic birds for Britain (we confess to regarding introductions with insular prejudice),

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W. M. GIBBONS, Registrar.

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moorhens in Hyde Park, the eagle and the canary (concerning cages), chanticleer, and the birds of an old garden. If the birds knew what Mr. Hudson has done for them, they would sing all the year round.

(5) It is difficult to imagine anything more delightful than Mr. Hudson's "Book of a Naturalist," and we wish he had called it vol. i. Why should there not be many volumes, when it is so easy to make one so good? So easy! for all that is necessary is to have (1) an intimate personal experience and a deep understanding of the life and conversation of animals as they live in more or less wild Nature; (2) an artistic or poetic sense which gives Blake's "double vision"; and (3) an ear for words that makes the pages of the book sing. The same subjects are often treated of by many painters, and likewise by many naturalists. Ants and wasps, bats and foxes, moles and earthworms, snakes and toads, pigs and potatoes—these are fair samples of Mr. Hudson's stock in trade; but he is a magician-pedlar, and the familiar things among his wares turn out to have most unexpectedly profound and subtle excellences. Here science and art seem to meet in a deepening of our appreciation of common things, and perhaps this is the biggest service that a man who sees can do to his day and generation.

Mr. Hudson wished to call his book "Diversions of a Naturalist," but Sir Ray Lankester was ahead of him. We do not think he lost much, for what he has given us are really "Appreciations," as Sir Ray Lankester's "diversions" were also. The expert biologists get down to the depths of life in a way that is indispensable and fundamental, but the field-naturalists, among whom Mr. Hudson stands out as Saul among the prophets, get at the heights of life in a way that is indispensable and supreme. What is contributed in these fascinating essays is a wealth of first-hand observations, and to this, of course, there are added the reflections of a highly gifted intelligence. But we submit that there is more—that feeling has a *rôle* in the interpretation of Nature, and that sympathetic insight (through æsthetic emotion at one pole, and sheer sense of kinship at the other) opens up one of the rights-of-way to reality. This is too academic in its phrasing, and unfair to Mr. Hudson, through whose writings sunlight streams and breezes blow; but we mean that this is the book of an expert naturalist and of a man of feeling as well.

(6) The entomologist is always discovering new wonders, and very frequently he has enthusiasm enough to wish to share his pleasure with others. Mr. Crabtree has the entomological enthusiasm right enough, but we are not sure about all his wonders. In the first place he is too much of an anthropomorphist, for he says the study of insect-life "provides a host of examples and illustrations of such noble aims as 'living for a purpose,' 'striving for the best,' 'helping one another,' 'bearing each other's burdens,' and 'sympathy in sorrow.'" He has interesting observations to describe, and he tells his story fairly well; but again there is the false note: he should not speak of his book selecting "representative members of the principal *species*," or of "the Pulex family." It is a pity that an author who seems to have seen a lot of things for himself should write like this: "The numerous family of Lice that is parasitic on certain animals is classed under the common term Hæmotopinus." Why do not publishers see to it, by utilising readily available advice, that this sort of thing is not printed? It is not good business, for it obscures the book's good qualities.

Many people see common insects like the lady-bird, the devil's coach-horse, the earwig, the frog-hopper, the green-fly, the may-fly, and the wasp, and would like to know more about them, especially if they can get the information not too learnedly expressed. Mr. Crabtree's book is well adapted to meet this reasonable demand. It deals pleasantly with about three dozen common insects, and there is a generous supply of photographic illustrations. But, again, Mr. Crabtree's reach too often exceeds his grasp; thus his story of cuckoo-spit is far from correct; we do not like to hear of female Aphides without ovaries, in which "multiplication occurs by the process of gemmation or budding on the individual Aphis." We are staggered by the crane-fly, the limbs of which are merely hooked together, so that a captured part has only to be hooked off; and we do not think that a wise approach to a very difficult problem is made by saying: "It may be said with sincerity that the development of *instinct* in ants is much akin to *reason* in higher mammals." But, forgiving a lapse in biological philosophy, we are pulled up by errors in grammar, for our eyes have fallen on more than one sentence like this: "To the thorax, or chest, is attached the fly's six limbs." Why should a scorpion be referred to as "the dangerous arachnid of the South American forests," and why should an author go out of his way to use an expression like "of that ilk" when he does not know what the words mean? We believe in popular natural history, but it should have a high standard of accuracy, and it should be written in English worthy of the subject. Mr. Crabtree's studies are interesting; they often describe observations; they are certainly instructive; but we are bound to say that there are too many flies in the ointment. And many of these flies are gratuitous.

(7) Miss Thompson tells in a pleasant way of corals and seeds, of the work of water and ice, of springs and seashore animals, and illustrates her talks with very clever drawings. To those who enjoy talks between a somewhat encyclopædic Miss Marshall and a number of children who ask extraordinarily appropriate and searching questions, the book will be welcome; our own impression, based on some experiments, is that neither children nor adults care for the "Sandford and Merton" mode of imparting instruction. The author has a very skilful pencil and a power of simple exposition; we wish she had chosen the direct method. J. A. T.

Notes.

MR. ALAN A. CAMPBELL SWINTON has been elected chairman of the council of the Royal Society of Arts for the ensuing year.

DR. EDRIDGE-GREEN, C.B.E., has been appointed a special examiner in colour vision and eyesight by the Board of Trade.

THE Civil List Pensions granted during the year ended March 31 are shown in a White Paper just issued, and include the following:—Mrs. Howell, in recognition of her late husband's eminent public service in the Geological Survey of Great Britain, 50*l.*; Miss Juliet Hepworth, in recognition of her late brother's services to meteorology and oceanography, 50*l.*; Mrs. K. Macdonald Goring, in recognition of her husband's services to biometrical science, 85*l.*; and Mrs. Leonard William King, in recognition of her husband's services to Assyrian and Babylonian study, 85*l.*

AT a public meeting held at the Mansion House in October, 1912, the following proposals for commemorating the work of Lord Lister were adopted:—The placing of a memorial in Westminster Abbey, to take the form of a tablet with medallion and inscription; the erection of a monument in a public place in London; and the establishment of an International Lister Memorial Fund for the advancement of surgery, from which either grants in aid of researches bearing on surgery or awards in recognition of distinguished contributions to surgical science should be made, irrespective of nationality. A meeting of the general committee was held in the rooms of the Royal Society on Monday, July 19, to receive and adopt the report of the executive committee appointed in 1912. The chairman, Sir Archibald Geikie, stated that the sums received in respect of subscriptions from the British Empire and foreign countries amounted to 11,846*l.* 5*s.* 10*d.* A memorial tablet, executed by Sir Thomas Brock, was unveiled in Westminster Abbey on November 1, 1915, and steps are being taken for the erection of a monument in a public place in London. In order to carry out the scheme for the establishment of the International Lister Memorial Fund for the Advancement of Surgery, it was resolved that:—(*a*) Out of the general fund a sum of 500*l.*, together with a bronze medal, be awarded every three years, irrespective of nationality, in recognition of distinguished contributions to surgical science, the recipient being required to give an address in London under the auspices of the Royal College of Surgeons of England. (*b*) The award be made by a committee constituted of members nominated by the Royal Society, Royal College of Surgeons of England, Royal College of Surgeons in Ireland, University of Edinburgh, and University of Glasgow. (*c*) Any surplus income of the general fund, after providing for the erection of a monument and defraying administrative expenses, be either devoted to the furtherance of surgical science by means of grants or invested to increase the capital of the fund. The Royal College of Surgeons of England has consented to become the trustees and administrators of the Lister Fund and to carry out its objects, subject to the above provisions of the scheme. The subscription list is still open, and the hon. treasurer of the fund is Sir Watson Cheyne, Bart., to whom donations may be addressed at the Royal Society, Burlington House, London, W.1.

A MARBLE statue to the memory of Wilbur Wright was unveiled on July 17 at Le Mans, where twelve years ago this aviator accomplished a flight of nearly a mile. We learn from the *Times* that the statue is the work of the sculptor Landowski, and typifies the struggle of man to conquer the air. The nude figure of a man is represented as having scaled a rugged mountain peak and as stretching out his arms to the hitherto unconquered element, air. The base of the monument is carved with bas-relief figures of Wilbur and Orville Wright and Léon Bollée, the Frenchman who collaborated in the early experiments.

THE thirty-ninth annual meeting of the Society of Chemical Industry was held at Newcastle-upon-Tyne on July 13–16. The gold medal of the society was presented to M. Paul Kestner, president of the Society of Chemical Industry of France, by Prof. Henry Louis, who read the presidential address of Mr. John Gray. Sir William J. Pope was elected president for the ensuing year. An invitation to hold the next annual general meeting at Montreal was accepted.

A CONGRESS of Philosophy, in which members of the Société Française de Philosophie are taking part, and to which the American Philosophical Association is sending delegates, is to take place at Oxford on September 24–27. Two of the subjects of discussion are likely to be of especial scientific interest: one a symposium on the principle of relativity, to be opened by Prof. Eddington, and the other a discussion to be opened by Dr. Head on disorders of symbolic thinking due to local lesions of the brain. The opening meeting of the congress will be presided over by Lord Haldane, and the inaugural address will be by Prof. Bergson. Arrangements are under the direction of Mr. A. H. Smith, New College, Oxford.

THE Faraday Society and the Physical Society of London are arranging to have a joint symposium and general discussion in October next upon the physics and chemistry of colloids and their bearing on industrial questions. The subject will be introduced by a brief survey of the present position of colloidal physics and chemistry, and there will then be discussion on the following subdivisions of the subject:—Emulsions and emulsification, physical properties of elastic gels, cataphoresis and electro-endosmose, precipitation in disperse systems, glass and pyrosols, and non-aqueous systems. In spite of the importance of colloidal physics and chemistry in many branches of manufacture, and of the interest which the subject has aroused in recent years, much light remains to be thrown on the nature of the manufacturing process in which colloids play a part. It is hoped that the discussion will focus attention on some of these problems, that its result will be to indicate lines of advance and suggest

further researches, and that it will be fruitful not only in helping to a fuller understanding of the laws of the colloidal state, but also in suggesting new applications for colloids in the laboratory and in the works. The exact date and place of meeting and further particulars will be announced later. In the meantime, anyone desirous of using the opportunity of the discussion to bring forward experimental matter or theoretical considerations bearing on the above-mentioned branches of the subject is asked to communicate as soon as possible with the secretary of the joint committee, Mr. F. S. Spiers, 10 Essex Street, London, W.C.2.

A SPECIAL meeting of the Röntgen Society was held on July 15 in the chemical theatre of University College, London, by kind permission of the authorities. The occasion was an address by Dr. W. D. Coolidge, director of the research laboratories of the General Electric Co., of Schenectady. An audience of more than 250 people gathered to hear from the inventor of the X-ray tube which bears his name a detailed account of the processes involved in the manufacture of the Coolidge tube—or rather we should say the Coolidge tubes, for a number of different types of tube, each suitable for different working conditions, are the outcome of the investigations carried out under Dr. Coolidge's direction over a number of years. Dr. Coolidge in his address laid considerable emphasis upon the amount of investigation entailed in the use of tungsten either as a hot filament or as the target of an X-ray tube. The welding of this highly brittle metal and its perfect annealing with copper are technical triumphs, and the details of these processes in their final stages were of very great interest. While the effort is at present being made by the General Electric Co. to standardise radiographic procedure by combining a high-tension outfit which automatically limits the quantity and quality of the X-rays from the tube, it is recognised that no such procedure is possible in radio-therapy at the present day. The limitations imposed upon the production of very short wave-length X-rays are largely technical ones, and we look with confidence to their production in the near future, for both in medical work and in the examination of metals and other materials they are likely to prove of great value. If the production of these more penetrating radiations involve new ideas in the construction of the X-ray tubes, those who heard Dr. Coolidge's address will feel that such considerations will not be allowed to delay what is becoming a seriously felt want.

IN a paper read before the Royal Statistical Society in April (Journal, 1920, vol. lxxxiii., part 3, pp. 1–44), Dr. T. H. C. Stevenson presented the results of an inquiry into the fertility of the various social classes in England and Wales from the middle of the nineteenth century to 1911. Child mortality varies directly and very markedly with the number of children born and the rapidity with which they are born. It also varies with the age of the mother at birth. If allowance is made for the differences of marrying age in different classes, fertility is found to increase downwards throughout the social scale. The difference in fertility between the classes is, broadly speaking, a new phenomenon, for it is small for marriages before 1861, and rapidly increases to a maximum for those of 1891–96. That the decline in the birth-rate is due to the artificial restraint of fertility is indicated by the following features: The gradual spread of the decline throughout society, from above downwards; the exceptionally low fertility of occupied mothers; and the increase in the defect for the higher social classes with increase of duration of marriage up to twenty-five years. The lowest fertility rates are returned for the most purely middle-class occupations —the professions. The comparatively low child mortality of the less fertile classes goes but a small way numerically to compensate for their low fertility. The classes which are least fertile when married are likewise those that marry latest in life. Ante-nuptial conception leads to great under-statement of the number of marriages of less than twelve months' duration. Such under-statement is the rule amongst all classes where the wife's marriage age is under twenty, and becomes less frequent as the wife's age increases. At ages above twenty its frequency varies with the social position, reaching its maximum amongst unskilled labourers.

PROF. E. W. MACBRIDE contributes to the latest number of *Scientia* (vol. xxviii., No. 99, 1920) a trenchant article on "The Method of Evolution." By the "force of heredity," he says, is meant the tendency of the offspring to resemble the parent. It is obvious that in some way this force must be modified as time progresses, otherwise evolution could not take place, and the manner and means of this modification are just what we mean by the phrase "method of evolution." The Darwinian view that large results may be reached by the selection of small individual variations is seriously weakened by "pure line" experiments. The mutationist view of the importance of "sport"-variations exhibiting Mendelian inheritance cannot be accepted as more than an accessory theory, for most mutations are of the nature of "cripples," and utterly unlike the differentiating characters which distinguish allied species. There remains a third alternative: the inheritance of the effects of use and disuse. This is *the* method of evolution, "the dominating influence which has moulded the animal world from simple beginnings into the great fabric of varied life which we see around us." If we ask for evidence of the transmission of somatic modifications, we are referred by Prof. MacBride to the researches of Kammerer. If we submit that opinion is divided as to the validity of these, we are told to repeat the experiments, which is, of course, a fair enough answer. In the meantime, we are invited to consider how bacteria, modified to perform feats in disruptive chemistry of which their ancestors were incapable, hand on their individually acquired new qualities to their abundant progeny. And if we suggest that this is not a test case, since bacteria have no soma and do not multiply by germ-cells, we are told that the distinction between somatoplasm and germplasm is a "Weismannian nightmare." All this points clearly to the need for fresh experiments.

PROF. STEPHENSON'S paper "On a Collection of Oligochæta from the Lesser-known Parts of India and from Eastern Persia" (Memoirs Indian Museum, vol. vii.) is very informative. The known Oligochæta, about 150 before 1883, were about 1000 species in 1911. To these Prof. Stephenson adds 24 species and 5 varieties, modestly remarking: "It can scarcely be said, however, that the results of the present investigation include anything of the first order of importance; it is now too late to expect it." One of the new species, *Nais gwaliorensis,* is about one-tenth of an inch long and one-hundredth of an inch broad, yet in an earlier paper the author shows this brevity far outdone by Annandale's *Chaetogaster spongillae.* Among very much larger forms the systematist may note that Prof. Stephenson here makes his *Eutyphoeus Kempi* a synonym of *Eutyphoeus chittagongianus,* Michaelsen, and that author's *bengalensis* a synonym of his species *Waltoni* in the same genus. So lately as 1893 "absence of branchiæ" was included in the definition of the Oligochæta. Now, not only does *Branchiura Sowerbyi,* Beddard, have, as its generic name implies, gills on the tail end, but Prof. Stephenson also finds a species of Branchiodrilus, "a Naid worm with gills remarkably like those of Branchiura, but on the anterior part of the body."

THE twenty-eighth Report, for the year 1919, on the Lancashire Sea-Fisheries Laboratory contains a note by Mr. A. Scott upon a midwinter invasion of the Barrow Channel by an immense swarm of the phosphorescent flagellate Noctiluca and the Ctenophores Pleurobrachia and Beroë. On December 16, 1919, Mr. Scott made one of his routine visits to the sandy mud-flats between tide-marks, and found that the area—500 yards wide and 1000 yards long—between Roa Island and Foulney appeared as if it had been thickly sprinkled with glass marbles. These were the Pleurobrachia, many of them of large size (22 mm. high), and mingled with them were stranded Beroë. At the water's edge was a brick-red, oily-looking zone 6 in. to 12 in. wide, and the water in the creeks was covered by a similar oily layer, which on examination proved to be composed of Noctiluca. Twenty-four hours later the area was again examined, but only one Pleurobrachia was found, and there was no Noctiluca in the plankton. It is quite unusual to find an abundance of Noctiluca and Ctenophores in this area in midwinter. Noctiluca has been abundant on former occasions along the coasts of North Wales and Lancashire, but hitherto only in the period between the beginning of August and the end of September.

THE "Reports for the Year 1919 on the Science Museum and on the Geological Survey and the Museum of Practical Geology" (H.M. Stationery Office, 1920, price 3*d.*) are accompanied by a map showing the grouping of institutions devoted to education and research in the great quadrangle between Cromwell and Prince Consort Roads, South Kensington. The Science Museum has gone into temporary occupation of part of the eastern block of new buildings while this block is being completed, the galleries thus occupied being left in an unfinished state until a second move onward can be made. The arrangement is a testimony to the energetic and necessary expansion of the collections, which now include an aeronautical division. The report on the Museum of Practical Geology refers to the congestion of its collections, which have been largely increased by the groups of materials of economic importance brought together in recent years. There is no reference, however, to any scheme of extended buildings. The publication of maps and memoirs has been maintained at a high level, and it is interesting to note how the public demand shows an enormous and intelligent preference for the "drift" series of colour-printed maps as against those showing the "solid" geology only.

THE Geological Survey of Scotland has issued the fourth of its series of memoirs dealing with the detailed economic geology of the central coalfield of Scotland, the present volume being devoted to Area VI., which forms a block near the centre of the field and includes the districts of Rutherglen, Hamilton, and Wishaw. This is naturally an area of very great economic importance, and comprises some of the most productive portions of the Scottish coalfield. A valuable feature of the publication is the series of sections obtained from borings and sinkings, which have been printed on separate sheets; it may perhaps be regretted that the scale selected is somewhat minute. It need scarcely be said that the geological relationships of the coal seams and of the various economic minerals met with in the field are described in full detail, and that the memoir, together with the revised maps which it is intended to accompany, will be of the greatest value to mining engineers whose professional work lies in that area of the Scottish coalfield.

A REPORT on the weather experienced at Falmouth Observatory has recently been issued by the Observatory Committee of the Royal Cornwall Polytechnic Society. The observatory is closely associated with the Meteorological Office, and many of the records for Falmouth appear in the several reports of the Office, which probably is sufficient reason for the small amount of work done actually at the observatory. Funds available at the spot are clearly limited, and the staff is, consequently, small. Pressure, temperature, and rainfall results in the report are compared with the means of the forty-five years 1871 to 1915, whilst in the Meteorological Office publications the records are compared with the new normals for thirty-five years, 1881 to 1915. Probably in course of time general uniformity in this respect will be adopted. The mean air temperature for November was a record for cold, and its minimum, 26° F., was the coldest for the year. The total rainfall for the first six months of the year was 5·89 in. greater than for the last six months, which is a reversal of the ordinary rule. October was a record for dryness, rainfall measuring 1·62 in. Bright sunshine had an average record for the year of 4·8 hours per day. October had 158·9 hours, which is a record for that month; the extreme range of the totals for October is 77·6 hours, not 69·2 hours, as stated in the report, for which result 1919 was overlooked. The table of sea temperatures from observations made in the harbour and the comparison with air temperatures is of considerable interest, but the differences from the air of the maxi-

mum and minimum sea values scarcely seem satisfactory, since the observations are not strictly for the same periods, the sea temperatures being for fewer days.

THE Seventh Report of the Industrial Fatigue Research Board (Textile Series, No. 1), dealing with "Individual Differences in Output in the Cotton Industry," has just been issued. It is the result of researches made by Mr. S. Wyatt, Investigator to the Board. The scope of the report represents an attempt to collect information on the question of the relative importance of the human and mechanical factors in various branches of the cotton industry. It is intended to be suggestive rather than conclusive in its nature, to lead on to a careful collection of facts and thence to more detailed and intensive investigations. There is great variety in the conditions obtaining in various types of cotton mills, some, for example, in which, as in the spinning of cotton, the output is almost entirely controlled by the machine, whereby individual differences in ability are reduced to a minimum; while in others, such as in the process of drawing-in by hand, there appears to be much more scope for the expression of individual differences of ability, and therefore of output, by the persons concerned. Thus it may be found possible, where there exist large individual differences of output—which implies that the mechanical factor is subsidiary—so to modify the human conditions of employment that increased efficiency, prosperity, and comfort may result. The inquiry has of necessity been of considerable difficulty, having regard to the variability of the conditions prevailing in the course of preparation and manufacture, yet valuable, if inconclusive, results have been reached, which at least show that the various processes in the cotton industry can be classified and graded according to the magnitude of the individual differences which they produce, wherein lies the relative importance of the human and mechanical forces. Scarcely any attempt has been made in the mills to determine efficiency in the various processes, yet the collection of statistical data would cause the employer and the manager to take a scientific interest in their work, stimulate inquiry and investigation, and lead to improved methods. We may reasonably ask why the workers should not be invited to participate in the research, since it is in their interests also that the best results should be secured.

THE International Institute of Agriculture at Rome has issued the following information with regard to the estimated yields of cereals throughout the world. In the United States the area under winter wheat is considerably smaller than that of last year. Moreover, the season has been somewhat unfavourable, so that the coming crop is estimated at 13·2 million tons, which is 66 per cent. of last year's yield and 86 per cent. of the five previous years' average. It is, however, probable that there are considerable stocks of old wheat still to be exported, and these, together with the reduced new crop, should make the exports for the coming season equal to those for the year ending June, 1920. Drought has considerably affected the crops in Algeria and in southern Italy, and the outlook in Poland is unpromising, especially for rye. In the other countries of the northern hemisphere the condition of the winter cereal crops is normal, while the recent wheat crop in British India shows an increase of 30 per cent. over last year's yield. The maize crop in Argentina is estimated at 30,000,000 quarters, which is 32 per cent. higher than the five previous years' average. This increased yield will probably be an important factor among the cereal resources of the coming season.

THE Journal of the British Science Guild for June contains a special tribute to Lord Sydenham, the retiring president, contributed by Sir O'Moore Creagh. A series of six articles reviews the administrative activities of the Guild, of special interest being the account of the reception by Mr. A. J. Balfour of the deputation on State awards for scientific and medical discovery. The deputation had a sympathetic reception, the justice of the principle being generally conceded, but Mr. Balfour suggested as a difficulty the exact allocation of credit to the authors of scientific discoveries. This problem, it is pointed out by Sir Ronald Ross, has already been dealt with satisfactorily by the Royal Society, the Nobel Prize Committee, and other authorities. It is suggested that pensions and awards might be included in the Civil List. Lt.-Col. W. A. J. O'Meara writes with experience of the need for the utilisation of science in Government Departments. An element of consequence is the concentration of power in the hands of the higher division clerks and the permanent staff, which doubtless militates against the introduction of new ideas. Memoranda by the Health Committee on the milk question raise a number of important points in connection with the purity of supply and the possibility of the communication of diseases through milk. Sir Thomas H. J. C. Goodwin's Chadwick lectures on "Army Hygiene in the War and After" (see NATURE for June 24, p. 532) and Mr. J. J. Robinson's popular lecture on "Knowledge in National Reconstruction," delivered before 1100 members of the Portsmouth Brotherhood, are summarised. The issue is completed by a list of the officers, fellows, and members of the Guild.

THE Ministry of Transport has stated that it is seriously considering the organised electrification of the railways, and the importance of this subject at the present time can scarcely be over-estimated. Sir Philip Dawson's paper on "Electric Railway Contact Systems," which was read to the Institution of Electrical Engineers on June 30, is, therefore, of immediate interest. Before a standard system of electrification can be evolved the question of the relative merits of collecting the current from an overhead system or from a third rail must be discussed. From the data given in the paper a strong case can be made out for overhead collection. The flexible method of suspending the overhead collecting wire on the Brighton Railway has proved thoroughly satisfactory, and the "double insulation" used throughout has reduced breakdowns to a minimum. With third-rail systems it is necessary to pay higher wages to the workmen employed on the line owing to the increased danger. The data given bring out the interesting fact that

the wear of the trolley wire is proportional to the current collected. When no current is taken the wear is almost negligibly small. A curious anomaly in the treatment of railways with and without Parliamentary powers was pointed out. The former railways are not allowed to have more than a 7-volt drop on their rails, whilst the latter have sometimes more than a 100-volt drop for short periods. It seems to us that a careful search should be made in neighbouring pipes, etc., for electrolytic damage in the latter case. If the damage should prove to be inappreciable, then the limit of 7 volts might be raised for all railways, as this would appreciably lower the cost of electrification.

MESSRS. NEWTON AND WRIGHT, LTD., desire it to be known that their business will be carried on in future from their works address, 471–77 Hornsey Road, N.19, which is now the head office of the company. In furtherance of their policy of restricting themselves to a wholesale business, an arrangement has been concluded with Messrs. Allen and Hanburys, Ltd., by which this firm becomes selling agents in the London area for Messrs. Newton and Wright, and also in those parts of the United Kingdom where the latter is not specially represented. Messrs. Allen and Hanburys are taking over the electro-medical showroom at 72 Wigmore Street, W.1, until recently occupied by Messrs. Newton and Wright, who will, however, have free access to these showrooms, and one of their directors will always be glad to meet country and other customers by appointment who may not have time to visit the head office at Hornsey Road. The arrangements with Messrs. Allen and Hanburys are so framed as not to preclude Messrs. Newton and Wright doing business with other trade houses, and the firm will be pleased to continue supplying their specialities through whatever trade house a customer may select.

THE special catalogues of Messrs. J. Wheldon and Co., 38 Great Queen Street, W.C.2, are always of interest and value, and the latest (New Series, No. 90) is no exception. It is a well-edited, classified list of upwards of 1200 books and pamphlets on ornithology. The sections are British Islands, Europe, Asia, Africa, North America, Central and South America, Australasia, General Systems, etc., Economic Ornithology, Miscellanea, and Morphology. Many scarce works are included. In addition, particulars are given of many complete sets or long runs of scientific journals. The catalogue should be of service to purchasers of books of science.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have just circulated the quarterly catalogue of new books and new editions added to their Medical and Scientific Circulating Library during the months April–June. It is a useful classified list of the works in science published in the period named, and should be found useful even to non-subscribers to the library. Messrs. Lewis have also issued a list of second-hand and surplus library books an agriculture, botany, chemistry, engineering, geology, physics, zoology, etc. Many of the volumes are offered for sale at greatly reduced prices.

Our Astronomical Column.

A NEW COMET.—The second cometary discovery of the year was made at Nice by M. Schaumasse on July 18 at 13h. 37·1m. G.M.T., in R.A. 1h. 47m. 52s., south decl. 1° 14′, daily motion +2m. 24s., S. 5′, 11th magnitude.

The following positions have been deduced on the assumption of uniform motion:

	R.A. h. m. s.	S. Decl. ° ′
July 23 ...	1 59 43	1 39
28 ...	2 11 43	2 4

The comet is a morning star, rising at 1 a.m. summer time. It is not very far from Tempel's comet, discovered at Kyoto at the end of May, but of which no further observations have come to hand.

Later.—M. Schaumasse now finds that his new comet is identical with Tempel's second periodic comet, the previous announcement by Mr. Kudara, of Kyoto, being erroneous. The time of perihelion now becomes 1920 June 9·67, a month earlier than the time deduced from Mr. Kudara's announcement.

The following is an approximate ephemeris for Greenwich midnight:

	R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
July 15 ...	1 40 4	1 14	0·1402	9·9674
23 ...	1 59 24	1 26	0·1488	9·9623
31 ...	2 16 40	1 53	0·1585	9·9577
Aug. 8 ...	2 30 52	2 36	0·1693	9·9522
16 ...	2 42 32	3 33	0·1805	9·9467
24 ...	2 50 48	4 47	0·1920	9·9403

PUBLICATIONS OF THE DOMINION ASTROPHYSICAL OBSERVATORY, VICTORIA, B.C., VOL. I., NO. 1.—This volume contains a full account of the inception of the scheme of constructing the great 72-in. equatorial, and demonstrates the immense amount of careful thought and consultation of experts, both opticians and astronomers, that preceded the adoption of the designs.

Before the site was settled, Mr. W. E. Harper tested the quality of seeing at a number of stations in different parts of Canada, using a 4½-in. Cooke photo-visual telescope. Victoria was finally selected, owing to the excellent seeing at night, though there was less sunshine than at Ottawa; the small diurnal range of temperature also favoured it.

The glass discs were cast at St. Gobain, the optical work was entrusted to the J. A. Brashear Co., and the mechanical work and dome to the Warner and Swasey Co.

The ball-bearings, in dustproof cases, prove very efficient, so that it is stated that when the clock is disconnected a 3½-lb. weight on a 26-ft. arm suffices to set the telescope in motion; a 400-lb. weight is found sufficient for the driving clock, which is wound automatically by an electric motor. The volume contains details of the zonal tests applied to the mirror, the results being very satisfactory. Temperature insulation, consisting of cotton-felt, is used round the mirror, and with the small temperature changes that take place at Victoria the definition will never be appreciably affected by this cause.

The comfort and convenience of the observers are studied, all the movements being carried out electrically. Details are also given of the powerful spectrograph, which is surrounded by a temperature-case. It is possible to use the instrument visually without removing the spectrograph, the image being displaced laterally by reflecting prisms.

Numerous large-scale photographs of the various parts make it easy to follow the descriptions.

Progress in Science and Pharmacy.[1]

By CHARLES ALEXANDER HILL.

TWENTY-FOUR years have passed since the British Pharmaceutical Conference met in this great city of Liverpool. On that occasion the late William Martindale in his presidential address dealt with the use in medicine of "active principles" in substitution of the natural, *i.e.* naturally occurring, drugs. At the same time he described the introduction of synthetic substances into medicine as a novelty.

To-day it is fitting to reflect upon the changes in pharmacy wrought by progress in science—progress in chemistry and biochemistry, in physics, in physiology, and in the science and practice of medicine; next, to examine the extent to which active principles and synthetics have replaced natural drugs; then tentatively to survey the lines upon which future development may be expected.

Of the changes that have occurred the increased use of synthetic drugs is the outstanding, though by no means the only, feature. It is noteworthy that important discoveries of new vegetable drugs are practically unknown. The animal kingdom, on the other hand, has furnished us with drugs of the first importance; of these the products of the pituitary body, the thyroid gland, and the suprarenal gland afford notable examples. The importance of these discoveries is in nowise diminished if the active principles have been synthesised and can be produced artificially.

The use of synthetic remedies in medicine is sometimes said to date from the introduction of antipyrin in 1884, but chloroform and chloral hydrate had long been known and used, and synthetic salicylic acid was freely used in 1877. Hypnone (acetophenone) followed in 1885 and antifebrin (acetanilide) in 1886. These were succeeded by phenacetin, sulphonal, and trional, and since then there has been a steady flow of new synthetic drugs.

To-day the world's annual consumption of phenazone or antipyrin may be roughly estimated at 100 tons, of phenacetin at 250 tons, and of medicinal salicylates (sodium salicylate, methyl salicylate, aspirin, and salol) at no less than 2500 tons, and these are a few only out of the multitude of pure chemical substances used in medicine.

Notwithstanding the remarkable extent to which synthetic drugs have come into use, and despite the increased employment of active principles according as our knowledge of these progresses, the use of the drugs themselves in the form of galenical preparations, whether "standardised" or not, continues to a remarkable, and perhaps significant, extent. Furthermore, as we shall see, signs are not wanting of a growing recognition of the truth that many a drug and many a food may contain valuable properties not readily determined by chemical methods. It may be only slowly that the full value of a drug discovered empirically can be stated in scientific terms. Paradoxical as it may seem, the tendency to-day, with advancing scientific knowledge, is to recognise the failure of the active principle to replace the parent drug.

When it happens, the replacement of a natural drug by a synthetic substance may be conceived as proceeding ideally in four stages. First, the drug is examined chemically, and from it is isolated a pure substance, frequently an alkaloid or a glucoside, which upon being subjected to physiological tests is found to have an effect similar to that of the parent drug; such a substance is termed the "active principle" of the drug. The second stage is to determine the chemical constitution of the isolated active principle; this, in general, is a matter of extreme difficulty, taxing the resources of our most brilliant organic chemists, which, indeed, is equally true of the third stage, which consists in effecting the synthesis of the substance. Once the synthesis has been successfully accomplished we arrive at the fourth and last stage, which is the manufacture of the substance upon a commercial scale. The case of suprarenal gland and adrenalin affords an illustration.

It does not follow as a matter of course that if the synthesis of a substance be accomplished the artificial or synthetic article will replace the naturally occurring one. Supposing quinine were to be synthesised, it is by no means to be assumed that it would be cheaper to produce it on a large scale in the laboratory than to get Nature to conduct the synthesis, and then to extract the alkaloid from cinchona bark and afterwards purify it. It has been amply illustrated in the case of cinchona bark that it pays to subsidise Nature and to encourage her to increase her yield. Intensive culture may be a better business proposition than laboratory manufacture.

Synthetic Drugs.

By far the larger number of chemical substances used in medicine are not the active principles of natural drugs. It would lead me beyond the confines of my address to attempt even a cursory survey of what has been accomplished in the limitless field of synthetic drugs, to the enormous consumption of which I have already made reference, or to make more than the barest mention of the fact that synthetic organic substances are employed as antiseptics, anæsthetics, narcotics, hypnotics, and antipyretics, and in the treatment of diseases, notably those of parasitic origin.

Nor need I remind you of the many attempts made by chemico-physiologists to correlate chemical constitution and physiological action. Much chemical and physiological work has been done in this fascinating field of research, and certain generalisations have resulted by deductive reasoning from very numerous data, yet it has to be admitted that really very little is known of this borderland subject. The physical condition of the substance, its solubility, especially its relative solubilities in different solvents ("partition coefficient"), its adsorptive power, osmotic properties, and other physical properties, have as much to do with its physiological action as has its constitutional formula.

It may indeed be that the purely chemical action of a drug is destined to play a subordinate *rôle* in therapy, and that, in the past, the physical action has not been sufficiently considered.

Chemotherapy shows us clearly that the physiological action of a substance is not due to one constituent only of that compound, but that it also depends largely upon the molecular orientation of the compound and the ratio of adsorption which exists between it and the protein colloidal particles through which this or that constituent is going to act. Consider arsenic, for example. In the treatment of disease plain liquor arsenicalis is not so effective as colloidal arsenic sulphide, nor is the latter so effective as arsenophenylglycine, nor the last so effective as diaminoarsenobenzene. They all contain arsenic, but the last, in virtue of its amino-groups, is able to be adsorbed in very large quantities by the protein colloidal particles; consequently, the greatest amount possible of the element gets taken up. So far as can be seen at present, the amino-groups are of great

[1] From the presidential address delivered at the Royal Institution, Liverpool, on July 20, at the fifty-seventh annual meeting of the British Pharmaceutical Conference.

importance in a chemotherapeutic compound, especially if they can be placed in the ortho-position to the element one wishes to incorporate.

Of greater importance than the group is the molecular orientation; one needs only to mention the effect of introducing an acetyl group to illustrate this point. Compare diorthoaminothiobenzene with its acetyl derivative; the former is practically a specific for metallic poisoning, while the latter is as inert as plain colloidal or sublimed sulphur. Even diparaaminothiobenzene cannot compare with the ortho-body. The addition of an acetyl group to salicylic acid results in a new analgesic property, while at the same time the undesirable after-effects of salicylates are in some measure eliminated. A similar addition to phenetidin gives us phenacetin with its valuable antipyretic properties. On the other hand, the addition of an acetyl group to parahydroxyphenylethylamine (an active principle of ergot) results in a loss of activity. The introduction of an acetyl group into the choline molecule converts this comparatively inert substance into a powerful heart poison. Highly interesting is the case of aconitine. This intensely poisonous alkaloid is the acetyl derivative of benzaconine, the latter substance being relatively non-toxic. Yet the introduction of further acetyl groups into the aconitine molecule does not increase, but diminishes, its toxicity.

Recent Advances in Biochemistry.

Theoretically, every ingredient of a drug or preparation must have some effect, though it may be so small as to be inappreciable by any known means; and some drugs and foods have constituents minute in quantity, and therefore long unknown, of the very highest degree of importance. Indeed, recent advances in biochemistry have proved the existence in drugs and foods of physiologically active substances which give a rational explanation of facts based upon experience and established empirically.

Fresh in the memories of all of us is the discovery of the cause and cure of beri-beri, constituting one of the romances of medical science. Beri-beri is a disease of a high mortality which ravaged tropical countries and caused much misery. It had long been connected in the minds of the investigators with the rice which formed the staple food of the populations affected by it, but it has only recently been discovered that the disease is caused by the refinements of rice-milling, brought about by the introduction of machinery. It was observed by Eijkmann, the medical officer to a prison in Java, that the poultry of their establishment suffered from symptoms remarkably like those of beri-beri, which was common in his gaol, where the inmates were fed on a rice diet. Investigations showed this observer that the fowls could be quickly cured by adding to their diet the pericarp and embryo of rice removed during the process of milling.

From this starting point there was established by research a complete correlation between the occurrence of beri-beri and the consumption of steam-milled rice. In districts where rice is polished by hand the disease does not frequently occur, because it rarely happens that the whole of the pericarp and embryo are removed by hand. Fowls fed on polished rice quickly suffered from polyneuritis, and birds almost at the point of death were quickly rescued, it was found, by the administration of a watery extract of rice polishings. Thus was beri-beri found to be caused by the absence from the diet of a substance soluble in water and present in rice polishings.

This water-soluble constituent belongs to a class of accessory food substances which have been somewhat unfortunately named "vitamines." Work on these vitamines can scarcely be said to have a chemical basis, since all attempts to isolate them have failed. At least three have been recognised: (1) water-soluble B factor, which prevents beri-beri, occurs in the seeds of plants and the eggs of animals, in yeast and liver and grain cereals.

Scorbutus or scurvy is a disease which in former times caused high mortality. Sailors particularly were subject to attack, this being due to the fact that they were not obtaining another water-soluble vitamine, (2) the anti-scorbutic factor. The disease yields readily to a diet of potatoes, cabbages, and most fresh fruits.

Thirdly, there is a fat-soluble vitamine; this is present in cream and butter and beef-fat, and affords us a rational explanation of our natural preference for real butter over vegetable margarine. Cod-liver oil, which may be regarded as intermediate between foods and drugs, has long enjoyed a deservedly great reputation as possessing qualities superior to those of other oils. These qualities are due to the fact that good cod-liver oil has a high vitamine content, and is therefore important in the prevention and cure of rickets. On the other hand, vegetable oils, such as linseed, olive, cottonseed, coconut, and palm, contain only negligible amounts of this vitamine.

Biochemistry shows us the importance of other accessory substances besides vitamines. Enzyme action has been shown to be modified or stimulated by the presence of other substances termed co-enzymes. Parallel phenomena have been observed in the digestive processes of mammals in the remarkable activating nature of bodies termed hormones.

It would be beyond the limits of my address to go further than these somewhat brief indications that naturally occurring drugs and foods contain substances that long remained unsuspected and still longer unrevealed, but quite enough will have been said to show how unsafe it is to substitute one thing for another.

Research.

It is not easy to state concisely what is to be distinguished as pharmaceutical research. All will agree that it means something more than an improvement in processes for the exhibition of drugs in pharmaceutical preparations. Does it mean problems arising out of the cultivation of drugs not hitherto grown within the Empire, or the intensive cultivation of indigenous drugs with a view to increased activity, or the chemical investigation of drugs for their active constituents; or, again, does it mean research in organic chemistry for the production of new synthetic remedies, or does it mean pharmacological experiments, or all of these things? I would submit to you the following consideration: We have seen that pharmaceutical preparations of drugs continue to find employment even after the active principles of those drugs have been isolated, and are readily available in a pure state. We have seen that drugs and food-drugs are found to have valuable properties which cannot be stated in definite terms in the present state of our knowledge. Further than this, as our knowledge of such bodies as vitamines, enzymes, and hormones advances, so increases our respect for the natural source of such bodies—they may be glands or they may be seeds—whether as a food or as a remedial agent. Such may be the fate of many an "old-fashioned" remedy about which hard words have been used merely because it was not fully understood. Here then, it seems to me, is presented a most fitting subject for pharmaceutical research: to determine and control the conditions of collection and preparation of the parent drug, the process of treatment and manufacture and the conditions of storage, to dis-

cover characters and devise tests within the scope of the skilled, trained pharmaceutical chemist without involving experiments upon living animals, so that the pharmaceutical preparation exhibiting the drug shall be both active and uniform.

The Future.

The annual meeting of the British Pharmaceutical Conference affords a great opportunity for all pharmacists to meet each other on common ground and consider their common interests. Is not the present a period in pharmaceutical history at which it is fitting that all of us whose lot is cast in pharmacy should band together for our common welfare? The demands of the business side of pharmacy are to-day so imperious and so obvious that there is a danger of neglecting what, to my mind, is of primary importance if we are to persist. If I am asked what path should be pointed out for pharmacists to pursue in order that the present condition of affairs may be improved and the outlook for the future made more bright, then I say without doubt that the answer lies in cultivating assiduously the scientific side of pharmacy; in the promotion, encouragement, and assistance of pharmaceutical research; in the improvement of pharmaceutical products; and in keeping pharmacy abreast of advances in chemistry, physiology, bacteriology, vaccine-therapy, and other kindred subjects.

Only by giving first place to the professional side of pharmacy, keeping as distinct as possible the purely business side and declining to mix with pharmacy proper business in things so far removed from drugs as to be derogatory to the calling of pharmacy—only thus will it be possible to maintain and enhance the esteem in which pharmacists are held by their fellowmen, both medical men and laymen, as well as public bodies and Government Departments.

The British Pharmaceutical Conference exists for "the cultivation of pharmaceutical science" and "to maintain uncompromisingly the principle of purity in medicine." Let pharmacists see to it that the conference receive full and generous support, and that no effort be spared to enable it to carry out these worthy objects. Thus shall pharmacists prosper and pharmacy flourish.

Medical Science and Education.

IN his wisely eloquent presidential address to the British Medical Association meeting at Cambridge Sir T. Clifford Allbutt struck many a nail on the head. He began with the claim that the universities, ancient and modern, from Alexandria to Edinburgh, have made the professions, and stated the university ambitions to be building up character, training in clear thinking, and imparting particular knowledge and experience. He confessed, however, that the new universities compare ill with the old in nourishing the imagination. There is need to learn how to teach; there is need for simplification by more blending of details into larger principles; and there is need to beware of letting our teaching stiffen into formulas. Another point, refreshingly illustrated, was the debt of other sciences to medicine, for what impulses have come from medical studies to cytology, to organic chemistry, to bacteriology, and so on, up to philosophy, as the address itself shows. In medical research, as elsewhere, natural observation is yielding more and more to artificial experiment as investigation penetrates from the more superficial to the deeper processes. "The progress of medicine must in large part be endogenous." "Mere observation—Nature's march past—will not count for much now; and as to family histories—well, they vary with each historian." Once more Sir Clifford Allbutt made a plea for the study of the elements and phases of disease in animals and plants—a comparative pathology that would stir the imagination of young workers and save the world from a wastage as unnecessary as it is incalculable. "Yet no one stirs, save to gyrate each in his own little circle. There is no imagination, no organisation of research, no cross-light from school to school, no mutual enlightenment among investigators, no big outlook. . . . How blind we are!" After a very severe but timely criticism of psychotherapy—a criticism which is not marked, however, by any lack of appreciation of the fruitfulness of experimental psychology—Sir Clifford Allbutt closed with some discussion of the immediate problems of general practice and preventive medicine. There is inspiration in the whole address (see *British Medical Journal*, No. 3105, pp. 1–8), not least in its final glimpse of the possibilities before medicine as a social service and international bond.

At the same meeting of the British Medical Association there was an exceedingly important discussion on the place of "preliminary science" in the medical curriculum—a discussion which will lead, we hope, to some highly desirable changes. In his introductory address Sir George Newman indicated several reforms—a quantitative lightening of the curriculum at both ends, a fresh orientation of the preliminary sciences in relation to the training of medical students, but, above all, more biology and more real biology. "It is the biological outlook and spirit that is required, the capacity 'to see great truths that touch and handle little ones'; for biology, pure and applied, is the most educative, germinative, and dynamic subject in the whole curriculum." Prof. S. J. Hickson emphasised the value of biological studies in cultivating habits of verification and precision, in preparing the ground for subsequent anatomical and physiological studies, and in introducing the student to practically important sets of facts, either very concrete as in the case of parasites and their carriers, or more theoretical as in the case of heredity. He recommended a reduction in the number of "types" so as to make room for more important studies, better orientation of what is taught, and more emphasis on fundamental questions—admittedly difficult as it is to handle them well in teaching beginners. Prof. A. Keith urged that "anatomy could be made a living, practical part of medicine if only the teacher would ask himself: Could this fact help me in diagnosis and treatment?" Sir Ernest Rutherford, speaking of physics, insisted on the necessity for a sound training in the fundamental methods and principles of the science before the medical curriculum is begun, and for a subsequent professional course oriented in a judicious way to future studies in physiology and the like. Prof. Lorrain Smith laid emphasis on the fundamental value of the preliminary sciences as a training in method and criticism, but maintained that the general introduction at present supplied is wasteful in its discontinuity with what follows later. It misses part of its aim because its bearings on more professional studies are not made clear. Prof. A. Smithells, speaking of chemistry, indicated some ways in which more value could be got out of the present opportunities if there were more adjustment to the particular ends in view. In general, there seemed to be agreement (see *British Medical Journal*, No. 3105, pp. 8–21) on two points: (1) The need for making sure of a firmer grasp of principles, and (2) the need for a re-orientation of the class-teaching in relation to the particular needs of the medical student.

First Conference of the International Federation of University Women.

THE International Federation of University Women held its first conference at Bedford College, London, on July 12–14, and it has been interesting to note how thoroughly the Federation deserves its name. If Great Britain and the United States were the most numerously represented, as they are the founder nations, there were plenty of other nationalities to meet them. France, Spain, Italy, Holland, Belgium, the Scandinavian countries, Czecho-Slovakia, India, and the Overseas Dominions of the British Empire had all sent their delegates to participate in the conference. The proceedings opened on the evening of July 12, when a large audience listened to speeches by Lord Grey of Fallodon, Prof. Caroline Spurgeon (Bedford College), Dean Virginia Gildersleeve (Barnard College, New York), and Prof. Winifred Cullis (the London School of Medicine for Women). Lord Grey emphasised the necessity for intercourse between the peoples of the world, and the women speakers outlined the means by which the International Federation intends to promote this necessary contact between the women of the universities of the world. Briefly, their aims are the establishment of travelling fellowships and international scholarships; the exchange of professors, lecturers, and students; the establishment of club-houses and other centres of international hospitality; and useful co-operation with the national bureaux of education in the various countries.

On the following days the foundations of the Federation were established. A constitution and by-laws were freely discussed and considerably amended before final adoption. The effect of these will be to establish a central office in London for general information, which will operate in connection with Committees on International Relations set up in each country which is a member of the Federation. Officers have been elected for the ensuing two years, the president being Prof. Spurgeon; the vice-president, Mrs. R. F. McWilliams, of Winnipeg; the treasurer, Mrs. Edgerton Parsons, of New York; and the secretary, Miss T. Bosanquet, assistant secretary to the Universities Bureau of the British Empire, 50 Russell Square, W.C.1.

Informal reports on the position of the higher education of women in the various countries represented were read, and steps will be taken to correlate the academic standards in the different universities.

The next meeting will be held in the summer of 1922. It is hoped that in the meantime each branch association of the Federation will work actively to further the aims of the Federation in its own country. The British Federation of University Women is losing no time in getting to work, and will initiate a campaign for the programme of the International Federation in the autumn.

Insect Pests.

IN connection with tropical agriculture, attention has been directed to the question of the influence of the condition of the host-plant on infestation with sucking insects. It is believed that such pests as thrips on cacao and froghopper blight on sugar-cane can be held in check by increasing the resistance of the plant by improving agricultural conditions. In the *Agricultural News* (vol. xix., No. 464) it is claimed that the "mosquito blight" of tea (caused by a capsid bug of the genus Helopeltis) is affected in a similar way, and that the condition of individual tea-bushes determines the susceptibility to attack. The distribution of mosquito blight appears to be connected with soil conditions, and analytical data indicate that soils on which the pest is prevalent show similarities in the potash-phosphoric acid ratio, the addition of potash having an appreciable, though irregular, action in reducing the blight. Water-logging tends to encourage infestation, probably because the vitality of bushes grown on such areas is lowered; draining is the remedy advised in such cases. Acidity and poverty of soil are other factors which vitiate the health of the tea-bushes, so rendering them more liable to attack.

The spread of prickly pear in Australia is so rapid that large areas of land will continue to be thrown out of cultivation year by year unless some effective measure of control can be devised. It is estimated that the pest claims for its own 1,000,000 acres of fresh land per annum. Various methods of eradication have been tried, but destruction by mechanical or chemical means has proved too expensive for use on a large scale. The pear cannot be fed off to stock, and the manufacture of potash and paper from it has not proved to be commercially successful. A fourth line of attack—destruction by natural enemies—is now being followed up (*Science and Industry*, vol. ii., No. 1). It is necessary to find some enemies of the prickly pear that will not attack other vegetation, as the introduction of "omnivorous vegetarians" would probably result in serious injury to other forms of plant-life. For this reason certain rodents, snails, and insects which are known to feed on prickly pear in America and Africa cannot be recommended for introduction into Australia. One insect, however, *Coccus indicus*, appears to feed exclusively on one form of pear, *Opuntia monocantha*, but unfortunately it will not feed upon the chief pest, *O. inermis*. It is recommended that experiments should be carried on to induce the insects to transfer their attention from one species to the other, if necessary by means of hybridising the pears. Other insects—bugs, flies, moths, and beetles—are known to feed upon one or other species of prickly pear, and it is possible that useful enemies might be introduced from Mexico and South America.

The loss caused by the jointworm flies of the genus Harmolita (Isosoma) in the United States runs into millions of dollars per annum, the wheat jointworm (*H. tritici*) being the greatest devastator. W. J. Phillips (Bull. 808, Professional Paper, U.S.A. Dept. Agric.) has gathered together the available information and classified the species into groups that attack grain crops, cultivated grasses, and wild grasses. The two first groups cause considerable loss by the injury they entail to the crops. The members of the last group, however, may possibly be beneficial in an economic sense, as they provide intermediate hosts for the parasitic insects which prey upon the genus, the more important parasites being common to the majority of species of Harmolita. The life-histories of several species are described, together with the way in which injury is caused to the plants attacked. *H. tritici* causes the most serious losses, reducing the yield of wheat by as much as 50 per cent., the grains being somewhat small and shrivelled. *H. grandis* is also confined to wheat, and produces two generations in the year, but as it is easily controlled its powers of destruction can be kept in check. Breeding experiments indicate that each species is probably confined to a single host, as it has proved impossible to induce the more important forms to attack other crops than that with which they are normally associated. The jointworms are much subject to parasitic attacks, and for this reason do not often get quite

out of hand and destroy an entire crop; but, even so, they exact a toll of from 1 to 5 bushels per acre unless control measures are adopted. Experiments seem to show that ploughing under the stubble is the most effective remedy, as wholesale destruction of the insects is thus brought about. It would be necessary to arrange the crop rotation so as to allow the wheat-stubble to be ploughed up, but if this could be done it is estimated that millions of dollars could be saved yearly.

Parasites such as lice and mites cause considerable loss in the poultry industry by reducing egg-production and injuring the quantity and quality of the flesh of the birds. A cheap but effective remedy is therefore much to be desired, and it is now claimed by F. C. Bishop and H. P. Wood (Farmers' Bulletin 801, U.S.A. Dept. Agric.) that sodium fluoride fulfils these conditions, and that, if properly used, one application will completely destroy all the lice present on any bird. The treatment can be carried out by dusting or by dipping. In the former case pinches of the fluoride are placed among the feathers close to the skin on the parts most frequently attacked; dusting with a shaker is less effective, and also causes more irritation to the nose and throat of the operator. In the latter case ¾–1 oz. of commercial sodium fluoride is dissolved in a gallon of tepid water, and the birds are then dipped for a few seconds. The lice die more rapidly in this case than when the dry powder is used. It is estimated that the cost of treatment works out to about one farthing per bird, 1 lb. of sodium fluoride sufficing for about a hundred hens.

Investigations of the Upper Air.[1]

THE interesting publications referred to below deal with the investigation of the upper air, the first two being written in German. Dr. Everdingen, in Holland, has experienced the same difficulty that has occurred in England and elsewhere in carrying on the investigation owing to the scarcity and badness of the necessary materials, on account of which the mean height of the kite and captive-balloon ascents, when compared with that of previous years, was reduced considerably. The two years' reports contain full particulars of each ascent made; they are noteworthy as showing the increasing importance of aeroplanes compared with the old method of kites as a means of observation.

The third publication, Geophysical Memoirs, No. 14, gives an account of the pilot-balloon ascents made in November and December, 1911, by Capt. Cave and Mr. J. S. Dines in the Scilly Isles. Plenty of information about the relation of the wind to the surface-pressure gradient up to a few kilometres height over land is available, but similar information about the wind over the sea is very scarce. The expedition to the Scilly Isles was planned and carried out by Capt. Cave expressly to meet this want, and the results, which contain a large and useful amount of information, have at last been published.

The islands are noted for their fine formation of rock, and they are exposed to the full force of the Atlantic gales; in no part does the surface rise much above the sea-level, and the whole land area is small, thus the influence of the land on the air-currents must also be small. Moreover, except to the south-west, readings of the barometer are available, and hence the isobars on the daily weather charts can be drawn in the neighbourhood of the islands with fair precision.

The balloons were mostly followed by two theodolites at the ends of a base line of 5260 metres, but on a few occasions, on account of the difficulty of reaching the distant station, only one was used. The period covered was from November 22 to December 8. The weather was mostly rough and stormy with a prevalence of clouds, so that the balloons could seldom be followed to any great height, but the conditions were very favourable for the purpose of the observations. The authors found, as they expected, that the effect of surface-friction is far less at St. Mary's than inland, and they give the loss of velocity at the anemometer head at Scilly as 20 per cent., against 35 to 50 per cent. at Ditcham Park.

The question of the rate of ascent of pilot balloons is considered. The same kind of balloon was used as at Ditcham Park and the same free lift given. The mean rate of ascent was 160·6 metres per minute. It has been found inland that balloons show a tendency to rise faster in the first half kilometre, but this was not the case at Scilly. The rate of ascent varied considerably from minute to minute, but no systematic difference was found, and hence the authors conclude that the general results obtained from single theodolites may be looked upon as quite trustworthy

The last section deals with the type and height of the clouds prevalent during each ascent, and some evidence was found of the motion of the upper clouds away from the centre of the depression which dominated the weather at the time.

The whole memoir is very interesting and should be read by every student of meteorology.

1 "Koninklijk Nederlandsch Meteorologisch Institut," No. 106. "Ergebnisse Aerologischer Beobachtungen," parts v. (1916) and vi. (1917). Air Ministry. Meteorological Office. Geophysical Memoirs, No. 14: "Soundings with Pilot-balloons in the Isles of Scilly."

Bionomics of *Glossina palpalis*.

NO. XVII. of the Reports of the Sleeping Sickness Commission of the Royal Society (H.M. Stationery Office, price 4*s*. net), which has recently been issued, includes the third, fourth, and fifth reports on the bionomics of *Glossina palpalis* on Lake Victoria by Dr. G. D. Hale Carpenter, of the Uganda Medical Service.

Interesting descriptions are given of the natural features and of the fauna and flora of the thirty-six islands visited. These should be consulted in the original by those interested. From a study of the conditions prevailing in these islands it was deduced that the conditions for the prevalence of fly above the average are (1) suitable breeding-grounds, viz. dry sand or gravel ridges representing old lake-shore levels; (2) abundant shade combined with open spaces to permit of the movements of the fly; and (3) absence of large spiders (? Nephila).

The characters of a suitable breeding-ground are the following: (1) Loose soil, (2) dry soil, (3) well-ventilated soil, (4) adequate shade, and (5) within 20–30 yards of water. Further research will probably enable us to define these conditions still more precisely and to decide whether they, as one would expect, are also the optimum for the development of pupæ.

The practical suggestion is made that fly may be controlled by constructing artificial shelters with the characters above defined which would be attractive to the fly as breeding-grounds, and where the pupæ would be regularly collected and destroyed. It might be possible to add some chemical to the soil in these shelters which would obviate the necessity of collection and destruction. The author has established the fact that flies pupate in these shelters.

The report is an example of the value of the methodical collection of data. Whether the destruction or control of Glossina, which seemed at first sight an almost hopeless quest, can be achieved by this method we shall no doubt soon learn.

J. W. W. S.

Dante and Trepidation.

IN a note entitled "La trepidazione in Dante?" (Atti della R. Accad. di Torino, vol. lii., p. 353) Signor O. Z. Bianco discusses the novel interpretation given by Duhem ("Le Système du monde," t. iv., chap. x.) of a well-known passage in the "Paradiso" (xxvii., 142–48):

> But ere that January pass to spring
> Through that small hundredth men neglect below,
> These higher spheres shall with loud bellowings ring;
> The tempest fierce, that seemed to move so slow,
> Shall whirl the poops where now the prows we see,
> So that the fleet shall on its right course go;
> And following on the flower, the true fruit be.
> (*Plumptre's translation.*)

The first two lines clearly allude to the difference between the Julian year and the true value of the tropical year, which Dante assumed equal to 1/100 day, the neglect of which was gradually making the spring equinox occur earlier, and would (if the error were not corrected) eventually make the spring begin in January. Duhem suggested that the second half of the passage alludes to the so-called trepidation of the equinoxes. According to the theory formulated by Tâbit ben Korra in the ninth century, the equinoxes do not move uniformly from east to west, but alternately advance and recede in a period of more than four thousand years. This imaginary phenomenon is not alluded to by Al Fargani, from whose text-book Dante seems to have derived his astronomical knowledge. Signor Bianco rejects Duhem's suggestion, which is at variance with what Dante says elsewhere ("Convito," ii., 6; "Purgat.," xi., 108) about the slow motion of 1° in a hundred years. It is surely much more natural to suppose that the poet simply meant that long before the spring equinox after some thousands of years had moved back into January, great upheavals would take place in Italy.

Japanese Botanical Work.

THE Journal of the College of Science of the Imperial University of Tokyo, vol. xliii., contains (article 1) an admirably illustrated monograph (in English) of the genus of brown seaweeds, Alaria, by Prof. K. Yendo. The author has studied the various species on the west coast of Vancouver Island, along the coast of the Kurile Islands and of Kamtschatka as well as in Japan, and also the material in some of the important European herbaria. The descriptive portion is preceded by a general account of the morphology, structure, and development. The vexed question of the cryptostomata in the brown seaweeds is discussed at some length, and the author concludes that these tufts of hairs, at any rate in the Laminarias, may be regarded as absorptive organs. A *résumé* is also given of the differing views held as to the life-history, especially as to evidence on the manner of renewal of the blades, of Alaria, which, the author considers, "may be either gradual or sudden, according to the conditions of the place where the plant grows." As regards the economic uses of Alaria, though *A. esculenta* was extensively used for food in earlier times in North-West Europe, and this and other species are still eaten in various sub-Arctic areas, the author concludes that the genus has very little value as human food or for kelp-ash. For manure it may be used equally well with other brown seaweeds. The species inhabit the colder northern seas, the greatest number being found within a range from about 42° N. up to the Arctic Circle. Fifteen species are recognised. Of these full descriptions are given, variations in form and synonymy are discussed, and a list of localities is cited. The form and structure of the species are illustrated in nineteen excellent double-page plates.

The same volume contains a short paper (article 2) by T. Matsushima describing investigations on the transpiration of cut branches, and an ecological study (article 3) by Y. Yoshii of the Ota dunes—both in German.

In the "Icones Plantarum Formosanarum," vol. viii., Bunzo Hayata continues his descriptive work on the flora of the Island of Formosa, based on the study of the collections of the Botanical Survey of the Government of Formosa. The present volume contains descriptions of species and varieties of flowering plants in various families, and of ferns; 111 new species and 17 varieties are included. The total number of species of the flora is brought up to 3458, contained in 1174 genera representing 169 families. The genus Citrus (orange, lemon, etc.) is treated at some length, as also are the figs, Ficus, of which the author recognises 29 species in Formosa. In addition to eighty-eight text-figures, the species are illustrated by fifteen excellent full-page plates showing habit and floral dissections.

Researches on Egyptian Cotton.

THE newly appointed Cotton Research Board for Egypt has issued a Preliminary Report, in which a sketch is given of the general significance of the Egyptian cotton crop and the formation and proposed operations of the new Board are described. Plans of the buildings under construction are shown, and a few illuminating figures serve to bring home to the reader the immense volume of detailed information required in the modern study of crops. An outline of the field of work to be undertaken by a staff of eleven non-Egyptian scientific workers and twenty Egyptians is given for the botanical, entomological, chemical, and physical sides, though the Board is rightly careful not to bind itself to a definite programme.

Those interested in cotton or in Egypt cannot fail to be very glad that this Board has at last come into existence, but the matter is of wider interest in that a move has here been made towards the separation of administration from research. Both functions have been hampered in the past history of many agricultural services by mutual confusion, and we anticipate that the step taken by Egypt in this matter will be generally adopted.

The only criticism we would offer on this report is upon the reason given for the establishment of the Board, to wit: "Past experience of . . . the disadvantages attaching to the investigation of cotton problems from the point of view of any one branch of science." We would rather have judged that Egyptian cotton had been singularly fortunate in the informal and voluntary co-operation of every branch of science, the schools of medicine and engineering, and the departments of survey and geology, as well as the agricultural organisations, having given invaluable help in all directions. We would suggest that past experience showed rather the need for a body (such as this Cotton Research Board) which would

cut across departmental boundaries, and give official status and help to the scientific co-operation already in existence. It is to be hoped that the Board may ultimately see its way so to extend its ranks as to effect *liaison* with bodies outside the official Egyptian Service. W. LAWRENCE BALLS.

University and Educational Intelligence.

CAMBRIDGE.—Applications are invited for the George Henry Lewes studentship in physiology, value 245*l*. Candidates must send their applications, with particulars of their qualifications and the subject of their proposed research, by July 31 to Prof. Langley at the Physiology School.

A further gift of 6000*l*. has been received from Mr. and Mrs. P. A. Molteno to meet the increased cost of labour and material in the building of the Molteno Institute of Parasitology. This avoids the need to reduce the accommodation originally proposed.

Mr. R. H. Vernon, Gonville and Caius College, has been appointed assistant to the professor of chemistry.

Honorary degrees are being conferred on the Spanish Ambassador, the President of Harvard University, Prof. H. Cushing, and Prof. J. J. Abel.

GLASGOW.—The following were among the degrees conferred on July 19:—*Doctor of Medicine (M.D.)*: (i) With Commendation: James Gordon Wilson—thesis, "A History of Influenza and its Variations." (ii) Ordinary Degrees: Albert Barnes Hughes—thesis, "Puerperal Eclampsia"; Donald MacKenzie MacRae—thesis, "The Bechuanaland Protectorate: Its People and Prevalent Diseases, with a special consideration of the effects of tropical residence and food in relation to health and disease"; and John Young—thesis, "Bacillary Dysentery."

LONDON.—Mr. Fisher, President of the Board of Education, has stated, in reply to a question asked in the House of Commons relating to the offer of the Bloomsbury site to the University of London, that when the time comes for King's College to move from the Strand to Bloomsbury, the Government is prepared to seek authority to purchase, at a fair valuation, the buildings at present occupied by King's College in the Strand, and the price so paid will be available towards the cost of the new buildings to be erected for King's College on the new site.

SHEFFIELD.—Dr. R. B. Wheeler has been appointed to the recently established chair in fuel technology, and Mr. Douglas Knoop to that of economics.

SIR JESSE BOOT has made a gift of 50,000*l*. to University College, Nottingham, in aid of the development of the scheme for a University of Nottingham. 30,000*l*. is for the building fund and 20,000*l*. for the foundation of a chair of chemistry.

THE council of University College, Swansea, has made the following appointments to headships of departments, viz.:—*Professor of Metallurgy:* Prof. C. A. Edwards. *Professor of Chemistry:* Dr. J. E. Coates. *Professor of Physics:* Dr. E. A. Evans. *Professor of Mathematics:* Lt.-Col. A. R. Richardson. *Lecturer in Geology:* Dr. A. E. Trueman. *Lecturer in History:* Mr. E. Ernest Hughes.

THE Trustees of the Beit Fellowships for Scientific Research, which were founded and endowed in 1913 by Sir Otto Beit to promote the advancement of science by means of research, have recently elected Mr. M. A. Hogan to a fellowship. Mr. Hogan was educated at the Catholic University School, Dublin, 1907–15, and has been a student at the University College, Dublin (National University of Ireland), from 1915 to date. Mr. Hogan will carry out his research at the Imperial College at South Kensington.

THE Industrial Fellowship System for the promotion of industrial research, originated by Prof. Robert Kennedy Duncan, has been in successful operation in the University of Pittsburgh since September, 1911. Full particulars of the system are given in a pamphlet by Mr. T. Ll. Humberstone published by the Board of Education. The seventh annual report of the Mellon Institute, founded in the University in 1913, states that the total funds contributed by industrial firms for the nine years ending March 1, 1920, was 1,213,425 dollars, and that in the year 1919–20 the number of fellowships was 47 and the number of fellows 83, the fellowships being 35 for individuals and 12 for groups of workers. A list of fellowships in operation at March 1, 1920, is published, which shows the great diversity of subjects of industrial research to which the scheme has been applied. The fact that the resources of the institute are fully used, and that applications exceed the available accommodation, is convincing evidence of the soundness of the principles on which the system is based. The institute is administered by the director, Dr. Raymond F. Bacon, assisted by an associate director and three assistant directors, who prepare schemes of research work, select the fellows, and supervise their investigations.

THE foundation-stone of the new buildings of the University College of Swansea was laid by his Majesty the King on Monday, July 19. A magnificent site of forty-five acres in Singleton Park, on the shores of Swansea Bay, has been presented to the college by the Corporation of Swansea, which has also granted the temporary use of Singleton Abbey for the housing of the faculty of arts and the administrative offices of the college. It should be a matter of encouragement to the council of the college that the main features of its policy received marked approval and support in the terms of the King's reply to the address of welcome on Saturday last. It is the natural ambition of Swansea to build up a strong School of Applied Science, including a department of metallurgy of the first rank. At the same time the educational ideals of the Welsh people demand for the great population of this industrial district the fullest provision for the study of the humanities and for the advancement of learning in the widest sense. The authorities of the college are fully alive to the magnitude of their opportunities and the greatness of their trust. Unmistakable proofs have already been given by representatives of all classes of deep interest in the work of the college and a determination to secure practical assistance. The wide publicity afforded by the Royal visit and the statesmanlike terms of the King's address cannot but serve to widen and strengthen both enthusiasm and practical support. The concluding terms of the King's reply to the address of welcome were as follows:—"Efficiency is much, but it is not all. We must never forget that education is a preparation for life, and that its true aim is the enlargement of the human spirit. It will be the task of your college to send out into the world men and women fully equipped for the material work which awaits them, and with minds attuned to high ideals, opened to the rich and varied interests of modern life, and steadfastly set towards the service of their fellows."

Societies and Academies.

EDINBURGH.

Royal Society, June 7.—Prof. F. O. Bower, president, in the chair.—D. **Balsillie**: The intrusive rocks of the Dundee district. These belong to two types, viz. diabases and felsites. The former are generally fine-grained dark masses that contain hypersthene and free quartz, which minerals, along with monoclinic pyroxene and abundant plagioclase felspar (60 per cent. anorthite), occur in a highly felspathic ground mass. Hornblende, biotite, iron ores, and apatite occur as accessories, the first-mentioned, however, only rarely. Occasionally free quartz disappears, the place of hypersthene being then taken by olivine. As a type of olivine diabase may be cited the large intrusive mass near Newton, west from Auchterhouse station. The hypersthene diabases are characterised by the presence of acid segregation veins that often show beautiful graphic intergrowth of quartz and felspar. Nearly all these basic rocks are much altered, the phenomenon of albitisation being of frequent occurrence, and typically displayed in the diabases of Castle Huntly, west from Dundee. The pink rocks would probably have been classed by the older writers as mica oligoclase porphyrites, which name still sufficiently describes them. Reference was also made to an outcrop of highly solidified ash occurring at Mill of Mains, north of Dundee, that probably marks the site of an old volcanic vent. In discussing the age of the intrusions, the opinion was put forward that these rocks of the Dundee district should be regarded as belonging to the volcanic cycle of Lower Old Red Sandstone times.—F. L. **Hitchcock**: An identical relation connecting seven vectors.

June 21.—Prof. F. O. Bower, president, in the chair.—J. **Goold**: The musical scale. The author described a new way of regarding the genesis of the musical scale. Beginning with the four notes, or with the three perfect fifth intervals determined by the four notes F, C, G, and D, the author showed that the group of four notes a major third above these, and the third group of four notes a major third below them, gave, when reduced to the range of one octave, all the notes of the recognised chromatic scale. Another point emphasised was that all the notes of the scale had relative frequencies which depended on powers and products of the numbers 3 and 5.—J. **Marshall**: A law of force giving stability to the Rutherford atom. It was shown that if the law of force between a positive nucleus and a negative electron were of the form

$$\frac{1}{r^2}\left(1-\frac{b^{n-2}}{r^{n-2}}\right)$$

a value of n can be found which will preserve the stability of a group of electrons not exceeding seven in number. Since b is small compared to the radius of an atom, this law is indistinguishable from the inverse square law for distances large in comparison with the radius of the atom. If in the case of an atom built up of a series of rings of electrons the tentative assumption be made that the inner rings act on the individuals of the outer rings as if the inner set were replaced by an equivalent charge at the centre, the investigation may be generalised to include such cases also; and it is found that for displacements perpendicular to the plane of the orbit the configuration is unstable when the number of electrons in the outer ring exceeds seven. This would seem to indicate that the atom could be built up of a series of rings of seven electrons, and that we should expect a periodicity in the chemical properties of the atoms corresponding to Mendeléeff's classification, which was stated by Newlands in 1864 in the form: "The eighth element starting from a given element is a kind of repetition of the first."—Prof. A. W. C. **Menzies**: The explanation of an outstanding anomaly in the results of measurement of dissociation pressures.—Prof. J. A. **Gunn** and Dr. D. G. **Marshall**: The harmala alkaloids in malaria.

PARIS.

Academy of Sciences, July 5.—M. Henri Deslandres in the chair.—A. **Lacroix**: An eruption of the Karthala volcano at Grand Comore in August, 1918. This eruption commenced with a quiet flow of lava; a fortnight later explosions commenced, with emission of ashes reaching a great height. The explosive emission is considered as being probably due to the action of superficial water.—Em. **Bourquelot** and M. **Bridel**: The biochemical preparation of cane-sugar, starting with gentianose. Experiments made in 1910 indicated the probability of cane-sugar being one of the products of emulsin on gentianose, but the sugar could not be isolated. In 1920, using emulsin specially purified from traces of invertin, after separation of the glucose as β-methylglucoside, saccharose was obtained in a pure state.—A. A. **Michelson**: The application of interference methods to astronomical measurements. A development of a method described in the *Philosophical Magazine* in 1896. Measurements on Capella made with the 250-cm. reflector at Mount Wilson Observatory gave the parallax of this star as slightly under $0{\cdot}050''$, with an accuracy of about 1/100oth of a second of arc. Experiments at Mount Wilson on a larger scale are contemplated.—W. **Kilian** and P. **Fallot**: The existence of the facies of various Jurassic layers in the province of Tarragon (Catalonia).—A. **Righi**: Observations concerning a recent note on Michelson's experiment. An adverse criticism of some calculations by M. Villey.—W. **Sierpinski**: The measurable B ensembles.—E. **Cartan**: The projective applicability of surfaces.—E. **Berger**: The production of chlorides with a primer.—M. **Godchot**: The oxidation of coal. The experiments described afford no support to the view recently put forward that the oxidation of coal results from the action of bacteria pre-existing in the coal.—E. E. **Blaise**: The action of substituted hydrazines upon acyclic 1 : 4-diketones. A study of the reaction between dipropionylethane and phenylhydrazine. Substituted hydrazines give pyrrol derivatives with 1 : 4-diketones.—M. **Delépine**: Ethylene sulphide, C_2H_4S. Previous attempts to prepare the sulphur analogue of ethylene oxide have been unsuccessful. It can be obtained by the action of sodium sulphide upon ethylene chlorothiocyanate, $CH_2Cl{\cdot}CH_2{\cdot}CNS$, and subsequent distillation in a current of steam. Ethylene thiocyanate, $CNS{\cdot}CH_2{\cdot}CH_2{\cdot}CNS$, can replace the chlorothiocyanate in this preparation.—J. **Bougault** and P. **Robin**: The iodoamidines. Benzamidine with iodine and dilute soda solution gives the compound $C_7H_8N_2I$, in which the iodine is attached to a nitrogen atom, since it is quantitatively removed by potassium iodide in acid solution. The reaction appears to be a general one for amidines.—M. **Guerbet**: A reaction for benzoic acid based on its diazotisation: its application to toxicological detection of atropine, cocaine, and stovaine. The reaction is based on the production of β-naphtholazobenzoic acid, and will detect readily 0·1 milligram of benzoic acid.—P. **Idrac**: Convection currents in the atmosphere in their relation to hovering flight and certain forms of clouds.—P. **Nottin**: The absorptive power of earth for manganese. When manganese solutions are treated with soil, manganese is fixed and some lime

is found in solution. Calcite was proved not to react with manganese salts, but lime was dissolved from aragonite and manganese retained.—M. **Gallaud**: A race of wallflowers with multiple and hereditary anomalies.—A. **Marie** and L. **MacAuliffe**: Study of 344 gypsies. An anthropometrical comparison with the French race.—E. **Roubaud**: The mode of action of powdered trioxymethylene on the larvæ of Anopheles. Further details of the best method of using trioxymethylene for the destruction of mosquito larvæ.—J. **Dufrenoy**: The excretion of vital colouring matters and degenerescence in Ascidians.—E. **Chatton**: A morphological and physiological xeno-parasitic complex: *Neresheimeria catenata* and *Fritillaria pellucida*.—R. **Combier**: The purification of sewage by activated sludge.—A. **Mayer**, L. **Plantefol**, and A. **Tournay**: The physiological action of symmetrical dichlorodimethyl ether.

CAPE TOWN.

Royal Society of South Africa, May 19.—Dr. A. Young in the chair.—J. **Moir**: Colour and chemical constitution. Part xi.: A systematic study of the brominated phenolphthaleins regarding the relation between position and colour. The spectra of twenty-three bromine derivatives of phenolphthalein are described, these being selected from the 658 possible isomers so as to give clear evidence of the value of each of the twelve possible positions for bromine as regards change of colour. These values are tabulated, whereby any of the uninvestigated isomers should be calculable. Phenolphthalein differs from benzaurine in not having a negative paraposition; hence the author concludes that the current chemical formula for the former is incorrect, and suggests a new formulation.—J. R. **Sutton**: The relationship between cloud and sunshine. A brief discussion of the observations of sunshine and cloud made during the twenty years 1900–19 at Kimberley. In a general way much sunshine postulates little cloud; but the relation is not intimate, and a sunshine recorder cannot be regarded as an automatic device for determining the cloudiness of the sky. August gets the most sunshine and February the most cloud.—Miss Ethel M. **Doidge**: The haustoria of the genera Meliola and Irene. The fungi belonging to the genus Meliola are true parasites, sending haustoria into the cells of the host. The most common type is that which has a fine filament penetrating the cuticle and a small globular, thin-walled, uninucleate vesicle in the epidermal cell. Certain species penetrate through the epidermis, through sclerenchyma cells, if these are present, into the first chlorophyll-containing cells of the mesophyll. The haustoria cause a considerable disorganisation of the cells into which they penetrate, and the mycelium completely blocks many of the stomata.

SYDNEY.

Linnean Society of New South Wales, May 26.—Mr. J. J. Fletcher, president, in the chair.—Dr. R. J. **Tillyard**: The Neuropteroid insects of the Hot Springs Region, New Zealand, in relation to the problem of trout-food. Examination of the contents of trout-stomachs showed that the most abundant foods were the green manuka-beetle, *Pyronota festiva*, the larvæ of caddis-flies of the family Leptoceridæ, and a small mollusc, Potamopyrgus sp. Less abundant were larvæ of dragonflies, mayflies, stoneflies, other families of caddis-flies, etc. Since the introduction of the trout the insect fauna of the region has been very greatly reduced, the percentage reduction being estimated as follows: Mayflies, more than 50; stoneflies, 80; and caddis-flies, 90. In the vicinity of a few streams to which the trout have no access insects are still comparatively very abundant. Suggestions for improving the position are made along two lines: (1) Improvement of the food-supply, and (2) reduction in the number of trout.—Dr. R. J. **Tillyard**: The Panorpoid complex. Additions to part 3. Additional evidence is brought forward from the study of the pupal tracheation of *Morova* (*Siculodes*) *subfasciata*, Walk., to support the conclusion that it is unlikely that any existing Heteroneurous type represents even a close approximation to the original archetype of the Rhopalocera.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. vi., No. 1, January).—C. **Barus**: An example of torsional viscous retrogression. Observations interesting in their bearing on Maxwell's theory of viscosity.—C. M. **Myers** and C. **Voegtlin**: The chemical isolation of vitamines. The method eliminates purines, histidine, proteins, and albumoses, leaving a liquid that can be crystallised, and probably contains histamine or histamine-like substances. The physiological action of the active fractions resembles that of extracts from the mucosa of the small intestine when the intestinal and yeast extracts are purified in the same manner.—C. G. **Abbot**: A new method of determining the solar constant of radiation. A method using the pyranometer applicable on many more days than the old method, and having the advantage that several independent observations of the solar constant may be made on a single day.—F. G. **Benedict**: The basal metabolism of boys from one to thirteen years of age. A formula and a curve are given, and it is shown that, although age and stature as well as body-weight must be considered in predicting heat output for adults, it is not necessary to consider more than the body-weight in the case of boys—a fact probably due to the close correlation between the changes in age, weight, and stature for boys.—R. A. **Dutcher**: The nature and function of the antineuritic vitamine. A general review of the theory, with numerous references, is followed by a brief sketch of the author's work, suggesting that the hormone supply is dependent upon the vitamine-content of the food.—H. F. **Osborn** and C. C. **Mook**: Reconstruction of the skeleton of the Sauropod Dinosaur Camarasaurus, Cope (Morosaurus, Marsh); and W. K. **Gregory**: Restoration of Camarasaurus and life-model. A restoration both in the articulature and in the musculature, with a brief statement of the essential characteristics of each.—W. D. **Matthew**: Plato's Atlantis in palæogeography. It is suggested that the present conformation of the Atlantic bottom dates back, in part at least, to the Palæozoic era.—A. A. **Noyes** and D. A. **MacInnes**: The ionisation and activity of largely ionised substances. A general discussion, with considerable bibliography, leading to the conclusion that most of the largely ionised inorganic substances at moderate concentration may be considered as completely ionised, and the decrease in the conductance-ratio wholly attributed to the decrease of ion mobility, and the change in activity-coefficient entirely attributed to some unknown effect of a physical nature.—A. C. **Lunn**: The commutativity of one-parameter transformations in real variables. A proof previously given by Lie and Engel applicable to analytic functions is supplanted by a proof assuming the existence of continuous first partial derivatives only.—D. L. **Webster**: The intensities of X-rays of the L series. II.: The critical potentials of the platinum lines. After a discussion of the special apparatus employed, a discussion of the lines observed places six lines in L_1, six in L_2, three in L_3. The faint lines of Dershem and Overn are unassigned.

Critical points and intensity ratios are discussed.—J. B. **Murphy**: The effect of physical agents on the resistance of mice to cancer. The evidence points to the lymphoid tissue as an important agent in the immunity reaction of transplanting cancer of mice.—H. C. **Sherman**: The protein requirement of maintenance in man. For the maintenance of healthy men and women an intake of not more than 35–45 grams of protein per "man" of 70 kg. per day is sufficient even when the protein is not especially selected, and hence the "standard" allowance of 1 gram of protein per kg. of body-weight per day provides an ample margin of safety.—R. P. **Cowles**: The transplanting of sea-anemones by hermit crabs. A study of behaviour with the problems it presents in this particular case.—J. A. **Anderson**: Spectra of explosions. Discussion of a new method for obtaining intense spectra of short duration, the new source of light being of the order of one hundred times the brilliancy of the sun.—Report of the Autumn Meeting: The report contains items of business, including the award of medals, the distribution of research grants, and the list of papers read before the Academy.

Books Received.

Gold: Its Place in the Economy of Mankind. By B. White. Pp. xi+130. (London: Sir I. Pitman and Sons, Ltd.) 3*s*. net.

British Museum (Natural History). Catalogue of the Lepidoptera Phalænæ in the British Museum. Supplement, vol. ii. Catalogue of the Lithosiadæ (Arctianæ) and Phalænoididæ in the Collection of the British Museum. By Sir George F. Hampson. Plates xlii–lxxi. (London: British Museum (Natural History).) 32*s*. 6*d*.

Splendours of the Sky. By Isabel M. Lewis. Pp. vii+343. (London: J. Murray.) 8*s*. net.

The United States Forest Policy. By Prof. J. Ise. Pp. 395. (New Haven: Yale University Press; London: Oxford University Press.) 21*s*. net.

Lectures on Modern Idealism. By J. Royce. Pp. xii+266. (New Haven: Yale University Press; London: Oxford University Press.) 12*s*. 6*d*. net.

The Mediæval Attitude towards Astrology, particularly in England. (Yale Studies in English, No. lx.) By T. O. Wedel. Pp. vii+168. (New Haven: Yale University Press; London: Oxford University Press.) 10*s*. 6*d*. net.

Some Famous Problems of the Theory of Numbers, and in particular Waring's Problem. An Inaugural Lecture delivered before the University of Oxford. By Prof. G. H. Hardy. Pp. 34. (Oxford: At the Clarendon Press.) 1*s*. 6*d*. net.

Anthropology and History. Being the twenty-second Robert Boyle Lecture delivered before the Oxford University Junior Scientific Club on June 9, 1920. By W. McDougall. Pp. 25. (London: Oxford University Press.) 2*s*. net.

Manuel de Topométrie. Opérations sur le Terrain et Calculs. By J. Baillaud. Pp. vii+222. (Paris: H. Dunod.) 13 francs.

Bureau of Education, India. Indian Education in 1918–19. Pp. ii+86+plates. (Calcutta: Government Printing Office.) 1.8 rupees.

Ministry of Agriculture, Egypt. Report on the Maintenance and Improvement of the Quality of Egyptian Cotton and the Increase of its Yield. By H. Martin Leake. Pp. iv+38. (Cairo: Government Press.) P.T. 5.

The National Physical Laboratory. Report for the Year 1919. Pp. 152. (London: H.M. Stationery Office.) 5*s*. net.

Dictionary of Explosives. By A. Marshall. Pp. xiv+159. (London: J. and A. Churchill.) 15*s*. net.

The North of Scotland College of Agriculture. Guide to Experiments at Craibstone, 1920. Pp. 44. (Aberdeen: Milne and Hutchison.)

Ministry of Public Works, Egypt. Report on Psychrometer Formulæ based on Observations in Egypt and the Sudan. (Physical Department Paper No. 2.) By E. B. H. Wade. Pp. ii+45–72+2 plates. (Cairo: Government Press.) P.T. 5.

The Journal of the Royal Anthropological Institute. Vol. xlix., July to December, 1919. Pp. 181–370+12. (London.) 15*s*. net.

An Ethno-Geographical Analysis of the Material Culture of Two Indian Tribes in the Gran Chaco. (Comparative Ethnographical Studies, i.) By E. Nordenskiöld. Pp. xi+295. The Changes in the Material Culture of Two Indian Tribes under the Influence of New Surroundings. (Comparative Ethnographical Studies, ii.) By E. Nordenskiöld. Pp. xvi+245. (London: Oxford University Press.) 20*s*. net, 2 vols.

Ministry of the Interior, Egypt. Department of Public Health. Reports and Notes of the Public Health Laboratories, Cairo. Egyptian Water Supplies. Pp. ii+105. (Cairo: Government Press.) P.T.20.

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NOTICE.

In consequence of the greatly increased cost of production, the published price of "NATURE" has been raised from 9d. to **1s.**, and the Subscription and General and Displayed Advertisement rates revised.

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Quarterly (13 Nos.)	13 0	16 0

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