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Contacts of Education and Industry.

THE Committee appointed by the President of the Board of Education and the Minister of Labour "to inquire into and advise upon the public system of education in relation to the requirements of trade and industry, with particular reference to the adequacy of the arrangements for enabling young persons to enter into and retain suitable employment," has now presented its second report,¹ which deals with the first part of the terms of reference. Already details of its recommendations have appeared in the press; and already certain criticisms of those recommendations, particularly with regard to their cautious framing, have been made.

It is not our purpose to attempt a defence against such criticisms. There can, indeed, be little doubt as to the cautious framing of the report. Its attitude towards the raising of the school leaving age, for example ("for the reasons given in the body of our report, we do not submit any recommendations . . ."), is doubtless disappointing when the weight of other opinion is considered. Its attitude, too, towards the development of full-time instruction in technical schools (which "must be considered with due regard to the factors of supply and demand") may not be very heartening. That the result of the growth of the internal system of examination is regarded as satisfactory; that "criticisms relating to basic subjects [taught in elementary schools] are too sweeping and are frequently made on insufficient ground"; that authoritative industrial opinion does not favour vocational training in primary schools; that the educational principles formulated by the Hadow Committee are accepted; that industry would benefit by a larger intake of pupils from secondary schools, and that to accomplish this the difficulty occasioned by the age of entry into apprenticeship, namely, sixteen years, "should be examined by the industries concerned"; that the grouped course system in evening schools is justifiable but should be more elastic; and that the system of advisory committees in connexion with technical schools "should as far as possible be made universal": all these points will be noted perhaps with a little impatience by those to whom the problems are familiar, and in their search for recommendations which shall show means of swift solution of these problems they may be apt to overlook not only the profounder

¹ Report of the Committee on Education and Industry (England and Wales). Second Part. Pp. 79. (London: H.M. Stationery Office, 1928.) 9d. net.

significances of this report, but also the fact that another committee, which has presented its report recently, has been dealing with the same terms of reference applied to Scotland.²

The two reports have been cast along similar lines, but the Scottish report seems bolder in its decisions. If the English committee hesitates concerning the school leaving age, the Scottish committee does not: in its first report it supported the raising of that age; in preparing this report the evidence "has confirmed us in the opinions therein expressed." Unlike the English report, too, it says clearly "attention should be given to the need for further development of whole-time technical education."

Probably the most disappointing feature of the English report is the fact that definite views were difficult to obtain from industrial sources. Yet both committees emphasise the need for employers to interest themselves in educational provision. The Scottish report puts it well:

"It is not merely that they have an interest in seeing that the money they provide is intelligently spent. They depend for their success on the mental calibre of their workers. The employer takes every care to obtain good raw material and machinery that is economical and efficient; he should be equally careful to obtain workers who will be able to use their brains as well as their hands in the fashioning of the material and the tending of the machinery."

We would commend that passage to the National Confederation of Employers' Organisations, which appears to have found itself unable to give authoritative answers to any questions except those of the raising of the school leaving age and the establishment of compulsory day continuation schools—both of which it opposed.

In spite of the fact, however, that the Confederation was unable to submit its views to the test of examination by oral evidence, we would underline its view that "the absence of collective views on the part of employers is due largely to lack of knowledge of the system," and its hope "that some way may be found of increasing that knowledge and securing contact and practical co-operation." We quote these two statements because we agree with the committee that they "remove the suspicion that the employers of this country had already formulated a body of definite views and requirements which were being ignored by those responsible for education." We agree also with the Committee's view that, since educa-

tional nomenclature is a source of difficulty, the Board of Education should issue a short handbook descriptive of the educational system. Anything which will help employers to repair their lack of knowledge of the system and so enable them to contribute their views must be done speedily—particularly since the Committee has rightly insisted that "industries must define their needs, and no other body can do it for them." Not entirely unconnected with this is the indifference of employers to technical education, and the fact that its importance is missed also by many educationists.

Valuable as all this may be to clear the ground for the *rapprochement* between education and industry, it does not present what we have called the profounder significances of the reports. There are pointers in both to the wider and deeper aspects of the problems under review.

The employer is recommended to look on primary, secondary, continuation, and technical education not as four distinct types, but as mutually related elements in a coherent system. He is advised to do this immediately, because "unless there is a totally unforeseen reversal of educational ideals this conception of education above the age of 11 is likely to be put into practice within a generation." No employer ought to miss the point of that quotation, particularly the last phrase.

There is good reason, too, for the warning sounded concerning the urgency of a solution to these problems: "any special measures which can be taken to secure the contact which every one desires should be taken with all possible speed before the educational position becomes so solidified that any modifications, however desirable, will be extremely difficult if not impossible to make."

With such significant prophecy and warning before us, it becomes ever more urgent that we should not regard education and industry as two self-contained and separate matters which have in some way to be joined together. The reports do not fail, therefore, to indicate matters not always clearly visualised.

If criticisms are made concerning lack of discipline on the part of pupils now leaving school, the Scottish committee wisely points out that it is one of the faults not so much of the school as of lack of parental control during the War, and has been accentuated by subsequent years of trade depression and unrest. Poor housing conditions are also noted as a contributory factor. It thus becomes clear that a complete science of civilisation is necessary before ideals can be translated into

² Committee on Education and Industry in Scotland. Second Report. Pp. 40. (Edinburgh and London: H.M. Stationery Office, 1928.) 9d. net.

practice. The same may be said when complaints are made that pupils tend to want black-coated jobs rather than to enter industry. In this connexion we would refer our readers to *NATURE* of Nov. 12, 1927. In an article entitled "Technical Education and Industry" we summed up the views of educationists and industrialists given at the Leeds meeting of the British Association, and suggested that "if industry has correctly expressed its needs, and education can fulfil those needs, there ought not to be the slightest difficulty in placing every properly qualified student. That is surely an 'acid test' of the relationship between school and employment." We showed, however, that the present facts do not supply much evidence of that relationship, and, if firms find their administrative sides are more attractive to qualified students than their industrial sides, we asked:

"Is it not generally true that difference of status exists? Is it not generally true that in times of bad trade it is the production side which suffers, while the administrative side enjoys something very like permanence? Can the employers help to avoid this—a very real threat to the future skill and welfare of industry?"

We are glad to note, therefore, that both reports press the importance of this aspect of the problem.

"If the schools, to meet the wishes of industry," says the English report, "give some particular form to their product, industry must do its best to see that there are corresponding places to be filled, and filled beneficially, by recruits of this kind." "... the black-coated worker," says the Scottish report, "has a higher social status, better opportunities for advancement, and more chance of continuous employment, while usually his wages are in the long run higher than those of the average industrial worker."

There can be no doubt, too, that each report has placed a finger upon essential factors in the question of effecting contact between education and industry. The administrative structures of the two differ. Education "is organised primarily on the basis of local government areas. Industry ... is organised mainly on a national basis ... trade and commerce are for the most part organised on a local basis."

Clearly, therefore, to secure correlation there must be both local and national action. Both committees emphasise the value—indeed the necessity—of local inquiries, not so much for their immediate result on school curriculum and organisation, but for their effect of drawing employers and workers, teachers and administrators together to

get to know each other personally and to appreciate each other's point of view.

Both committees also see that such local inquiries must be supplemented by national action, and they therefore make what we regard as their most important recommendation, namely, that a small national committee, representative of the views of employers, workers, local education authorities, and teachers, should be established by the Board of Education (in the case of Scotland by the Scottish Education Department) to undertake the necessary national negotiations. Briefly, the function of that committee would be to inform trade and industry of the educational system, to assist trade and industry in the formulation of their views, and to consider with education authorities how far those views can be met. It may be remembered that the machinery of the Emmott Committee (cf. *NATURE*, Jan. 14, 1928) has already made such a committee possible.

We have said that the reports have profounder significances than may be realised at first sight, even though some of their recommendations may not appear to give clear and final answers to the problem faced. But it is better, we think, to formulate those problems so that they may be seen in relation to modern development, and so that their urgency becomes apparent, than to propose piecemeal legislation which touches but lightly root causes and tendencies. For this reason we congratulate both committees on their attitude. In doing so, however, we must not fail to emphasise the fact that neither report may be regarded as self-sufficient even in the formulation of the problems. Both must be read in conjunction with the reports of other committees which have dealt with the other angles of those very problems. We would therefore refer our readers, in addition to those of our issues to which we have already referred, to *NATURE* of April 9, 1927, p. 517; Feb. 5, 1927, p. 185; and Jan. 8, 1927, p. 69, where these earlier reports have been discussed.

Finally, since there are not lacking those who think the educational problems involved can be solved by the mere addition of so-called 'practical' subjects to a so-called 'liberal' curriculum, we would suggest that the following extract from the English report is evidence that the Committee has grasped an important point in educational philosophy which is often missed, particularly by educationists: "Special subjects should not merely be added to the curriculum, but should be correlated and interwoven with the other subjects of the curriculum."

Common Sense in Engineering and Philanthropy.

Alfred Yarrow: his Life and Work. Compiled by Lady Yarrow. Popular Edition. Pp. xii + 276 + 78 plates. (London: E. Arnold and Co., 1928.) 5s. net.

THIS book of nearly 300 pages and nearly 100 plates details very fully the life and work of a remarkable man, who, though active and useful at the present day, is eighty-six years of age. Reading it conveys the impression that Sir Alfred Yarrow is not so much a remarkably clever man, as one who is guided in his actions entirely by common sense. Perhaps he showed this very early in life when he declined to take interest in languages, having neither voice nor ear for music, but made great progress in realistic studies, such as physics and mathematics. He showed the same spirit in his pranks when he pumped air into a gas main and put the lights out, and when he caused the cook with a tray of glass to get an electric shock from an electrically charged plate, causing her to drop and smash all the glass.

Sir Alfred Yarrow began life as a marine engineer at Ravenhill's on the Thames. While he took interest in many other things, he has remained a marine engineer throughout his life. In 1857 he rigged up a private telegraph with one of his friends, and this is believed to be the first private telegraph in England. When between eighteen and twenty years of age, he invented and patented a steam plough, which was made by a firm of engineers to whom he became the agent for the sale, and in that capacity he made enough money to get started in business as a boat-builder. In 1868 he commenced building high-speed steam launches, and up to the year 1875 he had built 350 of these. Between that date and 1880 he built torpedo boats obtaining a speed of $20\frac{1}{2}$ knots. In 1878 the first vessel of this type performed a sea voyage successfully with Sir Alfred Yarrow and his wife on board. In 1880 a Russian torpedo boat built by Sir Alfred Yarrow attained a speed of 22 knots, and steamed to the Black Sea.

Up to this time, all torpedo boats had been fitted with compound engines, but in 1885, Sir Alfred made a triple-expansion engine which gave an increased speed. In 1887 the first water-tube boiler made by his firm was fitted (in a second class torpedo boat). In 1892 he made an aluminium vessel for the French, but neglect on the part of her owners to protect the aluminium discredited the use of this metal for a considerable time. Up to

this time locomotive boilers only had been used in the fast small ships, but in the year 1892, Yarrow built two vessels, the *Havock* and *Hornet*, the second of which had water-tube boilers, the adoption of which increased the speed to 27.3 knots. In 1894 the so-called destroyer *Sokol* was the first vessel to obtain a speed of 30 knots. High tensile steel was first used in the construction of this vessel, and she was fitted with eight water-tube boilers. In 1896 the Dutch Government fitted a cruiser with Yarrow boilers of 7000 h.p. and Scotch boilers of 2250 h.p. History is repeating itself, as some of the latest Atlantic liners have similar combinations. In 1899, Sir Alfred Yarrow built destroyers for the Japanese government of 6000 h.p. and obtained a speed of $31\frac{1}{2}$ knots. In 1905 the first double-ended water-tube boiler made by his firm was fitted, and by 1910 the double-ended boilers were capable of developing 4500 h.p. each.

There is not much said in this book about the introduction of oil, but this undoubtedly had a great effect on the design and power produced by the Yarrow boilers. In 1911 superheat was introduced, showing a gain of 10 per cent at full speed, and 15 per cent at low speed. The *Lurcher* class of the British Navy attained a speed of 35 knots at this time. Since then the development of the destroyer has not been very great. Larger sizes, and consequent increases in speed and radius of action, have followed. The destroyer as it now exists is very largely the work of Sir Alfred Yarrow, though others, including Thornycroft and Normand, have contributed their share.

Other types of vessels difficult to design have been developed by Sir Alfred Yarrow for the Congo and the Nile and other parts of the world. These vessels have been sometimes for peace and sometimes for war. They were very light draft vessels, having sometimes stern wheels and sometimes screws with hinged flaps at their stern. Vessels of 120 ft. long, drawing 12 in. of water, and some even less than that, were built. Some had to be carried hundreds of miles by natives through forests, no part carried being more than 50 lb. in weight. The vessel was put together at the end of the long journey to the water of the lake for which she was intended.

So far, we have referred to the work of Sir Alfred Yarrow as an engineer. Many improvements which he introduced are simple and common sense but extremely useful. His work has been a steady development on safe lines, but has always proved useful.

The other parts of the book are connected with

Sir Alfred's work as an employer and his relations with the workmen, which seem also to have been guided by common sense, treating the workmen as comrades in engineering and as entitled to their proper share of the moneys received for the work.

Sir Alfred Yarrow's philanthropy has become so well known that it seems scarcely necessary to record his many gifts to the nation. Beginning with the last, we have a gift of £10,000 to the British Association, and £30,000 and £100,000 to the Royal Society. A gift of £20,000 was made during the War, to be distributed in amounts not exceeding £1000 for the capture or destruction of any enemy submarine or ship of war. As this fund was not all used up, the balance was devoted towards the Royal Merchant Seamen's Orphanage at Bearwood. He also offered a reward of £20 up to a total expenditure of £10,000 to anyone on board a merchant vessel who first sighted an enemy submarine.

This book is extremely interesting, both from the point of view of the life of a very useful man, and from the point of view of the history of a great deal of the high-class shipbuilding of the last fifty years. We have to thank Lady Yarrow for revealing so many interesting facts in such a very readable manner.

Lubrication and Lubricants.

Lubrication and Lubricants: a Treatise on the Theory and Practice of Lubrication, and on the Nature, Properties, and Testing of Lubricants. By Leonard Archbutt and R. Mountford Deeley. Fifth edition, revised throughout, greatly enlarged, reset. Pp. xxxii + 650. (London: Charles Griffin and Co., Ltd., 1927.) 36s. net.

THIS treatise is in all probability the most complete that has hitherto been published in the English language. The work is thoroughly comprehensive. The general lay-out is admirable; the opening chapter is a brief dissertation entitled "The Problem of Lubrication," and may be regarded in the light of an introduction. The problem is here epitomised in three pages of printed matter, and the ability with which the essentials of the subject have been dealt with in this limited space is masterly. The reader is left with a clear conception of the trend of modern thought and the complexity which recent investigations have introduced into a subject once regarded as comparatively simple.

In view of the fact that recent work has shown

the importance of the study of thin films and surface forces, it is not surprising to find some twenty-five pages devoted to the discussion of this field of investigation. Chapter v. deals with the theory of viscous lubrication. This section includes a reference to the Michell thrust bearing. While it is difficult to point to any omissions, one cannot help feeling that more space might have been devoted to this branch of the subject.

The next section (Chapters vi.-ix. inclusive) deals with the sources, preparation, and general properties, also the physical and chemical properties of lubricants, and includes methods of examination and testing. This section, which constitutes about half the volume of the book, is in itself a very thorough treatise for those interested in the laboratory aspect of the subject.

We next have what may be legitimately regarded as the engineer's section of the book, dealing with the frictional testing of lubrication, appliances for lubrication, and the design of lubricated bearings. All this work is commendable, but in view of the fact that there is literally no end to the subject, it can only be considered a bare outline. A short chapter included in this section on the design and lubrication of ball and roller bearings is welcome, in view of the fact that the rôle or part played by lubrication in roller and ball bearings is too easily forgotten.

Chapter xiv., dealing with lubrication of engines and machines, again can be scarcely regarded as exhaustive. This chapter alone could be well expanded into a whole volume if the authors had been writing an encyclopædia instead of a book. The concluding chapters dealing with the clarification and recovery of used oil and the management of machinery are no more than résumés. This is no fault of the authors, in view of the limited space.

It is curious to note in a work so thorough that no mention appears to be made of the synthetic lubricant known commercially as 'Halowax' (chemically, monochloronaphthalene). While it is true that this has but little present importance, save as an ingredient added to a certain brand of petrol to lubricate valve stems in internal combustion engines, the omission is remarkable on account of the fact that it is a lubricant which is unique in many respects and one with regard to which information is difficult to obtain.

Lastly, the index, though by no means perfect (who has ever achieved perfection in this respect!), is well above the average.

The New Reformation.

The New Reformation: from Physical to Spiritual Realities. By Michael Pupin. Pp. xvii + 273 + 8 plates. (London and New York: Charles Scribner's Sons, Ltd., 1927.) 8s. 6d. net.

MICHAEL PUPIN is a romantic figure in the world of science. He has told us the story of his life in his autobiography, "From Immigrant to Inventor" (reviewed in *NATURE* of Feb. 9, 1924), a pilgrimage on the stony path trodden by those 'saints of science'—Galileo, Newton, Lagrange, Faraday, Clerk Maxwell, Helmholtz—for whose lives he expresses unbounded praise and thanksgiving. A Serbian immigrant, Pupin landed in the United States with only five cents in his pocket, and these he promptly spent in the purchase of a piece of prune pie. The prune pie proved to be a "bogus prune pie." But the young immigrant felt no resentment against his adopted country for the loss of his initial capital. He has, indeed, become one of its most redoubtable champions. The trouble about America appears to be that it is equally easy to prove its idealism or its materialism. On that issue, Pupin is on the side of the angels; but, by a happy chance, he has greatly increased the capital wealth of the United States. The money value of his inventions in long-distance telephony alone has been estimated at one hundred million dollars. Some years ago the National Institute of Social Science presented him with a gold medal "almost as big as the full moon": he appreciated more the proud title of "public benefactor" accorded to him on that occasion.

In search of an answer to the question "What is light?" the ingenuous youth arrived at Trinity College, Cambridge, and asked for Clerk Maxwell, only to learn that Clerk Maxwell had died four years before. There Pupin studied for a year or so, under the mathematical giants of those days—Routh, Rayleigh, Adams, and Stokes. But the traditional Cambridge policy did not suit him, his inclinations being towards physics. Many other Cambridge men, he tells us, failed to find in tripos drills the stimulating elements of that scientific spirit which leads to original research.

At this time, Tyndall, having given some scientific lectures in the United States, decided "to devote every cent of the money which you have so generously poured in upon me to the education of young American philosophers in Germany." Science was in a bad way in the old country. A correspondent in *NATURE* suggested that science was "all but dead in England," and

"deadest of all at our Universities"—by science meaning "that searching for new knowledge which is its own reward." An enormous examining machine, on the most approved Chinese model, our correspondent said, was always at work, but . . .

Pupin took advantage of Tyndall's benefaction to study under Helmholtz at Berlin. Soon after his arrival, Helmholtz assured him that "a few scientific experiments successfully carried out usually lead to results more important than all mathematical theories"—a dictum which, curiously, has been amply confirmed at Cambridge in the Cavendish Laboratory, opened in 1874. After a long course at Berlin he obtained his doctor's degree. Matrimony, and an appointment at Columbia University, New York, followed, and he now looks back—if such a forward-looking man can look back—on a record of notable achievement both in scientific discovery and in the promotion of scientific research.

To this record Pupin has now added, by the publication of "The New Reformation," a scholarly contribution to the philosophy of science. The preliminary chapters on the history of science are excellently written, placing well-known facts in a new and interesting setting. Whatever Nature may do, science appears to progress *per saltum*. We jump from Archimedes, a space of fifteen hundred years, to that golden age,

"which listened to Martin Luther; listened also to Shakespeare, Gilbert, and Francis Bacon; was thrilled by the matchless art of Hals, Holbein, Leonardo da Vinci, Raphael, and Michelangelo; wondered at the astronomical achievements of Copernicus, Tycho Brahe, and Kepler; watched in spellbound admiration the first flashes of the flame of Galileo's genius."

"Spellbound admiration" of Galileo's genius is picturesque, and we hope it may be true. It was not shared by the Inquisition which confined Galileo as a prisoner in his own house. It is a shock to learn that Newton was born in the year in which Galileo died—Newton, who ran no risk of theological persecution, whose tomb in Westminster Abbey proclaims "he was the glory of mankind," whose contemporary, Halley, the astronomer, said, "It will never be permitted any mortal to approach nearer to Deity."

So the story unfolds itself. We feel we are approaching towards an answer to the question, "What is light?"—through Faraday, Davy's greatest discovery, to Clerk Maxwell, who wrote to a friend:

"I have a paper afloat, with an electro-magnetic theory of light, which, till I am convinced to the contrary, I hold to be great guns."

"What is Light?" Has an answer been given? If so, we may pass on to the even more difficult question, "What is Life?" In "The New Reformation" Pupin has attempted to find "a short and easy journey" from the physical realities of the inorganic world to those of the organic world, and to the world of our consciousness—the master problem which philosophers in all ages have endeavoured to solve. Order replaces chaos. Physical operations, governed by definite laws, show an orderly advance from lower to higher forms, and this applies equally to the organic and to the inorganic world. But what process of "creative co-ordination" interprets to our consciousness "the perfume of the rose, the comforting glow of the log in our fireplace, the ambrosial sweetness of the honey"? Electrical flux, an ultra-material substance, has become "a dynamically definite and hence perfectly intelligible physical entity" because the laws of its actions and reactions have been formulated in terms of Newtonian dynamics, verified by electrical radiation experiments.

Can we hope to understand in the same way the spiritual world? Pupin replies boldly that Christ's dynamics govern the spiritual world; love is the co-ordinating force, the counterpart of gravitation in the physical world; science and religion must supplement each other. "If the signs of the time do not deceive me, then there is a universal drift towards this mental attitude. This drift I call 'The New Reformation.'" T. LL. H.

Europeans in Abyssinia.

Seven Years in Southern Abyssinia. By Arnold Weinhold Hodson. Edited by C. Leonard Leese. Pp. xvi+267+24 plates. (London: T. Fisher Unwin, Ltd. (Ernest Benn, Ltd.), 1927.) 18s. net.

CAPTAIN HODSON was sent in 1914 to establish the first British Consulate in Southern Abyssinia, his immediate purpose being to safeguard the timid Boran tribes and the elephants of Kenya Colony against further raids across the border. His appointment was agreed to with some reluctance on the part of the Ethiopian government, partly because it was a reflection on that government's capacity to control the acts of its own peoples, but largely because of the ingrained and not altogether unfounded suspicion that all such appointments are symptomatic of the desire of Europeans to increase their influence in the last and only indigenous independent State in Africa. To add to Capt. Hodson's difficulties, he increased suspicion of his motives by having to

enter Abyssinia from the south—the railway from Jubito to Addis Ababa was not then constructed—as there is a legend among the peoples of Abyssinia that it is from the south that the white man will eventually overrun their country. The fact that it took the author nearly six years to establish his consulate, although the ruler at Addis Ababa ostensibly favoured the project from the outset, is not a reflection upon his courage, negotiating skill, or determination, but an indication of the state of chaos of the country and the contempt for Europeans which existed.

The volume is interesting from a political rather than a scientific point of view. It adds very little to our existing knowledge of the peoples, their origins, beliefs, customs, and occupations. Such matters are dealt with rather sketchily. There is the same lack of precision regarding geographical facts; for example, the sketch map provided of Southern Abyssinia, illustrating the routes followed by the author in his various journeys through the country, is very inadequate. A large-scale map showing, even roughly, the main physical features of the district would have lent interest to the text. Again, Capt. Hodson mentions that of the eight lakes in the chain from Rudolf to Zwai, four are salt- and four are fresh-water, some are infested with crocodiles, some are not. Why? he asks. We cannot say, but had he possessed more curiosity he might have supplied the answer. He informs us that some tribes dwelling near lake-shores do not eat the edible fish of the lakes and tributary streams, but he offers no explanation, though it would be of the greatest interest to know why these tribes differ so markedly in this respect from, say, the fish-loving Baganda or Kavirondo in the Victoria Nyanza region.

Nevertheless, this book will make an immediate appeal to all those interested in this little-explored part of Africa. The account given of the state of chaos and anarchy which prevailed at any distance from the capital up to the time the author left for the south-western district, of the difficulties which he encountered, and the irksome and thankless duties performed by the British military forces at Moyale—just across the border—of the inhumanity of the slave-making 'Christian' dominant race, and the prodigal waste of the country's wonderful natural resources, almost justifies the intervention of the European powers, or at least that of the League of Nations. It should provide much food for reflection for those chronic sentimentalists at home who see nought but evil in the impact of Europe on Abyssinia.

A. G. C.

Our Bookshelf.

The Theory of Functions of a Real Variable and the Theory of Fourier's Series. By Prof. E. W. Hobson. Vol. 1. Third edition, revised throughout and enlarged. Pp. xv + 736. (Cambridge: At the University Press, 1927.) 45s. net.

THE theory of functions of a real variable is a subject of fairly recent date and is necessarily expanding as new theorems are discovered and fresh generalisations effected. On the other hand, the refinements of modern investigations make an ever-increasing demand for rigorous examination of their mathematical groundwork. For this reason the mathematical physicist cannot afford to remain ignorant of the progress of function theory. Prof. Hobson has an admirable gift of lucid exposition of the subject of which he is a master, and the reader can follow him with delight into realms which may occasionally appear to belong to philosophy rather than to mathematics.

The second edition of vol. 1 appeared in 1921. The present, third edition, is a revision of the second. Much new matter has been added, thus extending the volume by 65 pages. Corrections and additions given at the end of vol. 2, which was published in 1926, have been incorporated, but the numeration of the sections has wisely been retained. The first four chapters develop the properties of numbers and sets of points. Chap. iv. in particular gives an exposition of transfinite numbers and order types, developed as an ordered body of doctrine and followed by a critical discussion of the validity of the theory. In those theorems the proof of which is based on the much-debated multiplicative axiom, the fact of its use has been pointed out. Chap. v. is devoted to the consideration of functions in general, their continuity, discontinuity, and differentiation.

The remaining three chapters are concerned with the theory of integration, which naturally begins with the Riemann integral. Prof. Hobson considers this as of great intrinsic importance in analysis, and the basis on which practical applications of the integral calculus will continue to rest. The sections dealing with the Riemann-Stieltjes integral have been rewritten. A discussion of the Lebesgue integral, which now holds first place in theoretical investigations, follows. A considerable part of the theory of integration in relation to series is to be found in vol. 2. The present volume concludes with a chapter on non-absolutely convergent integrals. The printing is of course excellent, and the price for a work of this importance is not excessive.

Hermes: or The Future of Chemistry. By T. W. Jones. (To-day and To-morrow series.) Pp. 88. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2s. 6d. net.

FEW topics appeal so much to our instinct of wonder as what the future may have in store. Whether the predictions are made by "Old Moore" or by the sober student of science, they invariably attract, and the more daring the prophet the greater

the attraction. The author of this essay is certainly to be classed among the more sober of the prophets; he is cautious to a degree; he bases his predictions on present tendencies, and as a rule does not venture more than a few paces into the unknown. Thus, he is sure that low-temperature carbonisation has come to stay, and that liquid fuels will be manufactured on a large scale from coal and by synthesis from such materials as hydrogen and carbon monoxide. Supplies of timber will become exhausted; buildings will be made mainly of metal, and building costs will fall when roofs and other parts are made by the casting of plastic cement. Cotton will maintain its ascendancy as the chief raw material of clothing, and nitro-cellulose lacquers will greatly reduce the consumption of paints. The author does not believe in the future of synthetic foods, at least of those that might be made from coal-tar products; but he appears to have overlooked the possibilities of 'mineral yeast,' which was made in Germany during the War, and is now attracting attention in Great Britain. Not long ago a president of the American Chemical Society said that within a century or two we should be able to supply the food demands of the world through micro-organisms working on mineral products!

Although the essay is well written and suggestive, there are a few deviations from the straight path of scientific accuracy. Chilean nitrate does not at present meet one-third of the world's needs for nitrogenous fertilisers, but 24 per cent (in 1926); the quantity of atmospheric nitrogen converted into fertilisers in 1926 was 970,250, and not 1,245,000 tons (the latter total includes Chilean nitrate), and no one familiar with the subject could have expected at least half as much again to be fixed in 1927. The most trustworthy estimate for 1927 is 1,179,000 metric tons. The assertion that the application of chemical science to matter is the *only* efficient method of controlling it for the needs of mankind will scarcely commend itself to the devotees of other branches of science.

Structural Engineering: Stresses, Graphical Statics, and Masonry. By Prof. G. F. Swain. Pp. x + 525. (New York: McGraw-Hill Book Co. Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 25s. net.

AMERICAN authors have been very active of late years in the production of comprehensive treatises on various aspects of structural theory and design. Prof. Swain, who is professor of civil engineering in Harvard University, is a leading exponent of this subject, and the present volume is the third in his ambitiously planned series of five on structural engineering. The previous two volumes dealt mainly with materials, but this third concentrates on the theories of statically determinate framed structures, of earth pressure, and of masonry structures.

The whole range of what is usually designated graphical statics is developed in very complete fashion; and the analytical methods of treatment for all problems involved in the discussion of frames

are clearly presented. A sketch is given of the development of structural forms and an interesting short chapter on the economics of simple trusses is included. The subject of impact is concisely discussed, but the details are mainly confined to the usual ideas and allowances, and no reference is made to the recent theoretical work of Prof. Inglis of Cambridge on this question. The treatment of earth-pressure theories is very adequate, and the author's critical development of the various principles and methods in this difficult subject is of special value. The chapters on masonry structures include studies of retaining walls, piers, dams, and stone arches, and present all the main principles free from the misleading profundity that occasionally characterises treatments of this subject.

Throughout the entire work, the author's grasp of method is well displayed, and many of his short chapters are models of concise presentation. He is mainly concerned with principles, and his development of and critical attitude towards these endow the book with a high educational value.

Beyond the Electron: a Lecture given at Girton College on March 3, 1928. By Sir J. J. Thomson. Pp. 44. (Cambridge: At the University Press, 1928.) 2s. 6d. net.

ALL who are interested in the discoveries of modern physics as to the intimate structure of the universe will be grateful to the authorities of Girton College for persuading Sir J. J. Thomson to deliver, and to the Cambridge University Press for publishing, this lecture. In the art of making the deep things of physics plain, not merely to the professional scientific worker but also to the educated world at large, Sir J. J. Thomson has few equals. It does not seem so very long since he was leading us beyond the atom into a new world of electrons. To him, however, "each discovery is not a terminus but an avenue leading to country as yet unexplored," and he now invites us to accompany him to a region still more remote and even more fascinating, "Beyond the Electron."

The invasion of this new domain has been made possible by the discovery, due to Davison and Kunsman and to Prof. G. P. Thomson, that in certain circumstances the electron can be diffracted in exactly the same way as light; a discovery which may be regarded as complementary to the now established fact that light under certain conditions can behave like a particle. In this lecture Sir J. J. Thomson deals with these new discoveries in his usual masterly manner, and draws for us a picture, as clear as it is interesting, of the way in which this twofold connexion between light and energy may arise. It is true that the phenomena can be dealt with by a method of analysis of de Broglie and Schrödinger. Those of us, however, who demand from research a picture of the universe rather than a set of mathematical equations, will be very grateful to Sir J. J. Thomson for the fascinating picture he has outlined so clearly in these delightful pages. We may add that those who desire a more formal exposition of the theory will find it in two mathematical appendices.

Electric Winders: a Manual on the Design, Construction, Application, and Operation of Winding Engines and Mine Hoists. By H. H. Broughton. Pp. 402. (London: Ernest Benn, Ltd., 1927.) 52s. 6d. net.

THE whole development of electric winding in mines has taken place within the comparatively short period of twenty years. The method has proved itself thoroughly trustworthy, and in many respects superior to the older steam-engine types. The ease with which automatic devices in aid of control may be incorporated in the equipment is a special advantage, and completely automatic installations have been designed in which even an operator is unnecessary.

In the present elaborate treatise on this subject, Mr. Broughton presents a vast range of valuable data on equipments of all types, designed for a wide variety of duties, which he examines and discusses with great care and thoroughness. Both the mechanical and electrical sides of the system are exhaustively treated, and all questions of type, performance and cost are systematically studied. The book is not exactly a text-book on design, but it contains that essential and accurate information which the designer must not ignore. It is at once a treatise and a book of reference, and should prove invaluable to the engineering student, to the designer and manufacturer, and to mining engineering staffs.

Untersuchungen zur Quantentheorie. Von Louis de Broglie. Übersetzt von Dr. Walther Becker. Pp. ii + 88. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1927.) 5-80 gold marks.

IT is sufficient evidence of the importance of M. de Broglie's memoir that the three years of rapid advance in quantum theory that have elapsed since it first appeared, still allow it to be republished in the form of a direct translation into the German. Not the least recognition that can be made of the author's fundamental contributions to the subject is that very recent work tempts us to query his statement in the preface (September 1927) that "la constitution d'une théorie ondulatoire de la matière dans le cadre de la physique du champ . . ." seemed remote; his own comments upon the work of Schrödinger and of Heisenberg are most generous.

Through Jade Gate and Central Asia: an Account of Journeys in Kansu, Turkestan, and the Gobi Desert. By Mildred Cable and Francesca French. Pp. xvi + 304 + 12 plates. (London: Constable and Co., Ltd., 1927.) 10s. net.

THIS is an account of a journey made by three members of the China Inland Mission who started from China and worked their way through Mongolia and Chinese Turkestan to Siberia. The prospects of such a journey would appal most men; the missionaries who made it were women. The difficulties, hardships, and dangers that were faced and overcome are not emphasised, but those who know the route they travelled will best appreciate the courage and endurance of the three ladies who write so modestly of their achievement.

Letters to the Editor.

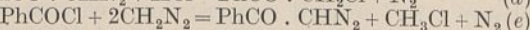
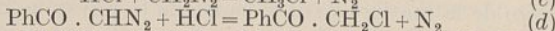
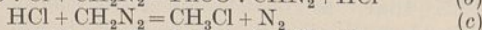
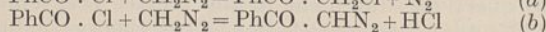
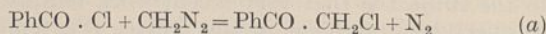
[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Nierenstein Reaction.

BEFORE commenting on the issues of scientific interest raised in the letter (NATURE, June 16, p. 940) entitled "The Nierenstein Reaction," we would point out that it is not suggested that the results of Nierenstein and his co-workers cannot be corroborated. Up to the present time, however, we have failed to corroborate them in the course of numerous attempted repetitions of various examples; moreover, we do not find that Arndt's recent work confirms that of Nierenstein in this field.

In reply to the last paragraph of Dr. Nierenstein's letter, we must point out that he incorrectly states that we described the supposed crystallisation of diphenyldibromodioxan from alcohol as an unconventionality; the actual sentence was: "The chemistry involved in the degradation of the latter substance (diphenyldibromodioxan) is of an unconventional type." The reference was mainly to the hydrolytic fission of an ether by aqueous alkali under mild conditions, and we think that an interpretation requiring such an assumption can be justly criticised. Our interest in the crystallisation of diphenyldibromodioxan was confined to the evidence of stability of the substance in alcoholic solution (which was implied by the preparation of a picrate in this medium); actually it was the analogous di-(triphenylmethyl)-dichlorodioxan that was crystallised from alcohol. Thus our admitted slip in transcribing an abstract of the paper by Lewis, Nierenstein, and Rich did not in any way distort the theoretical aspect.

Turning now to the main question and taking benzoyl chloride as an example to facilitate discussion, Nierenstein considers that the reaction in question takes place in accordance with the equation (a), whilst we contend that the process is represented by (b), followed by (c) and (d).



It was observed in separate experiments that the reaction (c) occurred much more rapidly than (d), and therefore when benzoyl chloride is added to diazomethane the process is represented by (b) and (c) until all the diazomethane is used up. The equation (e) thus expresses the net result when the chloride is gradually added to the diazomethane, whatever the relative proportions of the reagents. Equation (e) also represents the process when two or more molecular proportions of diazomethane are brought into reaction with one molecular proportion of the chloride under any conditions. That is to say, with an excess of diazomethane, it makes little difference whether the chloride is added to the diazomethane or the diazomethane to the chloride, and the product will be the diazo-ketone. Nierenstein has, however, prescribed the use of an excess of diazomethane for the preparation of several chloromethyl ketones.

The most interesting case arises when diazomethane (1 mol.) is gradually added to a solution of benzoyl

chloride (1 mol.). Experiments along these lines have been conducted, using as the solvent anhydrous ether and also ether dried over calcium chloride; the results were substantially the same in the two cases. The diazomethane was very rapidly attacked, and examination of the products after keeping for one hour after the cessation of the visible evolution of nitrogen showed that they consisted chiefly of diazoacetophenone and a little unchanged benzoyl chloride together with a very small proportion of chloracetophenone. This proves that (a) is not the primary action and that (b) and (c) are much more rapid than (d). The amount of unchanged benzoyl chloride was, however, less than half that originally used, and therefore the total result is summarised not by (e) alone, but by (e) and (b) in a certain relation determined by the conditions. Clearly, (b) will be followed in the course of time by the slow reaction (d), and thus the yield of chloracetophenone will be the higher the more effectively benzoyl chloride can compete with hydrogen chloride for the diazomethane that enters the system and also the longer the time, up to a limit, allowed for the completion of the reaction. In the early stages of the addition of diazomethane (1 mol.) to benzoyl chloride (1 mol.) the ratio of the concentration of the acid chloride to that of hydrogen chloride is large and the only important reaction is (b); as the addition proceeds the concentration of hydrogen chloride increases and that of the acid chloride diminishes, and since (c) can be shown independently to be a very facile and rapid reaction, it occurs to a greater and greater extent in the course of the process of admixture.

The observed immediate evolution of nitrogen is a measure, then, not of the formation of chloracetophenone in accordance with (a), but of the extent to which the final yield of chloracetophenone by (b) and (d) falls short of the theoretical.

Under favourable conditions we have found that the yield of chloracetophenone, ultimately obtainable from benzoyl chloride (1 mol.) and diazomethane (1 mol.) by slowly adding the latter to the former, and allowing more than twelve hours for the completion of the second phase (d), does not exceed 9 per cent of that theoretically possible; this was estimated by analytical methods and represents a maximum for this procedure. On the theoretical basis outlined above we anticipate that, using equimolecular proportions, the optimum conditions, (i) for the production of a high yield of diazoacetophenone if the product is worked up after a short time, and (ii) for the production of chloracetophenone if the mixture is kept for many hours, should be reached when the reagents are mixed as rapidly as possible. This gives the best chance for (b) to proceed to completion before (c) can supervene and cause loss.

When diazomethane (1 mol.) was added to an ethereal solution of benzoyl chloride (2 mol.) it was found that one-half of the benzoyl chloride was unacted upon; evidently the main reaction was (b). Even in this case, however, the product isolated after keeping overnight was a mixture of chloracetophenone and diazoacetophenone.

We are in agreement with the view expressed by Arndt that the course taken by the reaction may depend on the constitution of the acid chloride; this applies particularly to conditions under which reactions of the type (d) assume an important rôle. Thus we know that aliphatic diazo-ketones are more readily decomposed by acids than are the diazoacetophenones, and, on the other hand, the diazo-nitroacetophenones are particularly stable.

The experiments on which the above analysis is

based have been performed in collaboration with Dr. G. Schwarzenbach. The details will, it is hoped, be included in a subsequent publication.

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Adjustable Needle Valve Leaks.

A SATISFACTORY adjustable needle valve for admitting a small constant flow of gas into a highly exhausted vessel is difficult to make. A number of ingenious forms have been described by various workers.¹ The valve should close tightly, open

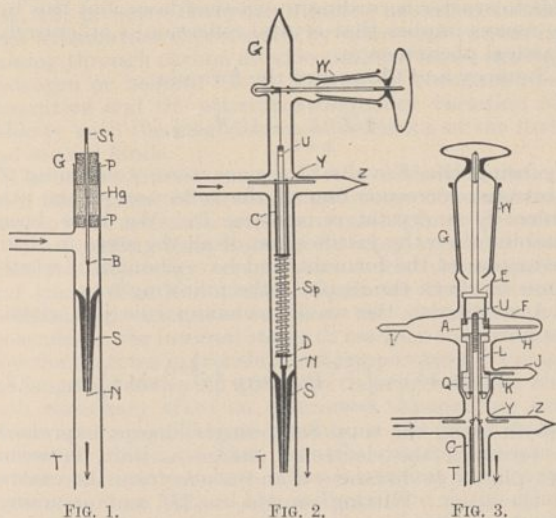


FIG. 1.

FIG. 2.

FIG. 3.

GT, Pyrex or Monax glass tube about 1 cm. in diameter.
S, Long valve seat made by drawing down capillary tubing, ring-sealed or waxed in position.
N, Valve needle made of copper wire tapered by dipping successively in acid.
PP, Plugs of cork to guide steel rod, and to retain mercury.
Hg, Mercury for making air-tight seal around St. Mercury is retained between plugs P, P, so that valve may be used in any position.

FIG. 2.

GT, Pyrex or Monax glass tube about 1 cm. in diameter.
S, Long valve seat, same as in (1) above.
N, Valve needle same as (1).
U, Upper end of needle stem, copper rod.
B, Brass washer soldered to needle stem.
Sp, Small steel rod for moving needle, fused to copper wire at B.
C, Brass supporting collar, rests on D, is held compressed against glass collar C, which in turn pushes against the yoke Y. Yoke is inserted through Z.
W, Winch for lowering or raising needle.

FIG. 3.

GT, Pyrex or Monax glass, upper half about 1.5 cm. in diameter.
C, Glass collar turned through 90°, showing the position of yoke Y.
U, Valve stem threaded at upper end.
L, Brass supporting collar seated on shoulder in glass tube.
Q, Slot in collar, and pin through needle stem.
K, Stud to keep collar from turning, inserted through J.
F, Flat enlargement blown in glass tube to allow pointer H to swing with nut A in lifting needle stem U. Enlargement carries a paper scale on outer circumference.
I, Nipple for inserting pointer H.
E, Spanner wrench.
W, Winch for engaging upper end of spanner wrench in turning nut A.

slowly, and yet it should have wide range. I have recently designed such a valve. The idea is not new; any originality that the device may have lies largely in the mechanical arrangement. Three forms, all employing very long and exceedingly narrow needles, are herewith described. The order is that of

increasing complexity. The last one admits of being calibrated.

(1) This adjustable leak is very simple. It was suggested and constructed by L. P. Garner, graduate student in electrical engineering and physics, and was recently used in our laboratory in the determination of pump speeds by the mercury pellet method.² The essential parts are shown in Fig. 1.

In constructing this valve (and the two that follow) considerable care must be taken in seating the needle. It should be ground in with rouge before placing the valve seat in position. Obviously the needle in this form is adjusted by hand.

(2) The second form of needle valve requires a little more care in glass-blowing. The adjustment of the needle is accomplished by a stiff spring actuated by a winch. This valve was designed and constructed by me while at the Cavendish Laboratory, Cambridge, and during the past year was used by Prof. G. L. Clark, of the University of Illinois, in connexion with a Hadding-Siegbahn gas-type diffraction X-ray tube. The pressure was maintained constant at 0.011 mm. of mercury for periods of 50 hours on continuous runs, using an ordinary type of mercury vapour pump supported by a Cenco-Hyvac oil pump. The essential parts are shown in Fig. 2.

This valve needle seats tightly, depending on the stiffness of the brass spring *Sp*. For this reason the winch *W* should be made rather rugged. It is well to make the squared aperture engaging the winch rod as shown in Fig. 2, instead of placing it at the end of the plug, where the strains are liable to crack the glass. Use a stout grade of white linen thread.

(3) The third form of adjustable leak differs from the second in the mechanism employed for raising and lowering the needle. This mechanism is sketched in Fig. 3, in which the lower part of the valve is omitted. As in Figs. 1 and 2, the construction is made clear by reference to the letters assigned to the various parts of the figure.

Referring to Fig. 3, the upper end of the valve stem, the yoke, the supporting collar, nut, and spanner wrench are all of metal (preferably brass), and the remainder is of glass. The valve stem *U* must move freely through the glass collar *C* and through the brass supporting collar *L*. The nut *A* rests on *L*. The slot *Q* should be of sufficient depth to allow an overall up-and-down movement of the valve stem *U* of about 1 cm. This will give a wide range of leaks. By means of the pointer *H* and attached scale any setting may be repeated.

Finally, the successful operation of these leak valves, especially when a minute leak is desired, depends upon the care used in drawing into shape and seating the long needle valve.

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The Velocity Coefficient for Bimolecular Reactions in Solution.

IN a letter under the above title in NATURE of May 12, the interchange of energy between solvent and dissolved reactant molecules is discussed. This matter was considered in a paper entitled "The Benzoylation of Amines: Part 3," in the *Journal of Physical Chemistry*, 673; 1926. If activated molecules of solute are deactivated by collision with solvent molecules, the latter molecules may either acquire a higher velocity, or be themselves activated,

¹ Kaye, "High Vacua," p. 51; Hopfield, *Amer. Jour. Optical Soc.*, vol. 12, p. 391; 1926.

² Kaye, *ibid.*, p. 162.

or radiation may be emitted, for the energy absorbed from the activated solute must go somewhere. The molecules of the solvent cannot acquire a higher velocity unless the temperature of the solution rises. I do not know whether there is any experimental evidence in support of this; what it amounts to in a simple case appears to be that if we isolate two vessels, one containing, say, benzene, and the other a solution of a reacting substance such as benzyl bromide in benzene, then the temperature of the latter should rise. If the reply is that unactivated molecules of the reactant absorb this energy of translation of the solute molecules, then the position is as suggested by Mr. Louis Kassel (*NATURE*, May 12), namely, that the effect of the third molecule, the solvent, should probably be as often activational as deactivational.

If it be assumed that the activated solute gives up its energy to the solvent by activating the solvent molecules, then, unless we assume that the distribution of activated solvent molecules is upset by the presence of the solute or reactant, these activated solute molecules will presumably sooner or later transform their energy to the form of kinetic energy, and the position will be as before. We can again consider an actual case, a pure solvent, for example, benzene and a solution such as benzyl bromide in benzene. The pure benzene will contain a certain proportion of activated molecules, the proportion being governed by the usual $e^{-E/RT}$ relation. Is this proportion upset by the addition of the reactant benzyl bromide? If we go on to consider the case of a solution in which bimolecular reaction is actually taking place, then since the activated reactant molecules are disappearing as a result of the reaction and the solute molecules are not, one would expect that the more probable direction for interchange of energy would be from solute to reactants.

There is another question which appears to me still open and unexplored. Is it justifiable to assume that the number of activated molecules present is actually given by the expression $e^{-E/RT}$ in the case of complex organic substances, or is it not possible that in such cases one may get what may be described as electron tautomerism, with the activated and the ordinary forms in more or less stable equilibrium as has been suggested by Baly? The ordinary equation for the distribution of energy would then only apply in a modified form to such systems, and the velocity of reaction would depend considerably upon the life of the activated molecules (cf. *J. Phys. Chem.*, 535; 1927). Conditions in a solution are peculiarly favourable to the stabilisation of such 'electron tautomers,' because the solvent molecules themselves can surround activated molecules and help in the production of a fairly stable system in which one or more of the electrons in the reactant molecule may be displaced from their ordinary positions by the absorption of the energy of activation. In effect, the solute would imitate feebly the behaviour of solute and solvent on ionisation.

This brings us back to the original Arrhenius conception of active molecules as a separate species, and remembering that Arrhenius based his conclusions on the behaviour of complex organic molecules in solution, it is possible that later extensions of his views derived from the behaviour of simple molecules in gaseous systems will not apply to more complex cases without considerable modification.

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No. 3065, VOL. 122]

Is Crystal Reflection of X-rays entirely a Classical Phenomenon?

IN a recent letter in *NATURE* of June 23, p. 983, Prof. G. E. M. Jauncey and Mr. W. D. Claus have made some remarks concerning the treatment of X-ray scattering by means of the new mechanics, and in this connexion we feel that the following comments may not be out of place.

According to the wave mechanics, the coherent and incoherent components of the scattered radiation are given by separate rules. It so happens that, over a wide range of wave-lengths, it is possible to give a picture of the process of coherent scattering by replacing the electrons by their corresponding Schrödinger charge density and supposing each element of this to scatter according to classical laws, but this by no means implies that crystal reflection is an entirely classical phenomenon.

Jauncey and Claus give the formula

$$-(1/Z) \sum_{n=1}^{n=\infty} (-1)^n F_n \gg \frac{1}{2}, \quad (1)$$

F_n being the F value for one atom, containing Z electrons, corresponding to the reflection of the n th order by a crystal of spacing D . We have been unable to see the justification of all the steps in their deduction of the formula, and have thought it worth while to check the result in the following way.

According to the wave-mechanics rule just given, we have

$$F(\sin \theta/\lambda) = \int_{-\infty}^{+\infty} P(a) \exp \left\{ i \frac{4\pi a}{\lambda} \sin \theta \right\} da, \quad (2)$$

$P(a)da$ being the total Schrödinger charge, expressed in terms of the electronic charge as unit, between two planes at distances a and $a+da$ from the centre of the atom. Putting $(\sin \theta)/\lambda = n/2D$, and assuming the charge distribution in the atom to be symmetrical with respect to a plane through its centre, parallel to the reflecting planes, we find by a simple summation

$$\begin{aligned} - \sum_{n=1}^{n=2N} (-1)^n F(n/2D) &= Z/2 \\ &- \frac{1}{2} \int_{-\infty}^{+\infty} P(a) \frac{\cos(2N + \frac{1}{2})2\pi a/D}{\cos \pi a/D} da, \end{aligned} \quad (3)$$

Assuming $P(a)=0$ for $a \geq \frac{1}{2}D$, that is that the atomic radius is less than one and a half times the spacing of the planes, it follows that

$$- \sum_{n=1}^{n=\infty} (-1)^n F(n/2D) = Z/2 - DP(D/2), \quad (4)$$

a result which has been given by Compton for the special case $P(a)=0$ for $a \geq D/2$, in which the second term on the right-hand side of (4) vanishes. Formula (4) is also true when heat motion is taken into account, if a suitably modified $P(a)$ is used, and if the generally scattered radiation is neglected.

Jauncey and Claus use the experimental results of Havighurst to check relation (1), and find it to be true in three out of the four cases chosen. In one case the sum of the series is greater than $\frac{1}{2}$, but it must be pointed out that the experimental F curve has been extrapolated in both directions, so that no definite conclusion can be based upon it.

Moreover, formula (4) is only true for very large values of N ; for small values, and with a suitable distribution $P(a)$, the integral in (3) may assume negative values, so that care is evidently required in applying the formula to a small number of spectra. It seems scarcely possible to decide for or against any theory of scattering by a method of this kind. There is in fact a very close agreement between the F curves

calculated for sodium and chlorine according to the rule given above, and the observed F curve when proper corrections are made for temperature (James, Waller, and Hartree, *Proc. Roy. Soc., A*, **118**, 334; 1928), and we feel that this is much the most direct type of test to which the theory can be subjected.

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Kinetics of Absorption of Ultra-sonic Waves.

RECENT work by Pierce (*Proc. Amer. Acad. Arts and Sci.*, **60**, No. 5; 1925, and Abello, *Proc. Nat. Acad. Sci.*, **13**, p. 699; 1927) has directed attention to the high attenuation experienced by ultra-sonic waves in passing through carbon dioxide and, to a lesser extent, hydrogen or helium. It is possible to correlate this absorption and the attendant frequency variation of velocity with the mechanisms of collisions of the first and second kinds.

The mean kinetic energy of the molecules varies from the regions of rarefaction to those of condensation, so if we associate with each small volume element a corresponding temperature, we may speak of the translational energy temperature variation in space and time. For low sound frequencies the collision mechanism is adequate to allow the distribution of molecules in the internal states to readjust itself to the slow fluctuations in translational temperature. Using the language of the old quantum theory, we define for each stationary state an associated temperature for which under equilibrium conditions the number of molecules would be that actually present for particular space-time values. For increasing frequency there is a phase lag and also a diminution in the relative amplitudes of the internal and translational energy temperature variations. This amplitude diminution is slight for some states and more marked for others. Accordingly, the gas begins to behave as if these latter states were absent and others only partially present; or, put otherwise, the specific heat decreases and the velocity of sound increases. The absorption on this theory is due to the out-of-phase components in the internal temperature changes, and also to the radiation loss of energy from excited states. The detailed analysis will be published in the *Physical Review*—the final results (except for some idealised cases for which reference may be made to Jeans's "Kinetic Theory of Gases" and to Herzfeld and Rice, *Physical Review*, April 1928) involve collision excitation probabilities and co-ordinate the experimental sound data with atomic structure knowledge.

Evidently, increasing the collision frequency acts to diminish the discrepancy between internal temperatures and the translational temperature. General considerations (applicable also if a viscosity explanation is offered) suggest that the absorption coefficient is to a first approximation dependent directly on the number of molecules in the path of the sound beam and inversely on the frequency of collision. It may then be shown that in a mixture of gases A and B , the ratio of the resulting absorption to the absorption of pure B at the same pressure is

$$e^{\frac{c(aN_A^2 - bNN_A)}{aN_A^2 - bNN_A + cN^2}}$$

where N and N_A refer to the concentrations of molecules of both types and of type A alone, respectively; e is proportional to sound path length, and the constants a, b, c satisfy the inequalities $c > b > a \geq 0$. $a = 0$ if one assumes that because of resonance or coupling effects collisions between similar molecules are on the

average more effective in promoting energy transfers than collisions between dissimilar ones.

Abello's empirical conclusion from his data was that the exponent supra is proportional to N_A . However, on referring to Abello's graphs for hydrogen and carbon dioxide, it is seen that the experimental absorption for N_A large is uniformly greater than predicted on his assumption of a linear dependence and seems rather to bear out the relation given above.

D. G. BOURGIN.

Department of Mathematics,
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May 21.

Abstracts of Royal Society Papers.

THE issue of NATURE of Mar. 24 contained a paragraph (p. 483) referring to a paper entitled "Statistical Experiments on the Motion of Electrons in Gases," by Mr. R. d'E. Atkinson, communicated to the Royal Society at a meeting on Mar. 15. Previous to the meeting the abstract of this paper written by Mr. Atkinson had been circulated to members of the Society.

The abstract contains definite statements which have led uninformed readers to believe that there are many errors in my publications on the subject of electricity in gases and in those of other physicists who have collaborated with me. Several people interested in this subject have expressed surprise that no answer has as yet appeared to the statements contained in the abstract.

I should like to direct attention to the fact that I wrote an answer to the statements contained in the abstract early in May and sent it to the *Philosophical Magazine*, but publication was refused on the ground that the abstract circulated by the Royal Society is not 'official,' and consequently no answer can be made to the statements contained in it.

If this view be accepted, it becomes possible for authors to have statements circulated and placed in a position so privileged that there is no opportunity of answering them except in a foreign journal.

It is perhaps not generally known that even after an 'abstract' has been circulated, the whole paper, or parts of it, may be refused publication by the Royal Society.

J. S. TOWNSEND.

Electrical Laboratory,
Oxford, July 11.

Does Methylene Blue penetrate Living Cells?

MISS IRWIN (NATURE, June 16, p. 939) implies that her observations affect the validity of vital staining with methylene blue. As one who has used this method extensively, may I ask whether the method depends upon "penetration of blue dye" as Miss Irwin assumes?

A muscle nerve preparation taken from a frog previously transfused with dilute solution of methylene blue behaves like a normal physiological preparation in respect of vigorous contraction on electrical stimulation through its nerve for upwards of an hour after the appearance of intensely stained nerve-endings. The muscle itself appears pale green by transmitted light, and the dye is evidently present in a reduced or partially reduced form. This applies to the whole of the muscle; but it is rare for more than half the nerves to be stained. I suppose the contracting muscle is alive; to think otherwise would do some violence to accepted vital criteria.

TUDOR JONES.

The University of Liverpool,
Department of Anatomy,
June 20.

Agriculture in India.

INDIA nowadays is rarely without its Commission, and these follow one another in rapid succession. The most recent one reporting is the Royal Commission on Agriculture,¹ which has been at work for the past two years, somewhat overshadowed latterly by the Simon Commission. The short title is rather misleading, for the terms of reference cover much wider ground: these include the "present position of agricultural and rural economy in India," and the Commission is asked to make "recommendations and to promote the welfare and prosperity of the rural population." Specifically mentioned besides agricultural and veterinary practice, are agricultural statistics, better crops and improvement in practice, dairy farming and breeding of stock, as well as methods of transport and marketing, agricultural finance and credit. But the intention of His Majesty's Government is perhaps more clearly indicated by the composition of the Commission, which includes no member of the Indian Agricultural Service.

For those, then, who might naturally look for a careful survey of the many problems facing Indian agriculture, the report will be somewhat disappointing. For a study of such questions they will have to depend chiefly on the mass of evidence which is now being published. The Commission contents itself, so far as the improvement of agriculture is concerned, with some 50-60 pages, but devotes a larger number of pages to the agricultural services and their organisation, having among its members those eminently fitted for dealing with this.

The Commission, in its letter of submission, writes as follows: "Throughout our Report we have endeavoured to make plain our conviction that no substantial improvement in agriculture can be effected unless the cultivator has the will to achieve a better standard of living and capacity, in terms of mental equipment and of physical health, to take advantage of the opportunities which science, wise laws, and good administration may place at his disposal. Of all the factors making for prosperous agriculture, by far the most important is the outlook of the peasant himself." When all is said and done, however, we do not think that the request in the terms of reference "in particular to investigate the measures now being taken for the promotion of agricultural research . . . the introduction of new and better crops, and improvement in agricultural practice," has received sufficient attention. The inclusion of experienced workers in these subjects would have strengthened the Commission, and rendered this part of its report more weighty and valuable.

The compact volume in which the report is printed runs to close on 900 pages, of which the first 100 are devoted to an unofficial summary, excellently written and of particular value to the general reader. We gather that the first step taken on landing in India was the preparation of the usual

questionnaire, which was very freely distributed. Replies to this numbered 783, and 395 witnesses were examined during the two years. The mass of literature comprised of these written statements and the subsequent examinations should form a useful library on Indian agriculture, and the present conditions of the rural population.

The report opens with an introductory chapter on "The Village," the unit of rural India, which is entirely different from anything in Great Britain. It consists in the main of a collection of mud houses huddled together like a flock of frightened sheep, in the midst of the fields belonging to it. This arrangement dates from ancient times, and obviously makes for mutual protection, for the cultivators were defenceless against bands of marauders. Besides this, the demands of their rulers varied from year to year and were sometimes crushing; and there was always the fear of famine if the monsoon failed. Selling the produce from their fields was non-existent in a small community all growing the same crops, and each cultivator was content with producing only the amount required for his family. Later, with added security under a settled government, matters improved, and there was a new-found feeling of safety. The land was divided up and the rights of ownership examined and recorded, and for the first time land, irrespective of crops, acquired a value. Each member of the village knew what proportion of the produce was his own—but the arrangement of centuries remained unaltered. Of the 500,000 villages in India, most are still untouched by metalled roads or railways, and are thus cut off from one another by impassable paths during the rains.

There is in India a marked absence of large-scale farming. All agricultural practices are dependent on the stated periods of the monsoons, and work on the land in the long dry season becomes impossible. Thus for half the year the cultivator has his time on his hands. It is always hard to change old-time customs, but not the least problem engaging the attention of the Commission appears to be that of placing the cultivator in a position, by the most varied ameliorations, to make use of this idle time.

In the second chapter there is a summary history of the efforts at applying scientific agriculture to India, from the enlistment of twelve American cotton planters in 1839 "to teach the cultivators to grow and clean cotton," and the celebrated order placed in England in 1863 by the Madras Government for "a steam plough, steam harrows and cultivators, seed drills, horse hoes, threshing machines and winnowers, chaff cutters and water lifts," to the establishment in 1903 by Lord Curzon of the Indian Agricultural Department. When the constitutional changes occurred in 1919, all departments connected with rural welfare were 'transferred' from the Government of India to the local governors, each acting through a minister. This of course included agriculture, with the exception of the central research stations for all India.

¹ Report of the Royal Commission on Agriculture in India. (Cmd. 3132.) Pp. v+100+ xviii+755. (London: H.M. Stationery Office, 1928.) 11s. net.

In Chapter iii. the Commission, dissatisfied with the incoherence of the present arrangement, proposes a new organisation for agricultural research. This scheme, although the Commission is not quite unanimous in matters of detail, appears to be well thought out and of value. At present the agricultural departments in the provinces are independent of one another and of the central research institutes, which are under the control of the Agricultural Adviser to the Government of India. This lack of connexion between all India and provincial departments is, and always has been, an anomaly, and the new organisation is designed to bring them into closer relations. For this purpose the establishment of an Imperial Council of Agricultural Research, with a lump sum of 50 lakhs of rupees as endowment, is recommended; the primary function of the council will be to co-ordinate agricultural and veterinary research in India with that in other parts of the British Empire and foreign countries.

The Imperial Council of Agricultural Research would consist of three whole-time officers and 36 others. Of the three, the chairman should be of wide administrative experience and, if possible, with Indian experience also, and the two others would deal with agricultural and veterinary research respectively. The 36 ordinary members would represent various interests in the country: 8 would be nominated by the Government of India, 18 would represent the provinces, 3 the universities, 1 each the Central Cotton Committee and the planting community, and the remaining 5 would be elected by the Council itself. The whole-time officers would be engaged for five years, and the rest nominated for three, periods subject to extension if desired. The post of agricultural adviser to the Government of India would naturally lapse under this scheme, and his advisory duties would be carried on by the chairman of the Council.

Special attention is directed to the Central Research Institute at Pusa. This, it is recommended, should be strengthened so as to become also a teaching centre for higher training in agriculture, as it is entirely desirable that India should be self-contained in this respect as soon as possible.

The allied subject of the agricultural services is dealt with in a long chapter (xix.) at the end of the report. While we consider it of even greater importance than that on the organisation of research, space forbids us from going into details. The general intention in the recommendations is to improve the status of these services, on the score of efficiency and because of the increased responsibilities imposed if the Commission's suggestions are endorsed. This applies not only to the rank and file, but in a special degree to the posts of provincial director of agriculture and the principal of the agricultural college, both of them being key positions in the improvement of agriculture. It is suggested that the hands of the former might be strengthened by the addition of an officer of somewhat lower status as joint director. The Commission is not in favour of short-term appointments—which are, it is true, generally uneconomic in principle and practice. As to the general recruitment for

the service, it is recommended that the system of scholarships so successfully initiated by the Colonial Office should be adopted; and in the case of all superior officers it is contended that the best men should be engaged, and that therefore recruitment should not be confined to one province, or even to India. The Institute at Pusa is again referred to, and the Commission recommends that the status of the principal and the heads of sections should be raised, in view of the increased demands made upon them.

Chapter vi. is devoted to agricultural improvement, and it is stated that the various factors affecting crop production, other than irrigation, are dealt with. The areas under the seventeen chief crops in India are given for general information. Soils and manures are rather fully discussed and take up about half of the chapter, a few pages are devoted to plant breeding, and a table is printed showing the areas under improved varieties; rather more space is devoted to seed distribution; agricultural implements are then considered, and a few concluding remarks are made on plant protection. The important subjects of rotation of crops and tillage are not included, in that they have been fully discussed by the recent Sugar and Cotton Committees.

There are 81 recommendations and conclusions at the end of chapter vi, although this formidable number could have been reduced by using longer paragraphs. As examples of useful conclusions the following may be given: the suggestion that a soil survey of India should be undertaken is vetoed: no diminution in the fertility of long-continued cultivated fields is anticipated: definite advice cannot be given by the agricultural department on the use of fertilisers by cultivators: neither export tax nor prohibition of export, of oil seeds, oil cakes, bones or fish manures, can be justified; and no legislation is needed for the adulteration of fertilisers.

As already indicated, we consider that this chapter will prove disappointing to those interested in agricultural problems, and hoping for new light on an extremely complicated enterprise, in which, despite occasional successes, the general result of their labour has often been very disheartening. This latter aspect is reflected in the way in which the Commission has presented this part of its report; for there is a singular absence of that enthusiasm which is so marked a feature whenever they deal with rural economy. As it is, the chapter summarises the information placed before the Commissioners, and is simple and clear, with an honest attempt to make suggestions where considered of possible advantage. In many cases there is practically nothing to be done but to go on working, and the Commission accordingly has various suggestions for the new Imperial Council of Agricultural Research. But it must be remembered that this subject is rather beyond the experience of the Commission as constituted, and could only be dealt with properly by a committee of experts in the various agricultural sciences, and in the practical aspects of Indian agriculture: such a body alone would be competent to collate the evidence and to discuss the improvement of Indian agriculture.

(To be continued.)

Reproduction, Lactation, and Vitamin E.

AS the dietary requirements for growth have become more clearly defined with the introduction of purified nutrients, it was soon observed that diets adequate for growth might not suffice for reproduction or lactation, either quantitatively or qualitatively. Quantitative deficiencies are easily remedied: investigation of the qualitative has led to a better appreciation of the part played by protein, salts, and vitamins in nutrition, and to the discovery of a new type of sterility. The young are dependent for their supplies upon the mother until they are weaned: inadequate diets during pregnancy are reflected in the condition of the young when born or later: during lactation such diets result in failure to rear the offspring. The growing organism requires different ratios between the various elements of the food as compared with the adult and the qualitative dietary requirements of the nursing mother depend chiefly on the necessity of satisfying these needs. Thus a relatively greater intake of certain salts and growth-promoting vitamins is required by a nursing mother than by an adult of the same weight who is not being subjected to a similar strain.

Failure of reproduction is a characteristic effect of many deficient diets and is usually shown by failure to breed or by failure to rear the young born. A special type of sterility has been described by H. M. Evans and his co-workers and shown to be associated with a dietary deficiency: the substance lacking is apparently an organic compound of unknown composition; it has been labelled vitamin E. Our knowledge of this vitamin has recently been collected by H. M. Evans, G. O. Burr, and T. L. Althausen ("The Antisterility Vitamine Fat Soluble E," *Memoirs of the University of California*, vol. 8). The sterility is unique in that implantation of the embryos in the uterus occurs normally, but later they are resorbed and no young are ever born. The sexual cycle in female rats suffering from vitamin E deficiency occurs normally: in other types of sterility, either the sexual cycle is disordered or implantation fails to occur. In the male, vitamin E sterility is accompanied by degeneration of the testicular glands.

To determine whether a given rat is suffering from vitamin E sterility it is essential to carry out fertility tests. The occurrence of œstrus or pro-œstrus must be observed, from the change in type of cell found in a vaginal smear, and must be followed by the signs of successful copulation with a fertile male, the presence of a vaginal plug and spermatozoa in the female passages. If implantation is successful the vaginal smear shows red-blood cells about the 13-15th day of gestation. In the authors' stock of animals, 5-18 per cent of successful matings are not followed by implantation: the animals used for testing for the presence of vitamin E should not show a higher percentage of failures, otherwise they are unsuitable for the test and are presumably suffering from some other type of deficiency. Resorption of the young occurs about

the 20-25th day and is shown by a gradual fall in weight of the animal, in contrast to the abrupt fall seen when a litter of living young is born. The suitability of the animal for the test can be controlled by supplying a source of vitamin E at the next gestation and obtaining a healthy litter.

Histological examination of the uterus of these animals at different stages of gestation shows that the development of the young is definitely retarded after the 8th day: about the 13th day many of the fetuses die and the placenta start to degenerate about the 16th day. Death is ascribed to changes in the yolk sacs, especially interference with hæmatopoiesis and failure of development of the fetal capillaries in the placenta. The fewness of the red-blood corpuscles as compared with the numbers seen in normal embryos is noticeable about the 11th day.

In contrast to the normal sex-life of the sterile female, the sterile male shows marked testicular degeneration. For a short period a male may be sterile and show normal testes histologically: that some change has already occurred in the organs, however, is shown by the fact that even prolonged administration of vitamin E will result in the cure of only 25 per cent of sterile males, and even in these most of the tubules will be degenerated. In the next stage the spermatozoa fail to show normal movements, and finally disappear: the animal becomes incapable of forming the vaginal plug on copulation with the female and in the last stage loses all sex interest.

The diet used to produce these effects contains alcohol-extracted casein, cooked corn starch, cod-liver oil, salts, lard, and yeast: it is thus adequate so far as the other dietary constituents are concerned. Sterile females supplied with a sufficiency of vitamin E will have a normal gestation and produce living young: by using such animals as test objects it has been possible to determine the distribution of the vitamin in Nature and to prepare extracts containing it in concentrated form. In general it may be stated that animal foods are not good sources of the vitamin: it is not stored in the testes and the viscera contain little: it is chiefly present in muscle and fat, though even here it is not in a concentrated form: milk contains little. Vegetable foods provide the most potent sources, especially lettuce and wheat-germ: the oil extracted from the latter has proved a convenient source. Fertility can be ensured by a dose of 0.55 gm. of the oil on the first day of gestation or by a daily dose of 25 mgm. during gestation. Experiments have shown that for any given gestation to be successful the vitamin must be present in adequate concentration in the body from the 5th to the 20th day of this gestation. Twenty times the minimum dose will suffice for two but not for three gestations: the vitamin is used up in the ordinary metabolic processes of the body, and although it is essential for gestation it does not appear to be utilised more rapidly during it. Sterile animals

contain less of the vitamin in their tissues than those on an adequate diet: it can be detected also in new-born young. It exerts its action on intraperitoneal injection as well as following oral administration. In excess it will not increase the fertility of the animals above the normal for the particular stock.

Preliminary experiments appear to show that vitamin E is also essential for normal lactation.

As regards its chemical properties, vitamin E shows close relationships to the group in which vitamins A and D are placed: it is found in the unsaponifiable fraction of wheat-germ oil, but is unstable to a hot saponification in this oil, although stable when in a purer condition. It is stable to aeration and hydrogenation but not to bromination: it is not destroyed by drying lettuce nor by cooking plant or animal tissues. By fractionation of wheat-germ oil a sterol-free fraction can be obtained, distilling at 225-230° C. at 0.01 mm. pressure, containing all the activity: no nitrogen, sulphur, or halogen is present in the active fraction, 5 mgm. of which fed on the day of mating will suffice to ensure a normal gestation. Its behaviour on fractionation thus resembles closely that of the growth-promoting fat soluble vitamin A.

Failure of reproduction on similar synthetic diets has been noted by other observers, especially by B. Sure, but Evans and his co-workers have made the most complete analysis of this particular type. U. Suzuki, W. Nakahara, and N. Hashimoto (*Proc. Imp. Academy, Tokyo*, vol. 3, p. 619; 1927; *Scientif. Papers, Instit. Phys. and Chem. Research*, vol. 7, p. 143; 1927), have obtained failure of reproduction with degeneration of the testes in the males, but without demonstrable changes in the ovaries in the females, when white rats were maintained on diets free from, or relatively low, in fat, vitamins A and B being supplied in the form of concentrates. Their diets, however, failed to secure absolutely normal growth. Evidence of resorption of embryos was obtained in a few of the females. It is probable that the results were due to vitamin E deficiency. W. P. Kennedy (*Quart. J. Exp. Physiol.*, vol. 16, p. 281; 1926) has also confirmed some of the details of Evans' work.

It may be pointed out in connexion with the examination of food materials as sources of certain of the vitamins, that there is some evidence that erroneous conclusions may be drawn when the substance under test is mixed in with the other constituents of the diet, owing to an interaction between it and some of these constituents resulting in a destruction, partial or complete, of the vitamin. Thus H. A. Mattill (*J. Am. Med. Ass.*, vol. 89, p. 1505; 1927) has adduced evidence that vitamins A and E may be oxidised in the presence of certain fats or salts in the diet: and H. M. Evans and G. O. Burr (*ibid.*, vol. 88, p. 1462, and vol. 89, p. 1587), have obtained similar results in the case of vitamin E. Lard among the fats and ferrous sulphate among the salts appear to be among the destructive agents: a definite relationship between the lard and the amount of wheat-germ necessary

to cure sterility has been demonstrated: hydrogenated lard appears to be without this effect: a ferric salt has not the same action as a ferrous salt.

Although so much attention has been recently directed towards the part played by the vitamins in reproduction and lactation, it is essential that the influence of the other constituents of the diet and the proper balance of all the constituents should not be omitted from consideration. Gladys A. Hartwell (*Biochem. J.*, vol. 21, p. 1076; 1927), using a diet of caseinogen, potato starch, butter, cod-liver oil, salts, and marmite, found that 16 per cent butter or 12 per cent with 4 per cent cod-liver oil and 16 per cent caseinogen produced nearly normal growth in rats: with 14 per cent cod-liver oil growth was less good, and no litters were produced: the uteri and mammary glands were abnormal and the testes in the male were frequently small and the animals sterile. With 16 per cent butter and 4 per cent cod-liver oil, reproduction was poor, the does dying or failing to rear their young: the males were fertile. Increasing the protein content or adding lactalbumin gave slightly better results, but the best were obtained with 12 per cent butter alone in the diet, although still not so satisfactory as among the animals of the stock colony. She suggests that excess of vitamins A and D may upset growth, or that vitamin E is necessary for growth as well as for fertility: it is possible that interaction between the constituents of the diet in the diet itself may be a factor in the results obtained: thus the cod-liver oil may inactivate the vitamin E of the butter. The same author has also shown that potato protein is inadequate for growth, reproduction, and lactation, probably due to the difficulty of feeding sufficient protein on a simple potato diet (*ibid.*, p. 282), and that an oatmeal diet, although it allows of fairly good growth, is not adequate for reproduction or lactation (*ibid.*, vol. 20, p. 750; 1926). In this case also the total protein in the diet was low. W. P. Kennedy (*loc. cit.*) has found that fertility is impaired by a high protein diet and also by one low in calcium, and that the movements of the isolated uterus of these animals in a bath of Ringer's solution may not be absolutely normal, as well as the response to variations in the calcium content of the surrounding fluid (*Quart. J. Exp. Physiol.*, vol. 16, p. 333; 1926).

U. Suzuki and N. Hashimoto (*Scientif. Papers, Instit. Phys. and Chem. Research*, vol. 4, p. 236; 1926) found that on a diet of condensed milk supplemented with salts and a vitamin B concentrate, growth was normal but reproduction rare: fertility was improved by the addition of 0.1-0.5 per cent cholesterol. These authors also report that a higher proportion of cholesterol in the diet was toxic, leading to cessation of growth and even death: there appeared to be a relationship between this toxic effect and the vitamin A content of the diet.

Apart from the reflection of the adequateness of a diet in the number and condition of the young

born—if the diet is so far adequate for reproduction—the condition, and especially the weight of the mother, form an index of its suitability. Miss Hartwell (*Biochem. J.*, vol. 21, p. 572; 1927) has found that on a variety of diets the mother rat gains about 20 gm. in weight during gestation, whether the diet is good or poor: in the latter case there are fewer young in the litter and many are born dead. On the other hand, during lactation the mother may lose up to one-third of her weight in supplying the needs of her young, if the diet is inadequate. Thus it appears that the mother only sacrifices her own tissues during lactation and not during gestation. S. Bartlett has found that cows also continue to grow during gestation and lactation provided that their diet

is satisfactory (*J. Agricult. Sci.*, vol. 16, p. 392; 1926). The necessity of proper diets is further shown by some figures published by Forbes and his co-workers (E. B. Forbes, J. A. Fries, W. W. Braman, and M. Kriss: *J. Agricult. Research*, vol. 33, p. 483; 1926). From metabolism experiments on cows it is concluded that the percentage utilisation of the metabolisable energy of the ration for maintenance reaches 75-80, for production 70-75, but for growth only about 60. Similar studies, which include milk analysis, can scarcely be carried out on rats owing to their small size, so that it is of interest to bring together the results obtained in the case of these two species of animals, and to note the similarity of their behaviour during gestation and lactation.

News and Views.

THE scientific and economic problems of the textile industry, to the importance of which considerable attention was paid at the Leeds meeting last year of the British Association, form the theme of several recent publications. Two noteworthy communications are "A Survey of Textile Industries" by Sir Arthur Balfour's Committee on Industry and Trade, and "A Survey of the Production and Utilisation of Wool," published by the British Research Association for the Woollen and Worsted Industries. The latter report is of a very general character. It summarises the extensive nature of the problems of the industry, and attempts to indicate lines of investigation for the improvement of the world's wool production for the particular purposes of textile manufacturers. Some of the observations made in the report are not very specific. The importance of the study of the "growth of wool on the living sheep, how it originates, how it develops, and how it attains its final form, and, above all, why fibres differ, why fleeces differ, why breeds differ," is of course obvious. But this matter seems to involve just those difficulties which make the answer to some of the fundamental biological problems a matter of the greatest interest and complexity. The report clearly emphasises the urgent necessity for a real systematisation and definition of certain properties of the wool fibre. It suggests a possible classification of wools from the point of view of their utility to the spinner and manufacturer, in accordance, first of all, with their milling properties, and, secondly, with their spinning powers.

THE real difficulty of progress in these matters depends on the fact that the fundamental properties of wool from the viewpoint of the spinner and manufacturer, if they are actually definable, are certainly not yet defined. The spinning power of a wool, it is true, is related to its quality, yet, as was pointed out in *NATURE* of Nov. 19, 1927 (p. 730), the quality number or count to which a particular wool will spin has at present no definite measure. Exact information upon the important processes of milling and felting is also not available. It is not surprising that one finds in these circumstances that "the blanket manufacturer knows exactly [the type of raw wool] which he requires, though not always is he able to

express it in words." As the report states, unless the fundamental properties of a raw wool are known in its relation to the purposes for which it will ultimately be used, experiments for developing new types of wool are bound to be of doubtful value. The wool textile technologist has conditions to meet, however, in connexion with the raw material, which scarcely exist in connexion with the supply of the raw material for other industries. For example, supplies and qualities of fleeces can under certain conditions be controlled, but, as Sir Arthur Balfour's committee points out, "the expansion of wool supplies [and presumably the quality] seems likely to be largely dependent on the price of wool (conjoined with the price of mutton) in relation to the price of other agricultural produce, notably, wheat and cereals." This aspect of the raw material supply for the textile industry, while it does not of course form directly a part of the problem of the standardisation of wool by scientific means, is bound to receive considerable attention by the economist and agriculturalist. Its relation with the technological points enumerated in the report of the British Research Association for the Woollen and Worsted Industries has doubtless already taken an important place in the considerations of that body.

SCIENTIFIC workers generally will welcome the statement made in the House of Commons on July 23 by Mr. A. M. Samuel, Financial Secretary to the Treasury, that the Government is prepared to exempt from Customs duty scientific cinematograph films brought into Great Britain solely for exhibition to scientific bodies. As was stated in our issue of July 21 (p. 103), the subject was raised early this month as a direct consequence of the difficulties experienced by Mr. W. H. Wright, the distinguished American astronomer who delivered the George Darwin lecture before the Royal Astronomical Society on June 8, in introducing his cinematograph film of Jupiter. On the report stage of the Finance Bill in the House of Commons on July 23, Capt. Ian Fraser moved a new clause providing that the Customs duties imposed by the Finance Act, 1925, on negative and positive cinematograph films should cease to be payable in the case of a film certified by the Royal Society to be

solely an illustration of scientific investigation, for exhibition before members of a recognised scientific body and imported only for the purpose of such exhibition free of charge. Mr. Samuel stated that the Royal Society has agreed to certify such films, and that the Customs officials will accept the statement. Capt. Fraser's clause was therefore read a second time and added to the Bill.

In his presidential address at the British Pharmaceutical Conference, delivered at Cheltenham on July 24, Mr. R. R. Bennett took as his subject "Recent Biochemical Discoveries in Relation to Pharmacy," and illustrated their relationship by reference to some of the recent work on the hormones and vitamins. Pharmacists are especially interested in this work from the point of view of the standards of purity and activity adopted, which, since many of the substances under review are of unknown chemical constitution, are based ultimately on biological tests. The standards adopted by the Health Committee of the League of Nations and by the Therapeutic Substances Act, 1925, may be taken as examples of the standards of reference which will be included in the new edition of the "British Pharmacopœia": pharmacists should be familiar with these standards and also with the methods of biological assay by means of which the activity of any preparation may be evaluated in terms of the standard. Mr. Bennett illustrated his thesis by referring to some of the recent work on the pituitary and thyroid glands, on the ovarian hormones, on insulin, and on the extract of liver which is effective in the treatment of pernicious anemia: the isolation and synthesis of thyroxine and the separation of the oxytocic and pressor principles of the posterior lobe of the pituitary gland were included in this section. In that on the vitamins special attention was directed to the recent work on the production of Vitamin D by irradiation of ergosterol. Reference was also made to the recent work on Vitamin B, including its differentiation into two separate accessory factors, and criticism directed to the standard for Vitamin A laid down in the "United States Pharmacopœia." In conclusion, Mr. Bennett referred to the interest shown in the development of biochemistry in its relation to pharmacy by the Pharmaceutical Society, as evidenced by the recent inauguration of the Society's Pharmacological Laboratories.

A USEFUL conference was held by the Association of Lighting Engineers at Sheffield on July 9-16. The discussions on road lighting, from the point of view both of the pedestrian and the car driver, were valuable, as they show how complex the problem is, depending as it does on difficult questions of physiology and psychology. The pedestrian wants to see small obstructions on the road and the numbers on the houses; the driver wants, in addition, to be able to pick out objects at a considerable distance in advance without the necessity of using his head lights. The two principal factors which enable objects to be distinguished by the eye are the contrast in brightness between the object and the background, and the shadow cast by the object itself. Experiments indicate

that the mechanism of visibility is not the same at high as at low illuminations. At high illuminations diversity of brightness plays the principal part.

It was pointed out by Mr. Waldram during the Sheffield conference that in one installation the street was illuminated evenly all over with minimum intensity. The illumination produced was like moonlight, and only in a few positions could pedestrians be distinguished. In another test the light was partially cut off so that dark streaks were produced across the road. In this case every pedestrian could be easily seen. The difference between the illumination produced on rough and smooth road surfaces by given light sources was also emphasised. On a polished road longitudinal streaks are formed running from the observer to each light source. The best way of detecting an obstruction is to watch whether any of the streaks are blocked out. It was generally agreed that it is inadvisable to have the light sources all on one side of the road. With polished or wet roads this system is dangerous. For narrow roads it is good to have the alternate lamps on opposite sides of the road, but for wide roads it is best to have the sources arranged evenly on each side of the road. The sources should be shaded from the driver's eyes, but the light should not be cut off from buildings and kerbs.

THE Association of British Chemical Manufacturers held its twelfth annual general meeting on July 12 under the chairmanship of Mr. C. A. Hill. Mr. Hill said that the Council considered it inadvisable to patronise more than one exhibition in each year, and recommended that the exhibition supported should be the British Industries Fair, to promote the success of which everything possible should be done. He referred to the work of the Resistant Metals Committee, remarking that the chemical industry is in great need of new materials for the construction of plant dealing with corrosive substances, and expressing the hope that important results would emerge from the concentrated and co-ordinated attack on the problems involved. Sir Max Muspratt reminded his audience that the 'safeguarding' policy is a double-edged sword; if they wanted the tariffs of the world reduced they must not be too exigent as to the terms they asked for safeguarding their own industries and the retention of the Dyestuffs Act. The A.B.C.M. monograph on chemical industry showed that, broadly speaking, Great Britain is a free-trade nation, although exceptions were forced upon it in respect of small sections of an enormous chemical industry. The Right Hon. J. W. Wilson spoke of the growth of big combines from small businesses, and of the relations between them. The honorary treasurer, Dr. E. F. Armstrong, expressed concern at the large number of foreign patents which have recently been taken out in Great Britain. These were, for the most part, not genuine inventions, but were taken out with the object of preventing British manufacturers making or using substances which often were well known. He suggested that the matter is one for the close attention of the Patents Committee. Further, he declared that the industry

is still in need of protection of the type afforded by 'safeguarding' and the Dyestuffs Act, a view which was emphasised also by Mr. Dawson.

THE rapid improvements that are being made in connexion with broadcast receiving apparatus for applying electrical devices to improve the gramophone, make it advisable to consider probable future developments. It is known that the quality of reproduction from a modern gramophone record can be greatly improved and the volume of the sound more easily controlled when electrical methods of reproduction are employed. The vibrations of the needle can be made to generate currents by means of what is called a 'pick-up' attached to the tone arm of the gramophone. These currents, after passing through a powerful amplifier, operate a loud speaker. The amplifier and loud speaker circuit, being the same as that used in broadcast reception, can be used for either purpose. For many homes in the future it seems probable that they will have broadcast receiving apparatus with eliminators which obviate the use of batteries, and an electrically driven gramophone turntable. The present trend of development seems to be in the direction of having a fixed electrical installation which can be controlled and heard in many rooms of the house. Some contractors have already made such installations, but they are still regarded as luxuries. In building new houses, the advisability of leaving conduits for possible requirements should be considered. It is possible that in the future we may have towns with as many as 50,000 private consumers, taking about 20 or 30 watts of electrical power for reproducing music mechanically for entertainment purposes. In this case a dynamo of at least a thousand kilowatt capacity would be required to supply them.

ACTIVE preparations are being made for the quadrennial International Congress of Mathematics to be held on Sept. 3-10 at Bologna. The business of the Congress is to be transacted in seven sections: (1) Arithmetic, algebra, analysis; (2) geometry; (3) mechanics, astronomy, geodesy, geophysics, physical-mathematics, theoretical physics; (4) statistics, mathematical economics, calculation of the probabilities, science of the actuary; (5) engineering and industrial applications; (6) elementary mathematics, didactical questions, mathematical logic; (7) philosophy, history of mathematics. In each section an attractive programme of lectures by experts has been arranged. On the social side, the national government and the cities of Bologna, Florence, Ravenna, Ferrara will give receptions. The visits organised will include important engineering works on the Tuscan-Emilian Apennines and the hydro-electric plant on the Lake of Ledro, near Lake Garda. A subscription of 50 lira will entitle a member to a copy of the *Acts* of the Congress, also to reduced fares on the Italian State railways between Aug. 20 and Sept. 30. Intending members should communicate first with Alla Commissione Esecutiva del Congresso Internazionale dei Matematici, Istituto Matematico della R. Università, Bologna, Italy. Dele-

gates have been appointed by the Universities of Aberdeen, Belfast, Birmingham, Cambridge, Edinburgh, Glasgow, Manchester, Oxford, St. Andrews and Toronto and Columbia University, the Royal Society of Edinburgh, and the Cambridge Philosophical Society.

THE nineteenth International Congress against Alcoholism will be held at Antwerp under the presidency of Prof. Zunz of Brussels, on Aug. 20-25, when the following papers of scientific interest will be read: The alcohol question and social hygiene, by Sir Arthur Newsholme; the concentration of alcohol in the blood and the diagnosis of drunkenness from the medico-legal and insurance aspects, by Prof. Firket of Liège; recent experiments on alcohol and heredity, by Prof. Laitinen of Helsingfors; changes in the endocrine glands in the descendants of alcoholics, the endocrine glands and inebriety, the permeability of the meninges in alcoholics, and the excitability of the cerebral tissue in the descendants of alcoholics, by Dr. Puusep, Director of the Neurological Clinic at Tartu; results of American prohibition from the hygienic aspect, by Prof. Haven Emerson of New York; social effects of the Belgian Liquor Law of 1919, by Dr. Vervaeck, Director of the Institute of Criminal Anthropology at Brussels, and Dr. Meeus, Director of the Laboratory for Criminal Anthropology at Antwerp; alcoholism in Russia, by Dr. Dahlgren of Malmö; and alcohol and sport, by Drs. Bellin du Coteau and Bergeron of Paris. Further information can be obtained from the General Secretary, Prof. Charles Verlat, Rue Van Dyck 10, Antwerp.

THE Horniman Museum of the London County Council is planning its zoological exhibits on lines which might be adopted by other museums with advantage to the inquiring public and to the spread of fundamental scientific knowledge. A series of 29 cases has been set apart to illustrate the evidences and the theories of evolution from the zoologist's point of view. Specimens have been selected to show classification, structure, embryology, fossils, and domestication, all points of the great central truth of evolution, and the cumulative evidences brought together in this compact way could scarcely fail to impress a thoughtful observer. A "Handbook to the Cases illustrating the Evolution of Animals," by H. N. Milligan, has just been issued (London: P. S. King and Son, Ltd. 6d. net). It is a well-balanced compilation, written without scrappiness, suitable for reading in the museum in front of the cases, or by the fireside at home, and stating the case for evolution fairly and in reasonable detail. An appendix suggests books suitable for readers who wish to pursue the subject.

AN earthquake of considerable intensity was recorded at Kew Observatory on July 18 at 19 h. 17 min. 51 sec. G.M.T. The epicentre, which was at a distance of 5870 miles, appeared to have been in Peru near that of the earthquake of April 9.

THE Russian Academy of Sciences has appointed a committee to arrange for the celebration of the

completion of forty years of scientific research by one of its members, Prof. P. Sushkin, the eminent zoologist. There will be a special meeting of the Academy in October, and it is hoped to publish a jubilee volume of papers.

THE Prince of Wales, who is a Trustee of the British Museum, has sent a donation to the British Museum East Africa Fund, which has been opened to enable the Trustees to continue the exploration of the deposits in East Africa containing fossil remains of large dinosaurs (see NATURE, July 21, p. 105). The scientific results of the exploration are likely to be of the greatest interest, and it is hoped that the Prince's example will stimulate a sufficient number of donors and so prevent the exploration being brought to a premature end.

THE Report of the Director-General of Public Health, New South Wales, for the year 1926 has recently been issued. In addition to vital statistics and administrative details, reports on scientific investigations carried out by officers of the Board are included. One of these deals with the ventilation of theatres, and certain standards are suggested; another gives a list of the species of fleas collected from rats and mice and their prevalence; and a third gives an account of paralysis which may follow the bite of a tick (*Ixodes holocyclus*).

NOTICE has been issued of the award in 1929 of the George Montefiore Foundation prize for an original work on electricity or its technical applications. This prize is awarded triennially by a jury of ten electrical engineers, five of whom are Belgian and five foreigners, under the auspices of the Association des Ingénieurs électriciens sortis de l'Institut électrotechnique Montefiore. The prize for 1929 is 29,000 francs, and the last date for the receipt of competing works is April 30, 1929. Particulars can be obtained from the general secretary of the Association, rue Saint-Gilles, 31, Liège, Belgium.

THE *Bulletin of Hygiene* announces (vol. 3, p. 89; 1928) that it has provisionally adopted the bacteriological nomenclature recommended by the American Society of Bacteriologists. This nomenclature is binomial and in accordance with botanical nomenclature, thus avoiding trinomial and polynomial names of species which have been hitherto commonly used by bacteriologists. Many new genera have also been constituted, so that related organisms are grouped together and separated from unrelated forms. Thus the term *Bacillus*, which formerly included a very heterogeneous collection of straight rod-shaped organisms, becomes restricted to aerobic sporing forms only.

FROM the July number of *Evolution* we learn that the fundamentalist campaign still continues unabated in certain of the States of U.S.A. In Arkansas the question is to be submitted to popular vote at the next election, as must be done if eight per cent of the voters sign a petition so requesting. Already more than 20,000 signatures, nearly twice the number required by law, have been obtained to a proposal for "An Act to prohibit in any University, Normal,

Public School, College or other educational institution in the State of Arkansas, that is supported in whole or in part from public funds, the teaching that man descended or ascended from a lower order of animals and providing a penalty for violation thereof." A curious way to put it, for an anti-evolutionist!

"NEWSLETTERS" continue to give supplementary information concerning the programme of the American Chemical Society's Institute of Chemistry, which is being held at Evanston, Illinois, on July 23-Aug. 18. The personnel is such as to inspire confidence that the audiences will be conducted with knowledge and discrimination over the extensive area selected for their mental excursions, and that the 'stories' which their guides have to tell will be well worth their attention. Names which catch the eye in glancing over the programmes are Dr. S. C. Lind on high energy in chemical reactions, Dr. W. P. Yant on chemical hazards, Dr. O. Kamm on the endocrine glands, Col. H. L. Gilchrist and Dr. W. L. Lewis on chemical defence, and Drs. C. A. Browne and H. G. Knight on agricultural chemistry.

THE appearance of the *Annual Report* for 1927 of the Council of the Yorkshire Philosophical Society offers an opportunity for commending the activities of this ancient institution, now in its one hundred and sixtieth year, to such as dwell in or are interested in the great county. The Council congratulates the members on a very successful year's working, but an analysis of the report suggests that the Society deserves more support than it is receiving. The membership, which now stands at 537, dropped by 32 during the year; and in spite of a welcome increase in gate money, indicating that greater use is being made of the Museum, and of a considerable reduction in expenditure on the grounds and Museum, there is a deficit on the year's working of £238, traceable to a decrease in the income derived from the Anderson bequest. A Million Shilling Fund has been opened with the view of enlarging the Museum and replacing old cases by modern bronze ones. In view of the expense likely to be involved in such a replacement, the Council may be interested to know that there seems to be a tendency in some of the large museums to revert to well-designed wooden casing.

MESSRS. Longmans and Co., Ltd., announce the early publication of the following books of science: "The Protamines and Histones," By the late Prof. A. Kossel. Translated by Dr. W. V. Thorpe (in Monographs on Biochemistry); "The Pressure Pulses in the Cardiovascular System," by Prof. C. J. Wiggers (in Monographs on Physiology); "The Principles of Applied Zoology," by Prof. R. A. Wardle; "Strain Energy Methods of Stress Analysis," by Prof. A. J. S. Pippard; "The Theory of Film Lubrication," by R. O. Boswall; and a new edition, revised by C. H. Rowe, of Salmon's "A Treatise of the Analytic Geometry of Three Dimensions." Vol. 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A highly qualified engineer with general works experience as

vice-principal of the Hyderabad State Technical Institute, India—The Wardle Engineering Co., Ltd., 8 Princes Street, Storey's Gate, S.W.1 (Aug. 1). A woman professor of physiology at the Lady Hardinge Medical College, Delhi—The Honorary Secretary, U.K. Branch Dufferin Fund, care of Major-General J. B. Smith, India Office, Whitehall, S.W.1 (Aug. 3). Two junior assistants in the Highways Department of the Manchester Corporation—The City Engineer, Town Hall, Manchester (Aug. 3). A lecturer in agricultural chemistry at the South-Eastern Agricultural College, Wye—The Secretary, South-Eastern Agricultural College, Wye, Kent (Aug. 4). An assistant for research in the Textile Industries Department of the University of Leeds—The Registrar, University, Leeds (Aug. 13). An assistant naturalist in the Fisheries Department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Aug. 13). An assistant lecturer in the department of education of King's College, London—The Secretary, King's College, Strand, W.C.2 (Aug. 17). An assistant analyst in the Government Analyst's Department, Trinidad—The Private Secretary (Appointments),

Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Aug. 20). An assistant in the Department of Physiology of London Hospital Medical College—The Dean, London Hospital Medical College, E.1 (Aug. 31). A professor of pathology in the University of Liverpool—The Registrar, University, Liverpool (Sept. 30). An engineer artificer for the Marine Department of the Government of the Gambia Colony—The Crown Agents for the Colonies, 4 Millbank, S.W.1, quoting M/839. A dietitian at St. Bartholomew's Hospital—The Clerk to the Governors, St. Bartholomew's Hospital, E.C.1. Lady graduate assistants at the Wool Research Association, Torridon, with knowledge (a) of economics, languages, or (b) physics or physical chemistry and languages—The Secretary, Wool Research Association, Torridon, Headingley, Leeds. Evening teachers of practical physics and chemistry for first-year students in the Engineering Department of the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon. A full-time graduate assistant, with works experience, to teach mechanical engineering subjects in the Darlington Technical College—The Chief Education Officer, Education Office, Darlington.

Our Astronomical Column.

RECENT SOLAR ACTIVITY.—Reference was made in NATURE of July 21 to the recent increase of sunspots. Another big spot has since made its appearance, and this with two others may be included in a list of naked-eye spots observed this year.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Max. Area.
3	June 22–July 5	June 28.9	19° S.	1/1200
4	July 6–July 18	July 12.4	8° N.	1/700
5	July 12–July 23	July 17.5	18° S.	1/700

Areas are expressed as the proportion of sun's hemisphere covered.

Group No. 3 was a single spot for the greater part of its transit. No. 4 was a pair of spots of which the leader was the larger at first, but later the follower predominated. No. 5 was a stream composed of a large spot followed by a compact cluster of smaller spots. The group grew rapidly from a few spots near the sun's east limb on July 12. On July 17 the entire length of the stream was 15° of longitude, or more than 100,000 miles.

PHOTOGRAPHY OF FAINT NEBULOSITIES.—The photography of faint nebulosities requires very great care if successful and trustworthy results, showing accurate detail uninfluenced by artificial nebulosities, are to be obtained. The technique of this work has been developed by Mr. F. E. Ross at the Yerkes Observatory, who is preparing a series of papers on the subject. The second paper of this series appears in the *Astrophysical Journal*, vol. 67, p. 281, in which the author describes his methods and the difficulties to be overcome. A 3-in. doublet of focal length 21 in. was used. Exposures of 2 hours reached the limiting magnitude for stars (15.4 mag.), beyond which it was not possible to obtain fainter stars by lengthening the exposure, though a definite gain in photographing nebulosities was obtainable. Earlier experimenters showed that it was possible to see more detail in original negatives than could be reproduced photographically, but improved methods of reproduction have now actually reversed this situation; it is interesting to find that Mr. Ross has been able to reproduce nebulosities (the genuineness of which was

confirmed) which could not be detected on the original negative. These results have been obtained by making intermediate prints on panchromatic plates, using a red filter in order to increase contrast, the transfer processes being four in number. Some very fine illustrations of nebulosities in Monoceros, Taurus, and Perseus obtained in this way are given and discussed in detail.

REPORTS OF THE CAMBRIDGE OBSERVATORIES.—The reports of both the Cambridge observatories have recently appeared. That under Prof. Eddington has been engaged on photographic determination of the proper motions of faint stars from plates taken at intervals of about twenty years. Dr. Knox Shaw has undertaken the study of the colour indices of the stars with the large refractor at the Radcliffe observatory.

A photo-electric photometer is being used on the Sheepshanks equatorial, a sodium cell being found to give the best results; magnitude 5.5 is the faintest that can be studied satisfactorily. Prof. J. J. Nassau and Mr. R. O. Redman have been studying the relation between absolute magnitude and spectral type, attacking the problem in several independent ways.

In the Solar Physics Observatory special studies have been made of the spectra of ϵ Andromedæ, P. Cygni, and Nova Pictoris. A period of about 24.6 days has been found for the first named; this is about a quarter of the main period 96.67 days found by R. H. Baker at Allegheny. Dr. Carroll has made several theoretical investigations on stellar spectra.

With the spectro-heliograph a diminution of solar activity was noted in the second half of 1927; the diminution in the areas of calcium flocculi, and the decline in the mean latitude of the groups to 15°, are taken to imply that the maximum was passed in 1927. Mr. Butler has studied the laws of progressive changes in the forms of flocculi. The observatory sent an expedition to Aal, Norway, for the eclipse of June 29, 1927; but clouds prevented any results being obtained.

Research Items.

THE BIRTHPLACE OF HUMANITY.—Prof. Henry Fairfield Osborn returns to his attack against the generally accepted theory of man's ancestry, in a short article in *Science* (June 8, 1928, p. 570). Darwin thought that "our progenitors, no doubt, were arboreal in their habits, and frequented some warm, forest-clad land," and, as was pointed out in a recent leading article in our columns, this is the view still widely held. From considerations of a general kind, however, Osborn argues that a warm, forest-clad area was not the sort of place to stimulate the great progressive development which led to the human stock. Recent ethnographical and physiographical evidence indicates that intelligent progressive and self-adaptive types of mankind arise in elevated upland or semi-arid environments, where the struggle for food is intense and where reliance is made on the invention of implements as well as weapons. Again, the first modernisation of the entire mammalian kingdom, geology indicates, occurred in Oligocene times and was seemingly due to a wave of aridity concurrent with the complete elevation of great continental plateaux. This geological change caused a branching of the ways of mammalian evolution, for pre-existing mammals were compelled to choose between the warm, enervating, forest-clad regions, or the temperate, stimulating plateaux. Is it likely that the forerunners of mankind were exempt from this compelling and fateful decision? Is it not more likely that the stimulus seen in the development of so many mammalian groups was also that which gave the urge to the primate ancestors of man? If Osborn's speculation is right, he looks to the uplands of Mongolia or Tibet, the top of the world, as the most favourable geographical centres for such development, the final proof of which must rest upon the efforts of the fossil hunter and explorer.

THE DYING GOD IN EGYPT.—Miss Murray has directed attention in Part I of *Ancient Egypt* for 1928 to passages in the Pyramid texts of Pepy and Merenra which appear to point to the sacrifice of the king as a fertility victim. Though the text is corrupt and the meaning of the religious ideas obscure, these passages seem to recite a demand of the people and the gods for the death of the king because he "has not eaten the Eye of Horus" and the "Limb of Osiris." The former expression usually means food. It is suggested that this may mean that if the king does not eat, perhaps owing to scarcity, he must die. The death, however, is ritual only, for he "lives on the bread of his father Atum" and his escape from death is compared with that of the god Setesh, this escape apparently being effected by ploughing the earth. The sacrifice takes place at a moon period, the new or the full, and presumably after a period of time, though the year is not given. Perhaps, as suggested by the tradition of Mykerinus, the length of his life was limited to seven years. The two lunar festivals of the month at new and full moon, it may be noted, were specially connected with the commemoration of the dead. The mention of the king as "a star opening the waters of heaven" would be a reference to his rain-making powers. The position of Setesh as the sacrificial victim whose example is to be followed by the king instead of, as usually, the principle of evil, may be due to the fact that Setesh was the god of the barren south. As the northern cult of Osiris advanced south, Setesh became the great enemy. The conflict of the Horus-people of the north and the people of the south was translated into the theory which made the son of Osiris the

avenger against the murderer of his father, and the more noble Osiris became, the more evil was Setesh.

SEAL LICE FROM NORTHERN REGIONS.—Lieferung XI, XI^d, of "Die Tierwelt der Nord- und Ostsee," contains an account of the body lice of the Pinnipedes by Ludwig Freund (*Anoplura Pinnipediorum*). It perhaps comes somewhat as a surprise to the uninitiated to find that such mammals as seals should harbour true lice, but these have been known for well over half a century, and they are here recorded from more than a dozen different species of seals. These lice belong exclusively to one family, the Echinophthiriidae, and only three genera are known from the area described, with ten species. The *Antarctophthirinae*, with five-jointed feelers, are provided with body scales, the *Echinophthirinae*, with four-jointed feelers, with specialised spines only. The function of these special scales and spines is to entangle air and so form an air sheath which surrounds the insects when under water. Those without scales occur chiefly on the head of the host and receive more air, whilst those with scales may occur on the body and survive a long immersion in water. Thus special respiratory facilities are provided for these marine lice. The author has illustrated his monograph with many careful original drawings in addition to those from other works. The original figures are chiefly of *Echinophthirius horridus*, which is common on several different seals, and has a wide range of distribution. The eggs of all those known are very firmly fixed to the hairs of the host.

INTESTINAL FLORA OF THE MOLE.—The microflora of the intestinal tract of the common mole, according to recent investigations of W. A. Kutejschikow (*Journal de biologie et de médecine expérimentales*, Moscow, 9; 1928), is extremely poor, the stomach content being practically sterile; only a few organisms of the *Bacillus coli* type were isolated, and these proved to be closely allied to the similar organisms from man, but different from them serologically. This poverty of the intestinal flora is the more remarkable because the mole lives in the upper layers of soil, which are very rich in micro-organisms; it may be explained by the very rapid course of the digestive processes in the mole, and perhaps by some special properties of its gastric juice. The mole presents in this respect a marked contrast with the shrew, which has a very rich and varied intestinal microflora.

CONTROL OF THE PEACH-BORER BY PARADICHLORBENZINE.—The peach-borer moth (*Ageria exitiosa*) is widely spread in North America, where its larvæ burrow into the tree-trunks just below the surface of the soil. In addition to peach the insect also affects apricot, nectarine, and plum. The use of paradichlorobenzene is becoming increasingly favoured as a means of control ever since Blakeslee discovered its value in 1919. A great deal of experimental work has been carried out with reference to the application of this substance in different parts of the United States, and the most recent contribution to the subject will be found in *Technical Bulletin, U.S. Dept. of Agriculture* (No. 58, March 1928), by Messrs. O. I. Snapp and C. H. Alden. These workers report that paradichlorobenzene has been used on the same trees in one orchard for five consecutive years with no discernible tree injury and almost complete eradication of the borers. In the south it should not be used on trees less than four years old. Before applying it all grass, stones, and refuse are cleared away for a foot radius from the trunk, and $\frac{3}{4}$ oz. to 1 oz. of paradichlorobenzene crystals are distributed

in a continuous ring about $1\frac{1}{2}$ inches from the trunk. The crystals are then covered with soil, which is packed around the tree to form a mound. An exposure of from four to six weeks was found to give excellent control, the borers having been killed by the gas given off.

WING DIMORPHISM IN WEEVILS.—The inheritance of long and short wings in the weevil, *Sitona hispidula*, is the subject of a study by Miss Dorothy J. Jackson (*Trans. Roy. Soc. Edin.*, vol. 55, part 3, No. 27). The two forms are carefully described and figured. In the form with short, truncate wings, the structure of the metanotum and metapleura is greatly altered, especially the parts serving for attachment of wing muscles. Some of the long-winged weevils differed from normal in having the wing muscles greatly reduced and modified, but in the brachypterous weevils these muscles were further reduced and difficult to find, their place being taken by body fat. Breeding experiments involving more than 600 weevils showed that the brachypterous type behaved as a simple Mendelian dominant to long wings. There were also indications that the short-winged type was more viable, perhaps owing to the presence of the reserve fat. Reduction in the wing muscles was unaccompanied by any change in the muscles that lift the elytra. Both forms of the weevil are found to be common in Europe, where the two forms frequently occur together; but hitherto only the long-winged type has been found in America. Evidence from breeding indicates that the abnormal condition of the wing muscles in long-winged weevils is inherited, probably as a Mendelian recessive. Interbreeding occurs between the long- and short-winged types, and about half of the wild short-winged insects were found to be heterozygous. Of 34 species of *Sitona* examined, ten were found to show wing dimorphism, and this number will probably be increased. In 12 species only long wings were found, and in 12 others only short wings. Other families of Coleoptera frequently contain species in which the wings are reduced or absent, and wing dimorphism is recorded in several. The origin of the wingless condition in flying insects is discussed, and it is pointed out that the facts in *Sitona* are not in accord with any theory of disuse. The conclusion is drawn that wing reduction has arisen through abrupt mutations, and is a very ancient phenomenon in Coleoptera. It may form the basis of selection under certain conditions, but since apterous species occur in the most diverse situations, the flightless condition is probably in many cases of little importance in determining the survival of a species.

ANTARCTIC PLANT LIFE.—Some interesting facts regarding Antarctic and sub-Antarctic vegetation are recorded by R. N. Rudmose Brown, the polar geographer and naturalist ("Problems of Polar Research," *Amer. Geog. Soc.*, Special Publ. No. 7). Antarctic plant life is necessarily confined to the edges of the Continent, the mountain ranges, and islands near the coast. The great ice sheet is completely devoid of any form of life. The poverty of the flora compared with that of the same latitudes in the North Polar regions is striking. The Arctic regions support some four hundred species of flowering plants as against only two species in the Antarctic. This may be ascribed to the shortness of the Antarctic summer and the remarkably low temperatures, for no month has a mean temperature above freezing point. As a rule, December is well advanced before the rays of the sun lay bare what little soil occurs in a few places. Only for a month or six weeks is the vegetation, except lichens on cliff faces, exposed to sunlight. The ground thaws to a depth of only a

few inches on a few cloudless days, and even then is saturated with ice-cold water in which root hairs are physiologically inactive. Mosses are numerous, and form one of the chief constituents of the vegetation, and more than fifty species have been recorded, mostly from Graham Land. Fruiting specimens are rare, and only six species have been found showing this mode of reproduction. About seventy species of freshwater algae have been found in the South Orkneys, the most interesting being species of *Sphaerella*, which colours snow red. Marine algae are very abundant in Antarctic Seas, and grow at times in pools which are frozen solid all winter. Luxuriant genera like *Laminaria* and *Macrocystis* flourish only on sub-Antarctic coasts which remain open throughout the year. Most remarkable of all, however, is the wealth of diatom life, in strong contrast to its scarcity in warm seas. The important factors operating in this case are probably decreased activity of denitrifying bacteria at low temperatures, the tendency for the surface layers of water to sink and be replaced by deeper layers richer in nitrates, and the abundance of silica in polar seas owing to the low temperature of the water and the great quantities of glacier-swept debris from the land.

PERMIAN FOSSIL INSECTS OF NORTHERN RUSSIA.—Mr. A. V. Martynov has published some very interesting results of his extensive studies on the fossil insects found in several localities in northern European Russia in the Permian strata (*Travaux du Musée Géologique près l'Académie des Sciences*, Leningrad, vol. 4; 1928). A very large number of new species, genera, and some new families are described in the paper (written in English), and fully illustrated on the 19 plates. An analysis of the fauna found shows that the greater portion of the Permian fauna of northern Russia, about three-fourths of the species, was not related either to the Carboniferous or to the Permian faunas of western Europe; about one-half of these species showed some more or less definite relations to the Lower Permian fauna of Kansas and partly also to the Upper Permian fauna of Australia. The forms of the 'Kansas type' are all characterised by their rather small dimensions, while the Permian forms of Europe are mostly large; this suggests that the fauna of the 'Kansas type' developed under less favourable climatic conditions than the European fauna of the same period, probably in some land north or north-west from Kansas during the Lower Permian period; then it migrated by the North Pacific bridge to the Angara continent and penetrated farther westwards, reaching European Russia in the Upper Permian period. A meridional sea which extended at that time right across the present European Russia from north to south, stopped the fauna from reaching western Europe, where a distinct Permian fauna consisting of large forms developed under very different and more favourable climatic conditions. Certain affinities between the Permian faunas of northern Russia and of Australia are difficult to explain in the present state of our knowledge.

EARTH-TILTINGS PRECEDING EARTHQUAKES.—Two interesting papers on this subject are published in the *Proceedings* of the Imperial Academy, Tokyo (vol. 4, pp. 148-153). Mr. S. Haeno has examined the records of two horizontal pendulums at Tokyo specially designed for the purpose. He notices the existence of two regular variations, one diurnal, the locus of the vector end being an elliptic curve with a major axis of $0.57''$ in the direction N. 80° W.; the other annual, the locus of the vector end being roughly elliptical, with a major axis of $10''$ in the direction N. 50° E. These regular variations agree

closely with variations of the earth's temperature at a depth of 10 cm. In addition, the records sometimes indicate variations of an irregular type, one of which occurred just before the Haneda earthquake of Aug. 3, 1926. In the other paper, Prof. A. Imamura describes the tilting of the earth for forty days before the great earthquake of Sept. 1, 1923. From July 18 until July 30 the tilting southwards may be regarded as a normal variation of land-level caused by the gradual increase of air temperature. Then came a very conspicuous and abnormal tilting of nearly 1.7" downwards towards W. by N., which continued until Aug. 17. During the succeeding fortnight the changes were normal until the morning of Sept. 1, when a sharp tilting of 0.3" occurred in eight hours, ended abruptly by the great shock.

NATURAL GAS-AIR EXPLOSIONS.—Since for testing purposes, and for the study of gas explosions on a large scale, British investigators use methane, whilst in the United States of America natural gas—a mixture of the simpler hydrocarbons, and variable in its composition—is employed, a comparison of the two methods became desirable. The work, which was carried out at Pittsburgh under a scheme of co-operation between the Safety in Mines Research Board of Great Britain and the Bureau of Mines, U.S.A., is described in *Technical Paper of the U.S. Bureau of Mines*, No. 427, by H. F. Coward and H. P. Greenwald. The results amply confirm provisional conclusions that the use of natural gas (composed of paraffin hydrocarbons with not more than 2 or 3 per cent of nitrogen) instead of methane for testing the safety underground of electrical equipment, flame lamps, and explosives is justified, any slight difference being, in fact, on the safe side. The lower limit of inflammability of a natural gas in air may be calculated almost exactly, and the higher limit approximately, from the limits of its constituent hydrocarbons. From the results of a combustion analysis giving the ratio between the contraction on explosion and the volume of carbon dioxide thereby formed, and reference to a curve, the lower limit may be found with equal accuracy in the absence of knowledge of the exact composition of the natural gas. It is interesting to find that the speed of uniform movement of flame, that is, the initial stage in the propagation of flame from the open end of a tube towards the closed end, can be calculated for mixtures of various samples of natural gas and air from data for the individual hydrocarbons on the basis of the so-called "law of flame speeds." Many of the experiments were carried out with a tube 100 ft. long and 12 in. in diameter, in order that the conditions should approach those obtaining in industry.

A NEW PERIODIC TABLE.—Prof. Yamamoto, of the Kyoto University Observatory, has recently revised a form of periodic table of the elements which he first published in January 1927 in a Japanese journal of astronomy entitled *The Heavens*. In this table the elements are arranged in families and series in much the usual way, but fall into two main groups. One of these groups contains elements almost all of which do not appear to be present in the stars or in the sun, while the other includes most of the elements so far observed in stellar spectra.

THE REACTION BETWEEN METHANE AND STEAM.—The reaction: $\text{CH}_4 + 2\text{H}_2\text{O} \rightleftharpoons \text{CO}_2 + 4\text{H}_2$ has been investigated at 500° C. and 1 atm. pressure by R. N. Pease and P. R. Chesebro, who describe their results in the May issue of the *Journal of the American Chemical Society*. The equilibrium was approached from both sides, the gas mixtures being passed at measured rates of flow over a supported nickel-thoria catalyst at 505° C.

and then analysed. The average value of the equilibrium constant at this temperature was found to be 0.037, while that calculated from the free energy equations of Lewis and Randall is 0.0387, thus showing that the expression used for the free energy of methane at 500° C. is satisfactory. The presence of about 1 per cent of carbon monoxide in the effluent gas indicates that the reactions $\text{CH}_4 + \text{H}_2\text{O} \rightleftharpoons \text{CO} + 3\text{H}_2$ and $\text{CO}_2 + \text{H}_2 \rightleftharpoons \text{CO} + \text{H}_2\text{O}$ also take place to some extent. The reactions between methane and steam at high temperatures form a possible source of hydrogen and hydrogen-carbon monoxide mixtures, the concentration of the carbon monoxide being decreased if required by the use of excess of steam.

PURIFICATION OF INVERTASE.—The problem of obtaining a pure preparation of the enzyme invertase has been partially solved by some recent work of Sastri and Norris (*Jour. of Indian Inst. of Science*, vol. 2A, Part 1). Several methods in use for the purification of invertase have not so far succeeded in producing the enzyme free from both protein and yeast gum. The most difficult part of the problem, however, is the removal of substances closely allied to the enzyme itself, and probably consisting of inactivated enzymes, zymogens, and decomposition products of invertase. The method of Sastri and Norris consists essentially in the autolysis of the yeast in the presence of toluene, after which the liquor is concentrated by freezing. Various impurities are then absorbed by kaolin, which is centrifuged out and the clear liquor siphoned off. The enzyme is then precipitated by ammonium sulphate (which does not inactivate the invertase), and the precipitate is washed with water. Removal of the sulphate by dialysis follows, and the enzyme is absorbed by aluminium hydroxide, which is later filtered off by a bed of previously ignited kieselguhr. The preparation is white and free from yeast gum. It is odourless and gives neither the Molische test for carbohydrates nor the Millon test for proteins. It gives, however, a very faint biuret reaction and the xanthoprotein reaction. The nitrogen content and ash content are both very low. It is free from maltase, oxidase, reductase, and all other enzymes known to be contained in yeast. The activity of the preparation is expressed by the 'time value' defined by Willstätter and Kuhn, and changes during the process of purification from $\pm 0^\circ = 430$ minutes in the original yeast liquor to $\pm 0^\circ = 0.91$ minutes in the purified enzyme.

THE CARBONISATION PROCESS.—The eighteenth Report of the Joint Research Committee of the Institution of Gas Engineers and the University of Leeds records a continuation of the study of the carbonisation process carried out in the Corbet Woodall Experimental Plant at the University of Leeds. It deals with the effect of size of coal treated and with the effect of admixture of ferric oxide (2.2 per cent), calcium carbonate (3.4 per cent), sodium carbonate (3.3 per cent), with the Nottinghamshire coal distilled. The retorting temperature was reduced to 915° C., and the results were largely parallel with those obtained in previous tests at 980°. Experiments with blends of coal and coke did not promise great advantage. Striking effects were observed with the mixtures of coal and inorganic compounds. The yield of gas in therms was always increased—with the soda by 12 per cent—and this was ascribed partly to the more far-reaching decomposition of steam by the reactive coke. It was only the mixture with calcium carbonate which gave a much greater yield of ammonia. The reactivities of the cokes were increased by the presence of the inorganic compounds, but abnormalities require further investigation.

The Forest Research Institute, Dehra Dun, India.

By ALEX. RODGER, Inspector-General of Forests, India.

THE history of forest research and education in forestry in India has been intimately connected with Dehra Dun for the last fifty years, as the first college for training Indians in forestry was started there in the year 1878. Dehra Dun was chosen because of its favourable position for the study of two important types of Indian forests, those where Sal (*Shorea robusta*) predominates, and the coniferous forests of the Himalayas, which are all well represented close to Dehra Dun, and also because of its delightful situation and (during most of the year) its favourable climate.

About twenty-five years ago it was realised that the proper conservation, development, and utilisation of the magnificent State forests in India (covering 250,000 square miles, or 23 per cent of the total area

that considerable expenditure on research in forestry, calculated to improve the methods of growing, developing, and exploiting the forests, was justified.

The first buildings used for research were, as usually happens in such cases, small places, situated wherever anything suitable could be obtained. In 1913, however, a proper building was constructed, containing laboratories, offices, and museums for the silviculturist, economist, and entomologist. The botanist and chemist were housed in separate buildings on the same estate. This was the first attempt to concentrate forest research in proper buildings, and it was soon realised how useful the concentration was. With modern development of forestry in the field, work increased rapidly, and in 1920 much more ambitious plans were drawn up. These comprised a large

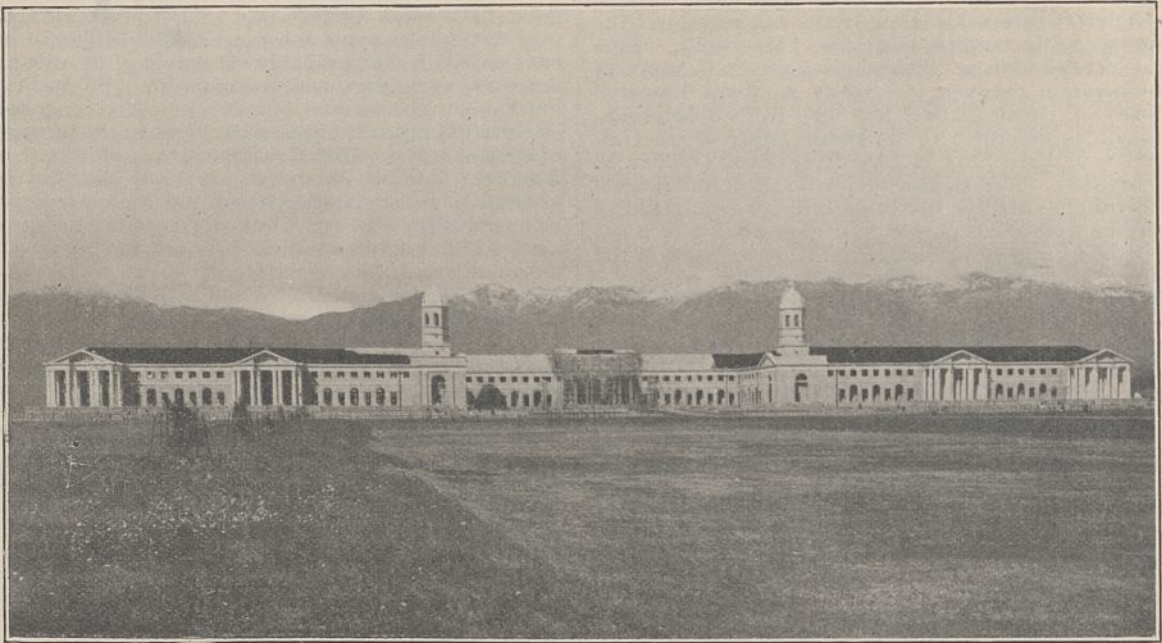


FIG. 1.—Main building of the Forest Research Institute, Dehra Dun, with the Himalayas in the background.

of the country) depended on organised research, and a start was made in a small way by the appointment of a forest zoologist, who began work on insect pests in 1900. The outlook on research of professional forest officers has changed very much since that day. It is recorded that an officer high up in the department was indignant because the first research officer had produced no literature within a year after his appointment. Public opinion rapidly matured, and about twenty years ago four other research officers were appointed. It was considered at that time that the conduct of research in forestry in India should be divided into five branches, covering silviculture, economy, botany, entomology, and chemistry, and this arrangement has lasted to the present day.

Including the area under forest in Indian States, about one quarter of the Indian Empire is covered with forest, and the net revenue in British India in the year 1925-26 was two million pounds, gross receipts amounting to $4\frac{1}{2}$ million pounds and expenditure to $2\frac{1}{2}$ million. The surplus has more than doubled during the last twenty years. It will be recognised

building with workshops, electric plant, stores, insectary, and residences of different grades, all situated on an estate of 1200 acres which was acquired close to Dehra Dun. The main building (Fig. 1) will be completed in 1928. In this fine building there is ample accommodation for the five branches, and possibly part of the Forest College will also occupy it. The new building contains six museums, with floor space of 26,000 square feet, a convocation hall with 6000 square feet, and numerous laboratories and offices, which have a floor space of about 63,000 square feet. The architect is Mr. C. G. Blomfield, of Delhi.

The aim of the staff of the Forest Research Institute is to find out and publish everything about the forests and forest products of India which will be of use to the public and to the forest departments of the various provinces and of the Indian States. Information when collected is published at once and is available to any one, and no small part of the time of the controlling staff is taken up in answering inquiries from every conceivable source. Most of these inquiries come, of course, from India, but there is

scarcely any part of the world with which the staff is not in communication, and inquiries are regularly received from almost every country where forestry and forest products are of any importance.

The cost of the Forest Research Institute is entirely met by the Government of India, the annual expenditure being about £70,000. The total capital cost of the new Forest Research Institute, which is not yet quite completed, will be about £750,000, surely a record for forest research. The majority of the controlling staff is composed of forest officers deputed from their provinces, but there is a number of specialists who deal with subjects such as timber testing and kiln seasoning. The total staff of the Forest Research Institute and College comprises 35 controlling and 260 subordinate members. The Institute is constantly visited by forest officers and others from every part of the world, and some of those visitors stay for a considerable period, and take a course in one or more of the special lines dealt with. The work done by the various branches is of course closely related, and constant consultations take place between the branch officers, but it will be convenient to describe the scope of the work done under the various heads.

SYLVICULTURE.

This, although not the largest, is the senior branch, as is proper in a Forest Research Institute. Prof. Troup, who is now Director of the Imperial Forestry Institute at Oxford, was the pioneer in modern scientific sylviculture in India, and he embodied the results of his observations in his three fine volumes "The Sylviculture of Indian Trees," published by the Clarendon Press in 1921. Since Prof. Troup left Dehra Dun the branch has developed considerably, and the work of the Imperial sylviculturist is co-ordinated with that of a number of provincial sylviculturists in Madras, Burma, Bengal, etc. Sample plots to determine the best method of growing important species, and to obtain figures for volume, increment, etc., have been established in many forests throughout India and Burma, and the working up of the statistical data obtained from all these sample plots is undertaken at Dehra Dun. Yield and volume tables for important species are regularly published, and a great deal of work is done on the germination and development of the seeds of forest trees. Working plans are examined for provinces, and all sylvicultural matters constantly discussed with local officers.

Model plantations of several important species are being made on the estate at Dehra Dun close to the Forest Research Institute, partly with the view of making them into demonstration areas for the students at the College, which is under the same president as the Forest Research Institute. The sylviculturist can rarely, of course, show such immediate results as the forest economist, but, with the present rapid additions to our knowledge of how to treat the forests of India, the value of the forests as a great asset of the country will increase steadily. Sustained scientific management in the case of valuable property which does not come to maturity for 100 or 150 years is, of course, of the utmost importance.

ECONOMY.

Forest economy or utilisation has developed at the Forest Research Institute more than any other branch, and has in fact been divided already into sections, covering wood technology, timber testing, wood preservation, kiln seasoning, paper pulp, minor forest products, and wood working. The workshops for this branch are separate from the main building and were constructed before it. This branch is in intimate relation with the most important users of timber and forest products, for example, the railways and the Gun Carriage Factory, and is continually giving advice to these and to other commercial and semi-commercial concerns. To ensure continuity of experimental work, a triennial programme is passed by the Inspector-General of Forests and the different inquiries are carried on under the provisions of printed projects in which the lines of research are laid down.



FIG. 2.—Experimental Sturtevant kiln at the Forest Research Institute, Dehra Dun, showing timber stacked ready for seasoning.

In the Timber Testing Section more than 200,000 tests have been carried out during the last five years, and a great quantity of valuable data about all the more important Indian timbers has been collected. As examples of the results of tests made in the laboratories, the life of aeroplane wing spars in India was extended from five to seven years, and it is expected that local wood will be used on a large scale in the oil wells of Burma in place of the expensive imported hickory.

In a climate like that of India nothing can be more important for users of timber than to see that their wood is properly treated before it is made up. Experimental seasoning kilns have now been running for some years at Dehra Dun, and the best method of seasoning many important Indian timbers has been ascertained. As a result of the work done at Dehra Dun, the Gun Carriage and Rifle Factories and the Railway Board are installing batteries of kilns. The Forest Research Institute carried out most successfully seasoning operations on 1000 walnut rifle parts, seasoning them all in seven weeks instead of five years. Timber endures so many hardships in the fierce climate of India between the forest and the factory,

that proper seasoning is of the utmost importance, and this is now being realised by timber users.

The most important work done in the Wood Preservation Section is in connexion with railway sleepers. It might appear that India would have no difficulty about the supply of railway sleepers, but this is far from being the case, and the supply of durable woods (such as deodar and teak) which resist white ants is insufficient. The Forest Research Institute has concentrated on treating sleepers of second class woods in such a way that they can be economically used to take the place of the more durable timbers. Success has been obtained, and several railways have built, or are building, plants to undertake the treatment of the cheaper Indian timbers. This will result in the profitable utilisation of millions of tons of second class woods, which would not otherwise find a market for years to come.

Bamboos cover very large areas in the Indian

The Wood-Working Section is a most important part of the economic branch. It receives large quantities of timber from all over India and Burma, and converts them to the sizes required for experimental work in all the other sections. In the section itself all the most important woods of India and Burma are used for carpentry, veneering, plywood, etc., and the volume of work in the section increases daily. Indian carpenters are being trained in large numbers in modern methods of wood-working. A modern sawmill deals with the logs, and a fully equipped machine-shop handles the output from the sawmill.

In considering the total export trade of India in forest products, it may be noted that the value of minor products exported considerably exceeds that of timber. The value of lac exported annually runs into millions of pounds. The section of the Forest Research Institute which deals with these products has never been properly manned or equipped, and it is only now that properly organised investigation into many important products is being undertaken. The large majority of forest species yield something of use to man, and in Burma alone, where there are some 3000 woody plants, there is an immense field for investigation. Skilled modern treatment of the resin of one of the Indian pines in the Punjab and the United Provinces has already resulted in India becoming largely self-supporting in the matter of turpentine. Among other forest products which offer profitable fields for scientific inquiry are gums, oils, cutch, fibres, tanning and dyeing materials, charcoal, drugs, spices, and fodder plants.

FOREST BOTANY.

Systematic work and mycology take up most of the time of the officers of this branch. The mycologist has only just been appointed, but already good progress has been made in investigating an important fungus on conifers.

The preparation of floras and the management of the new arboretum come under this branch, and an important part of the work of the botanists is the determination of species. A surprising amount of incorrect information regarding the identity of plants is received from forest tracts.

FOREST ENTOMOLOGY.

This, the first of the branches of the Forest Research Institute to be founded, is now a large and flourishing concern. The laboratories and insectary at the new Institute are spacious and up-to-date, and the collections are splendidly housed.

One of the most important subjects to which the officers of this branch have devoted themselves is the enormous damage done to the valuable Sal (*Shorea robusta*) forests of Central and Northern India by a beetle, and the measures devised for checking the damage have been most successful.

Systematic entomology plays an important part in all investigations. Defoliators and other pests attacking teak are under investigation, and all the more important species in India come under the consideration of the entomologists. The intimate

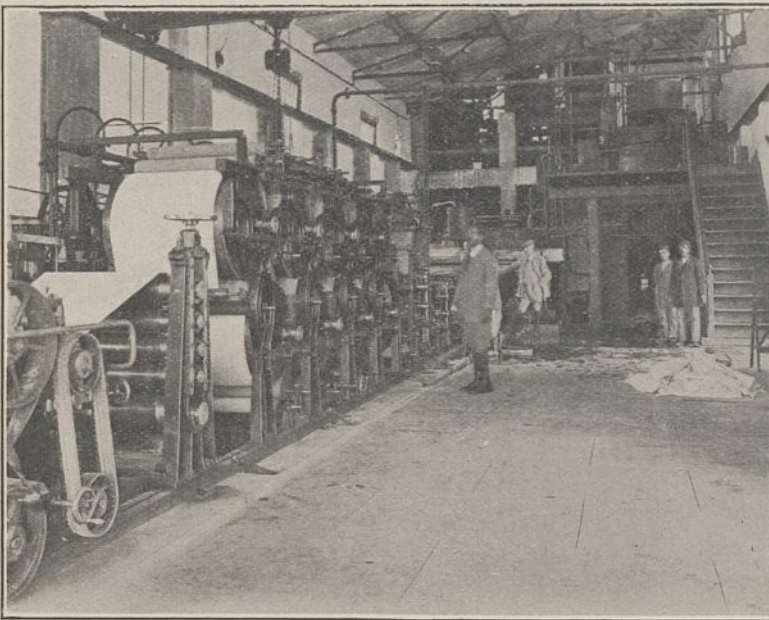


FIG. 3.—Paper pulp experimental machine at the Forest Research Institute, Dehra Dun.

forests, and the Forest Research Institute has done a great deal of work to prove that they can be profitably utilised in the form of paper pulp. Difficulties in digestion have been overcome through the skilled investigations of Mr. Raitt, who has also examined and reported on pulp propositions in the forest. As soon as the price of wood pulp rises, due to the exhaustion of supplies, bamboo will come into its own. It is believed that it may be found possible to use it for making artificial silk, and samples have been sent to England for trial.

The basis of all proper utilisation of timber is a knowledge of its structure, and this is especially the case in India, where there are so many different hard woods. Dr. Brown, of the University of Syracuse, U.S.A., was employed by the Government of India for a short period, and laid the foundations of the scientific study of the microscopical structure of Indian timbers. He published a "Manual of Indian Wood Technology" and is now training an Indian at Syracuse for the Institute. The Institute receives numerous specimens of wood with the request that they may be identified, and this can only be done by a highly trained wood technologist.

connexion between science and profitable forestry is never lost sight of. Many minor pests are being studied, and help is given to all provinces in solving their problems.

CHEMISTRY.

This is the smallest branch of the Forest Research Institute and its work is chiefly complementary to that of the others. It will be sufficient as an example to refer to the description of work on minor forest products given above, and it is easy to realise how important a part chemistry must play in the examination of the problems they provide. The study of forest soils is carried on in association with the silviculturist, and the analysis of mixtures used for preserving wood is another example of the activities of the branch.

EDUCATION.

All the research officers take part in the instruction of the students at the Forest College as an important part of their duties. This applies not only to the members of the staff who specialise in entomology, botany, etc., but also to the experts in timber testing, wood-working, paper pulp, seasoning and wood preservation.

PUBLICATIONS.

The results of the work done at the Forest Research Institute are published by the Government Press as soon as possible. Some 200 *Records*, *Bulletins*, etc., have appeared since 1905, as well as many manuals, floras, and volumes on other aspects of forestry.

International Astronomical Union.

LEYDEN MEETING.

THE third ordinary general assembly of the International Astronomical Union was held at Leyden on July 5-13. It was by far the most representative meeting so far held, astronomers of twenty-eight different countries being present. Incidentally, it was the largest gathering of astronomers ever held. During the meeting the adhesion of Rumania to the International Research Council and to the Astronomical Union was announced, increasing the total number of members to twenty-four. The close of the meeting left a very general hopefulness that before the next meeting of the Union most of the seven nations present as visitors for the first time (Germany, Austria, Hungary, Russia, China, Esthonia, Lithuania) would have become members of the Union.

The meeting opened with a reception by the Dutch government at the beautiful old Ridderzaal in The Hague. Addresses were delivered by His Excellency the Minister of Education, Arts and Sciences, the president of the Royal Academy of Sciences at Amsterdam, the Rector Magnificus of the University of Leyden, and the president of the International Astronomical Union (Prof. W. de Sitter, Director of the Leyden Observatory). The keynote of these addresses was one of gratification that under the auspices of neutral Holland the countries separated by the War had found it possible to come together again in the pursuit of science and the study of astronomy. Throughout the meeting, abundant hospitality was organised by the local committee, of which the efficient and active secretary was Dr. C. H. Hins, of the Leyden Observatory. Here we need only mention a trip to the Lake District near Haarlem, a most interesting tour round the reclaiming works by which within a generation the Zuider Zee is to be reclaimed and large stretches of country lost seven hundred years ago to be once more made fertile; a visit to the Frans Hals Museum at Haarlem, and various receptions and garden parties. Honorary degrees were conferred by the University of Leyden upon M. H. Deslandres, Director of the Paris-Meudon Observatories, and upon Dr. Küstner, late director of the Bonn Observatory. The latter was, unfortunately, prevented by ill-health from attending the meeting, and Dr. Guthnick acted as his proxy.

The main work of the Union was performed at the sessions of twenty-eight commissions. A few of the resolutions of general interest brought forward by the commissions and adopted by the Union may be referred to here. It was agreed to publish, with the help of Prof. Stroobant (Uccle), a list of observatories and astronomical staffs, and with the help of M. Delporte an atlas on a small scale with a list of arcs

definitely fixing by hour circles and parallels of latitude the boundaries of the constellations. It was agreed to advise astronomers for the present not to use the term G.M.T. (Greenwich Mean Time), which changed its significance on Jan. 1, 1925, but to use for time reckoned from Greenwich Mean Midnight the term G.C.T. (Greenwich Civil Time), W.Z. (Weltzeit), or U.T. (Universal Time). The expression G.M.A.T. (Greenwich Mean Astronomical Time) should be used by anyone reckoning time from Greenwich mean noon.

The report of the Commission on Dynamical Astronomy contained an interesting statement by Prof. de Sitter of the terms required to convert Newtonian or uniform time to astronomical time given by the variable rotation of the earth. The Commission on Solar Physics, collaborating with a commission of the International Research Council on solar and terrestrial relationships, agreed on an index of solar activity. It was also agreed to urge on the Dutch government the need of observing the total eclipse of May 9, 1929, visible in Sumatra, and on the Australian government the need of observing that eclipse and the eclipse of Oct. 22, 1930, visible in the island of Niuaufu, in the Tonga protectorate. Further useful co-operation between eclipse observers of different countries was arranged, and a further study of the distribution of the continuous spectrum of the sun in the ultra-violet was urged. The growing importance of line spectrophotometry in the study of the sun's atmosphere was also recognised.

The Committee on Wave Lengths, for which Dr. Babcock had prepared a very valuable report, recommended a number of secondary standards of iron lines, and also a table of standards of solar wavelengths. Both of these were adopted by the Union. The most important problems in wave-length determination were also scheduled for immediate attention. The Commission on the Physical Observations of Planets urged further work on the absorption bands in planetary spectra and undertook to compile a catalogue for the names of Martian markings. The Commission on Lunar Nomenclature is nearing the end of its work of compiling a definitive catalogue of the markings on the moon. The Commission on Longitude Determination by Wireless reported that it would repeat the experiments of October 1926 about the year 1933, when the lessons of the previous experiments have been fully studied and steps taken to determine and eliminate systematic errors revealed in the previous work. The Committee on Variation of Latitude reported that a new latitude station in latitude 39° N. would shortly be established at Kitab, near Samarkand, under the Uzbekistan-Soviet

Government, with Prof. Nefedjew of Perm in charge; also work was to be started at Lembang in Java, near the equator, and there was a hope that observations might soon be commenced at Adelaide and La Plata, two southern stations in the same latitude, and with a longitude difference of nearly 12 hours.

The Commission on Shooting Stars decided to compile a new catalogue of radiant of meteor showers and to develop the photographic study of meteors. The Commission on the Carte du Ciel reported that the completion of the work was in sight, and the financial support of the Union was considerably increased with the view of hastening its completion. The reports of the Commissions on Stellar Parallaxes and Photometry showed plenty of important work done and in hand, but proposed no serious changes in present work. The Commissions on Double Stars and Radial Velocities were concerned in selecting lists of stars for co-operative or special observation. The Commission on Variable Stars secured several small grants for catalogues and for the publication of observations, and asked for more systematic observations of the spectra of variable stars. The Commission on Nebulae and Stellar Clusters adumbrated several important schemes to complete the survey of the heavens before starting a fresh catalogue and scheme of classification; also it is examining how to secure accurate positions of nebulae, to serve as a background against which a rotation of the galaxy might be shown.

The Commission on Stellar Classification, in order to widen the scope of its activities and to apply many physical criteria which modern spectral analysis and spectrophotometry are rendering of importance, has changed its name to the Commission on Stellar Spectra. The Commission on the Bureau de l'Heure asked for an increased grant, which led to a motion being put to the general assembly by the executive committee expressing the hope that some reorganisation of the Bureau would be possible and that after

1931, the end of the present convention, the Union might be relieved of the present charge upon its income involved in maintaining the Bureau de l'Heure.

The Commission on Stellar Statistics is undertaking the execution of tables of conversion of equatorial co-ordinates and proper motions into galactic ones. Finally, the Commission on the Solar Parallax has arranged for the necessary observations, including photometric and spectroscopic ones, to be made in connexion with the approaching conjunction of Eros. Fresh commissions have been appointed to act until the next general assembly; the commission on solar rotation has been absorbed into that on solar physics, and a new commission on stellar constitution, with Prof. Eddington as chairman, has been appointed.

The next meeting of the Union is, on the invitation of the American delegates, to be held early in September 1932, in the eastern United States. The date and place are chosen partly to fit in with a total eclipse of the sun through Canada and the eastern United States on Aug. 31, 1932. As the present convention ends in 1931, there will have to be an intermediate extraordinary assembly of the Union between now and then. The new executive is charged with the tasks of appointing a committee to revise the present statutes, of modifying the present practice limiting membership of the Union to members of various commissions, of preparing fresh regulations for the Bureau de l'Heure, and of securing a new lease of life for the Union after 1931. The new executive committee consists of Sir Frank Dyson (president), Prof. Schlesinger, Prof. Abetti, Prof. Andoyer, Prof. Norlund, and Prof. Nušl (vice-presidents), and Lieut.-Col. Stratton (general secretary).

The final meeting of the general assembly closed with thanks to the Union's hosts, and especially to Prof. de Sitter, who combined the double task of chief host and president at this most successful meeting, and has ruled over the Union through a difficult period of its life.

The Carbon-Nitrogen Ratio in Wheat.

SINCE the publication in 1918 of Kraus and Kraybill's fundamental work on the vegetation and reproduction of the tomato, the carbon-nitrogen ratio has been recognised as a factor of prime importance in the growth and reproduction of the plant. Recently some careful work by Phyllis A. Hicks on the carbon-nitrogen ratio in wheat has confirmed and somewhat extended the conclusions of the two American workers referred to above (*New Phytologist*, vol. 27, No. 1).

It is pointed out that the primary value of the relation lies in the fact that the growth of the plant is dependent on the balance between the metabolic processes of carbon assimilation and respiration on one hand, and nitrogen assimilation on the other. In the present work, pure lines of three strains of wheat were used, two spring and one winter variety, and the carbon-nitrogen ratios were determined at close intervals in the life-histories of the plants by microchemical analysis. 'Carbon' is taken as embracing all forms of carbon in the plant, and 'nitrogen' all forms of nitrogen.

It was found that a low carbon, medium nitrogen, and low carbon-nitrogen ratio encourages vegetative growth. Vegetative activity reduces nitrogen percentage steadily, but the carbon rises to a maximum about half-way through the life-history and again falls considerably before blooming. This is taken to explain the double carbon maxima for apple spur results, since carbon maxima in themselves have

nothing to do with flower formation. The carbon-nitrogen ratio rises steadily throughout the vegetation period, and when a sufficiently high ratio obtains, flowering occurs. Strong support is given to the contention of Kraus and Kraybill that fruitfulness is associated neither with highest nitrates nor with highest carbohydrates, but with a condition of balance between them.

Every cultural strain has its own distinctive carbon-nitrogen ratio, at which flowering occurs, but in every case it represents the maximum of the ascending ratio curve. In this relation an interesting difference between the spring and winter strains of wheat is noted. A ratio of 14-17 covers the range of conditions favourable for flowering in both spring varieties, whereas a ratio of 31 is required for the winter variety. This agrees with the conclusions of Hedlund, that varieties of wheat with a higher percentage dry weight are more winter hardy; and the higher percentage dry weight is due to high carbon content, which compensates for the longer seedling life under winter conditions. Senescence is accompanied by a high carbon-nitrogen ratio, and senescence changes can be prevented at the expense of flowering by controlling nitrogen content. It is suggested that it may be possible to apply nitrogen to annual plants in such proportions and at such periods as would first of all allow of flower and seed production, and then prevent senescence of the tissues or induce rejuvenescence.

University and Educational Intelligence.

EDINBURGH.—At the meeting of the University Court on July 16 a letter was received from the Distillers' Company, Ltd., stating that the Company is impressed by the good work which the Technical Chemistry Department of the University is doing "in fitting trained chemists to take part in British industry by giving them a knowledge of engineering and familiarity with plant used in technical operations." The Company is therefore prepared to become financially responsible for a studentship in the University carrying cash payments at the rate of £100 per annum to the recipient, and such University fees as may be necessary. The studentship would be awarded to a candidate who has completed his course in chemistry and is willing to devote a further year to study in the Technical Chemistry Department.

The Company is willing to find a position for the selected student for a year on trial in its organisation at a salary commencing at not less than £250 per annum. The Court gratefully accepted the offer and resolved to institute the studentship.

LEEDS.—Mr. W. T. Astbury has been appointed to the lectureship in textile physics, one of the posts instituted under the new scheme of research in the Clothworkers' Departments.

LONDON.—Prof. John Macmurray has been appointed as from Aug. 1 to the Grote chair of philosophy of mind and logic tenable at University College. Mr. Macmurray was in 1919–20 lecturer in philosophy in the University of Manchester, and in 1920–22 professor of philosophy at University College, Johannesburg. Since 1922 he has been fellow, classical tutor, and Jowett lecturer in philosophy at Balliol College, Oxford. He is the author, with C. R. Morris, of "The History of Philosophy in Europe since Hegel" (in the press).

Dr. Robert Donaldson has been appointed as from Aug. 1 to the Sir William Dunn chair of pathology tenable at Guy's Hospital Medical School. Dr. Donaldson is the author of "Practical Morbid Histology" (1923), and of numerous articles in the medical journals.

Mr. S. J. Cowell has been appointed as from Sept. 1 to the University chair of dietetics tenable at St. Thomas's Hospital Medical School. Mr. Cowell received his medical education at Queens' College, Cambridge, and at University College Hospital, and since January 1923 has been assistant to Prof. E. Mellanby at the University and Royal Infirmary, Sheffield. In 1926 he opened a discussion before the Public Health Section of the British Medical Association and has published papers on non-specific desensitisation, concentration of the blood in adrenal insufficiency, effect of iodine on hyperthyroidism in man, and irradiation of milk and the healing of rickets.

Dr. H. D. Wright has been appointed as from Oct. 1 to the University readership in bacteriology tenable at University College Hospital Medical School. Dr. Wright studied at the Universities of Tasmania and Edinburgh. From 1920 until 1923 he was lecturer in bacteriology in the University of Edinburgh, and in 1921–23 assistant director of the Research Laboratory of the Royal College of Physicians, Edinburgh. Since 1923 he has been lecturer in bacteriology at University College Hospital Medical School.

Mr. S. L. Baker has been appointed as from Sept. 1 to the University readership in morbid anatomy and

histology tenable at Middlesex Hospital Medical School. Mr. Baker has been senior assistant in the Bland-Sutton Institute of Pathology since July 1922 and lecturer in morbid histology at the Middlesex Hospital Medical School since May 1923.

THE Air Ministry announces that about 120 officers will be required by the Royal Air Force for flying duties during the next few months. Applicants must be between the ages of eighteen and twenty-five years, well-educated, and of good eyesight and physique. Short service commissions are granted for five years' service on the active list and four in the reserve. Application forms can be obtained from the Secretary, Air Ministry, Kingsway, London, W.C.2.

THE trustees of the Beit Fellowships for scientific research have made the following elections to fellowships tenable at the Imperial College of Science and Technology, for two years 1928–29 and 1929–30, of the value of £250 per annum: Dr. R. H. Purcell, subject of research—"Change of properties of pure substances on intensive drying; problems in catalysis with special reference to the unique influence of water." Mr. A. A. Fitch, subject of research—"(*a*) The metamorphic aureole of the Dartmoor granite; (*b*) Investigation of a part of the Central Weald." Mr. J. M. Frankland, subject of research—"Effect of constitution and treatment on the mechanical properties of steel."

THE following awards for the year 1928–29 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: Fellowships have been renewed to: Mr. C. G. Akhurst (Fellow, 1927–28, at the Rothamsted Experimental Station) for one year at the Imperial College of Tropical Agriculture, Trinidad; Mr. F. Witt (Fellow, 1927–28, at the Gas Institute, Karlsruhe) for one year in a German industrial fuel undertaking. Fellowships have also been awarded to: Mr. H. K. Cameron, University College, London; Mr. H. Diamond, University College, London; Mr. F. L. Gilbert, University College, Nottingham, and Cambridge; Mr. C. H. Lea, University of Liverpool; Mr. A. H. Loveless, of the Imperial College, London; Mr. H. Smith, of the Imperial College, London. Seventy grants-in-aid have also been awarded to young men and women employed in chemical works, to facilitate their further studies.

THE Medical Research Council announces that on behalf of the Rockefeller Foundation it has made the following awards of fellowships provided by the Foundation and tenable in the United States of America during the academic year 1928–29. These fellowships are awarded to graduates who have had some training in research work either in the primary sciences of medicine or in clinical medicine or surgery, and are likely to profit by a period of work at a university or other chosen centre in America before taking up positions for higher teaching or research in the British Isles. Dr. L. E. Bayliss, Sharpey Scholar at University College, London; Dr. A. V. Neale, Children's Hospital, Birmingham; Dr. F. J. W. Roughton, lecturer in physico-chemical aspects of physiology, University of Cambridge; Dorothy Stuart Russell, Baron Institute of Pathology, London Hospital; Mr. Arthur Wormall, lecturer in biochemistry, University of Leeds.

Calendar of Customs and Festivals.

July 29.

ST. MARTHA was specially venerated in Provence, where she converted the inhabitants to Christianity after her landing at Marseilles in the company of Mary (transformed into St. Mary Magdalene) and Lazarus. She is especially identified with Tarascon and Beaucaire, a famous fair being held at the latter town on her feast day. At Tarascon the saint slew the *tarasque*, a fearsome dragon-like monster which was devastating the country. This victory was afterwards celebrated in an annual procession of the *tarasque*, a representation of the monster, for long an object of great veneration. In the Revolution it was burnt by the people of Arles. A second, made some four years later, was also seized and conveyed to Beaucaire.

THE FEAST OF CHERRIES.—At Hamburg, on the feast of St. Martha, it was a custom for the children to parade the town bearing green boughs decked with cherries. This was said to commemorate the successful intercession of the children of the town in 1432, when it was threatened with destruction by the victorious Hussites.

July 30.

MACE MONDAY.—On the first Monday after St. Anne's Feast there used to take place at Newbury a mock election of 'the mayor of Bartlemas.' A dinner was provided at which bacon and beans were the chief dish. A procession took place in the course of the day, at which a cabbage on a stick took the place of the mace. Records from other localities, for example, Devonshire, indicate that bacon and beans formed the recognised dish marking Mace Monday.

August 1.

S. PETRI AD VINCULA.—A feast in veneration of the chains with which St. Peter was bound in prison, one of which was deposited at Rome and one at Constantinople. The filings from these chains were of special virtue; but they were not available for every suppliant, the use of the file at times producing no result.

GULE OF AUGUST: LAMMAS.—Various explanations have been given of these names applied to the first day of August. Medieval expositors connected gule with *gula*, and said it was so called from the cure of the daughter of the tribune Quirinus of an affection of the throat by kissing the chains of St. Peter on this day. A more probable derivation connects it with the Celtic *Gwyl* or *Wyl*, a feast.

An obviously popular etymology derives Lammas from *Lamb mass*, explaining the name as based upon a payment of a live lamb as a condition of tenure of land to the diocese of York, to be made to the Cathedral of St. Peter at York on this day. St. Peter's Pence were payable in England on the same day. In the Sarum Manual it is given as the day of the blessing of the first fruits, and it is therefore suggested that it is the *Hlaf* or loaf mass, the day of the offering of the first corn, or alternatively from *La-ith-mas*, a fanciful interpretation, based upon a meaning of *ith* as grain, especially wheat, and *mas* meaning 'mast.' In the Highlands the day is known as *Lunasdal*, not a Celtic term, which connects it with moon-worship, and it is suggested that the English name may have a similar derivation from *Lunamas*.

The first day of August, called Lughnasadh, was one of the Celtic quarter-days, but, with the February quarter-day, was of later introduction than the six-monthly division at May and November. It was the occasion of a number of great fairs in

Ireland, and was devoted to games of a communal character. A fair was held at Taltin, in Co. Meath, a centre of great sanctity in early times, at which Lug, the sun god, instituted games in honour of the dead. There were others almost equally celebrated at Cruachan in Roscommon and at Carman, near Wexford. These fairs, if properly observed, were reputed to ensure plenty in corn, milk, fruit, and fish, as well as prosperity generally and peace. All were connected with the cult of the dead. In the Isle of Man there are traces of a ceremonial observance in the custom of rising early on the morning of Aug. 1 climbing to the top of a high hill, and returning with water from a well known for its curative properties.

The games of the Irish fairs and feasts find a parallel in Scotland as part of a curious custom noted at the end of the eighteenth century by Dr. James Anderson. Early in the summer the herdsmen of the Lothians used to form themselves into bands according to locality, and began to build, approximately in the centre of each district, forts or mounds of turf of conical shape, rising to seven or eight feet, which were surmounted by a flag post. During the time of building, these structures were jealously guarded, as to destroy the fort of a rival faction was a great honour. On the day of the festival each band marched out from the village under a captain, armed with staves, and bearing a flag. They took up their position at the mound, and until midday either attacked another party or waited to be attacked. They then returned, and the rest of the day until sunset was taken up with games, the prize of the first race being a bonnet ornamented with ribbons and exhibited on a pole, a feature which is curiously suggestive of a head-hunting celebration.

In the Highlands, cattle were sained at Lammas. Tar was put on the tail and ears, charms said to their udders, and red and blue threads put on their tails. The vessels in which milk and butter were kept were protected from evil influences by various ceremonies with balls of hair, plants, and fire. Curds and butter were specially prepared for a feast, at which it was important that everyone should get as much as he wanted. Menses were smeared on doorposts and window frames to keep away evil influences.

In Ireland, according to Cormac's glossary, Lammas was one of the four great festivals of the Druids, which fell in February, May, August, and November, and at which fires were lighted up.

August 3.

In Ireland on the Friday, Saturday, and Sunday following Lammas, it was believed that the influence of Aynia was peculiarly potent. Aynia was one of three 'hags' or witches who were especially prominent in Irish popular belief, Aynia more particularly in the north. The three hags, Aynia, Bav, and Vera, are survivals of three pagan goddesses, Bav being the goddess of war, and Aynia the goddess of the moon. She is still regarded as closely connected with lunatics. A lunatic escaping control will make his way to 'Aynia's seat' at Dunany. Should he succeed in sitting in the 'seat' three times, he will never recover. All the rabid dogs of Ireland are drawn to the same spot. Aynia was also a patron of letters, and it is she who introduces men of learning to the next world. She possessed unbounded influence over the human form, being regarded as the vital spark which once in twenty-four hours traverses the human frame. On this account the blood-letter would never work on the days sacred to her. It was also believed that on these three days it was dangerous to bathe, nor would fishermen put to sea; if they did, one or more would be drowned before their return.

Societies and Academies.

DUBLIN.

Royal Dublin Society, June 26.—Report of the Irish Radium Committee for the year 1927. 14,306 millicuries of radon were issued during the year for therapeutic purposes. Reports are included from two of the largest users of radon recording the results of the treatment of 292 cases of malignant and non-malignant disease.—C. Boyle, M. Murphy, and H. A. Cummins: 'Blossom-wilt' of apple trees and 'wither-tip' of plum trees with special reference to two biologic forms of *Monilia cinerea* Bon. The results of culture and infection experiments using the 'wither-tip' and 'blossom-wilt' forms of *Monilia cinerea* show that the two forms are physiologically different. These results are in conformity with those of Wormald, and justify the distinction *forma mali* and *forma pruni* for the forms occurring on apple and plum respectively.—T. Dillon and E. F. Lavelle: A suggested method for the utilisation of seaweed. Seaweed might be utilised by throwing it into tanks near the shore and allowing it to decay, when the liquid running off would contain potash, iodine, and organic matter. A small-scale experiment with Laminariæ showed satisfactory iodine recovery. The organic bodies obtained were acetic, propionic, and other acids. The advantages of the suggested process are: (1) winter tangle could be used, (2) the initial operations would be carried out on the spot, and (3) the organic matter would be recovered.—A. G. G. Leonard and P. F. Whelan: Spectrographic analyses of Irish ring-money, and of an alloy found in commercial calcium carbide. In some museum specimens of Irish ring-money the gold sheath is incomplete, a core of white metal being exposed in places. Examination of the spark spectrum showed that this core consists of remarkably pure tin. An alloy, found in calcium carbide, which showed great resistance to acids, was found to consist of iron, titanium, and silicon. Chemical analysis showed that the percentages of these elements were about 66, 22, and 11 respectively.—L. B. Smyth: *Salpingium palinorsum*: A new carboniferous coral. This new genus and species of coral occurs in the carboniferous limestone of Hook Head, Co. Wexford, Ireland, at a level correlated with the C_1 sub-zone of Vaughan. It consists of a tube about 4 mm. in diameter, with strongly thickened walls. Simple tabulæ occur at intervals of 2-4 mm., and septal striæ are seen in places, being elsewhere presumably engulfed by stereoplasm. At irregular intervals the tube is surrounded by thin trumpet-like expansions, three or four times the diameter of the tube, bearing septal ridges. It is suggested that the structure is due to rejuvenescence. The affinities are doubtful.—L. P. W. Renouf: A preliminary account of Loughine (Lough Hyne), Co. Cork. Loughine or Lough Hyne, situated some sixty miles south-west of the city of Cork, though only a little more than a quarter of a square mile in area, presents many interesting features. It is land-locked except at the south-east corner, where the tide rushes in and out with great force through a narrow neck less than twenty yards in width, and on account of a deep sill it continues to ebb for more than three hours after the beginning of the flood tide from the Atlantic twelve hundred yards to the south. The lough attains a depth of twenty-nine fathoms. The Laminarian zone is practically absent, with the result that at neap tides, when on account of the sill the ebb from the lough is greatest, the Coralline zone is exposed, and a number of what are ordinarily deep-water forms are found in as little as two inches of water. Though the number of

species is not remarkable, many of them are represented by countless numbers of individuals, and at least one which appears to be new, for which the name *Ethropodium hibernicum* is tentatively suggested, has been discovered.

CAPE TOWN.

Royal Society of South Africa, May 16.—John F. V. Phillips: The influence of *Usnea* sp. (near *Barbata*, Fr.) upon the supporting tree. Work at the Research Station, Deepwells, Knysna, on the relationship between *Usnea* and the *Podocarps* has shown that the lichen is definitely detrimental, in that its fungal component is parasitic upon the tissues external to (and sometimes internal to) the cork-cambium. Vigorous crowns may be infected as well as defective ones. The lichen cannot develop luxuriantly under the conditions of light, temperature, and humidity holding in undisturbed high forest, but grows apace when these factors are suddenly and severely altered by heavy exploitation.—J. S. Thomas: The action of ammonia on germanium tetrachloride: germanium imide. Ammonia reacts vigorously with germanium chloride, giving a white substance having a composition $\text{GeCl}_4 \cdot 6\text{NH}_3$. When treated with ammonia under pressure, a compound having the formula $\text{GeCl}_4 \cdot 16\text{NH}_3$ is produced, which may be a mixture of $\text{Ge}(\text{NH}_3)_2$ with $4\text{NH}_4\text{Cl}$. An apparatus was constructed in which the preparation of the germanium chloride, treatment with ammonia, etc., could be carried out without at any period opening the vessel to the air. In this way a product was obtained the analysis of which corresponded to 99.2 per cent $\text{Ge}(\text{NH}_3)_2$. The compound is a white powder which reacts very violently with water and combines directly with hydrogen chloride, forming the imide hydrochloride.—W. W. Southwood: Compounds of germanium tetrachloride with certain amines: (1) Compounds with aniline. The product formed by germanium chloride and aniline is a mixture of aniline hydrochloride and the substituted di-imide hydrochloride. (2) Compounds with ethylamine. Excess ethylamine distilled into GeCl_4 produced $\text{GeCl}_4 \cdot 6\text{C}_2\text{H}_5\text{NH}_2$. In ethereal solution the free substituted di-imide $\text{Ge}(\text{NC}_2\text{H}_5)_2$ was obtained. The compound containing six molecules of amine has a high dissociation pressure, and yielded the substituted di-imide hydrochloride.—James Moir: Colour and chemical constitution (Part 24). A complete investigation of the triphenylcarbinol or 'aniline' dyes. There are 23 possible dyes and these possess in all 75 absorption bands in solutions of differing reaction (pH). A theory and method of calculation from chemical constitution are put forward explaining nearly seventy of the bands.—Letitia Starke: The spermatogenesis of *Holopterna alata*. The somatic number of chromosomes is 20, the reduced number 10. There is slight heteromorphism, but an X Y pair is not recognisable. As in other Hemiptera, there is a diffuse stage intercalated in the heterotype prophase.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Mar. 13.—C. Juel: 'Elementary' curves and surfaces. An 'elementary' curve in space is a closed continuous curve composed of a finite number of arcs of the third order; for example, certain curves of the fourth order. It can exist non-analytically. An 'elementary' surface similarly is composed of a finite number of parts of the second or third order; for example, a cyclic ovaloid. Certain conditions of continuity being given, it can only exist algebraically.

April 27.—D. la Cour: Recent research in Greenland on terrestrial magnetism. For the study of the

magnetic field of the earth and certain relationships between the earth and the sun, research on magnetic variations near the magnetic pole are of particular interest. Long series of observations in Arctic regions are required and, at the suggestion of the International Union of Geodesy and Geophysics, Denmark established a magnetic observatory at Godhavn two years ago for this purpose. This observatory is farther north than any other, and by its special equipment for measuring the vertical intensity, will produce most valuable results. The observations so far show a characteristic diurnal variation of the magnetic elements, and indicate a relationship between magnetism and rotation of the earth and between the magnetism and rotation of the sun.—Oluf Thomsen: The existence of four blood-groups in man, illustrated by 275 descendants of 100 AB-matings (and 78 children with only one AB-parent). The object was to discover if Bernstein's hypothesis of three allelomorph genes for blood-groups (*A*, *B*, *R*) is correct. The results are in accord with those to be expected on Bernstein's theory and completely inconsistent with the hypothesis of two independent gene-pairs. The latest modification of Bernstein's hypothesis (by Furuhashi, Ichida, and Kishi) will not withstand serious criticism.

SYDNEY.

Linnean Society of New South Wales, May 30.—F. A. Craft: The physiography of the Cox River basin. Cox's River rises near Wallerawang and Lithgow, and pursues a winding course to join the Wollondilly River in Burragorang Valley. Along the course of the main river and certain of its tributaries there are remarkable ancient valleys, which have been trenched by deep modern canyons. Three of these valleys are recognised, namely, Lithgow-Wallerawang (3100 feet); Kanimbla (2200 feet); and Kowmung (500 to 2800 feet). To the north of Cox River the average elevation is 3300 feet; to the south, the plateau area around Jenolan averages 4000 feet. The plateau has been elevated in stages; the uplift is of a complex nature, involving an earlier northern and a later southern and western phase; and there have been great changes in stream-flow since the commencement of uplift.—R. J. Tillyard: The larva of *Hemiphysalis mirabilis* (Odonata). Full-grown larvæ of this tiny damselfly, considered to be the most archaic type of Odonata at present existing, were discovered last November in a backwater of the Goulburn River at Alexandra, Vic. The most interesting characters are the primitive mandibles showing characters suggestive of Mayfly larvæ; the trifid hypopharynx; the remarkably composite type of labial mask, which shows Lestid and Synlestid affinities and is the only mask known to possess both glossæ and paraglossæ; the primitive gizzard; the Synlestid type of caudal gills; and, above all, the extraordinary scheme of wing-tracheation, which differs from that of all other Odonata in possessing no tracheal supply for the interpolated veins, and no anal trachea.—Ida A. Brown: The geology of the south coast of New South Wales (Part 1). The palæozoic geology of the Moruya district. The metamorphosed sediments of the district consist of apparently unfossiliferous slates, phyllites, and quartzites, which were folded and faulted about meridional axes probably at the close of the Silurian period. In late (?) Devonian time this series was intruded by a composite batholith, which is elongated in a direction of structural weakness running north-north-west and south-south-east, and produced well-marked contact metamorphic effects in the invaded sediments. The igneous rocks comprising the batholith form a complete subalkaline or

calcic igneous complex, and include three main plutonic types—diorite-gabbro, tonalite-granodiorite, and biotite-granite—which were injected in order of decreasing basicity and increasing alkalinity.

VIENNA.

Academy of Sciences, Mar. 8.—O. Deutschberger: The compounds participating in the composition of the residual carbon and residual nitrogen in blood, especially the oxyprotein acids. More than half of the carbon in dealbuminated blood appears unexplained. The oxyprotein acids form barium salts soluble in water but insoluble in alcohol. These substances represent break-down products of albumen. Analyses were made of defibrinated horse blood. The atomic ratios of the total oxyprotein acid fraction gave $C_{100}H_{144}N_{24}$.—E. Steinach and H. Kun: The secretion of the male gonad and its dependence on the hormone of the frontal lobe. Experiments on infantiles, eunuchoids and seniles (Part 2). The pituitary extract of bull and cow is alike active; it influences infantile testicles and ovary, it is not sex-specific. Active extract can be obtained from urine of pregnancy. But pituitary extract is not itself a sexual hormone, it does not work on castrates and it cannot replace the sexual hormones: it is only an activator of the sex-glands. Occasional eunuchoid rats were sexually developed after pituitary injections; aged male rats were sexually reactivated.—J. Schaffer: The so-called proliferous atrophy of fatty tissue. Examination of the epiglottis of a menagerie elephant which died of starvation during the War.—M. Kohn and R. Kramer: Halogenated *o*-anisidine (Communication 30 on bromo-phenols).—M. Kohn and R. Kramer: On 3, 4, 5-trichloro-phenol (Communication 31).—M. Kohn and M. K. Feldmann: Preparation of 2, 6-dibrom-*m*-xyloquinone from symmetrical xylol (Communication 32).—M. Kohn and E. Gurewitsch: Chloro- and bromo-pyrogallol-ether (Communication 33).—A. Smekal: Diffusion and recrystallisation. Recrystallisation is a stabilisation procedure which takes place in certain temperature ranges by the diffusion of free ions in the gaps of the crystal lattice. The possibility of diffusion can be examined by electric conductivity measurements.—F. M. Exner: The circulation of cold and warm air between high and low latitudes. The deviations of the daily temperatures from the average temperatures of the same places for 90 winter days and for 129 places of the northern hemisphere were plotted. This led to the detection of streams of cold or warm air from higher to lower latitudes or vice versa.—J. Mayer and O. Hiedl: The absolutely smallest discriminants of biquadratic number-bodies.—N. Hofreiter: A new reduction theory for definite quaternary quadratic forms.—K. W. F. Kohlrausch: Energy losses and ionisation in the passage of α - or β -particles through matter. An attempt to determine the dependence of (1) loss of velocity, (2) range, and (3) differential ionisation upon the velocity of the particles and upon the material.—E. Tschermak: Hybridisation results in lentils and beans.—O. Dischendorfer: Condensation of aldehydes with phenols (2). On *m*-nitrobenzal-di- β -naphthol.

Mar. 15.—J. Pollak, E. Gebauer-Fülneegg, and E. Blumenstock-Halward: The action of chloro-sulphonic acid on phenols.—J. Pollak and E. Blumenstock-Halward: The determination of the constitution of β -naphthol-disulpho-chloride.—J. Pollak, E. Riesz, and Z. Kahane: Amino-thio-phenol derivatives.—E. Späth and F. Wessely: The active components of genuine coto bark. The constitution of cotoine.—E. Späth and G. Burger: A synthesis of pyridin derivatives.—F. Sigmund: Catalytic hydration of the nucleus of aromatic and fatty aromatic aldehydes in

the form of their acetals (1). Hexa-hydro-phenyl-acetaldehyde-dimethyl-acetal.—F. Schiller: The fruit of *Viscum album* and *Loranthus europæus* and the production of bird-lime. *Viscum* does not yield a sufficiently sticky material, *Loranthus* does; it contains caoutchouc.—O. Gugenberger: Contributions to the geology of Asia Minor with special reference to the Anatolian lias.—F. Hölzl and F. Viditz: The alkylation of hexa-cyano-chromic acid.—E. Rona: The preparation of polonium from radium compounds and active lead salts. Precipitation with hydrogen sulphide.—S. Meyer: The disintegration constant of actinium. The half period is 13.4 years.—K. Fritsch: Observations on flower-visiting insects in Styria, 1907.—A. Winkler: Studies on the interior Alpine tertiary deposits and their relations to the *Augenstein* fields of the northern Alps.—A. Kieslinger: The Lavant valley disturbance and its relation to the tectonics of the eastern Alps.

April 26.—R. Wegscheider and J. Mehl: Systems Na_2CO_3 — NaHCO_3 — H_2O . Two double salts were found, one of them anhydrous Na_2CO_3 , 3 NaHCO_3 . Experiments were tried at various temperatures up to 94.5° , and with addition of 24 gm. common salt to 100 gm. water.—A. Kailan and Y. M. Diab: Velocity of esterification of mono-amino-benzoic acid and of the 1- and 2-pyridin carboxylic acids in glycol and glycerine.—A. Kailan and E. Krakauer: Velocities of esterification of the nitro-benzoic acids in ethylene-glycol and of the naphthoic acids in glycerine.—J. Kozeny: On developed turbulence.—F. Feigl and H. Gleich: Relations between atom grouping and specific affinity (7). Metallic salts of imid-azol derivatives.—F. Feigl and E. Bäcker: Addition compounds of thallium dienoil salts with carbon disulphide (8).—F. Feigl and A. Deutsch: Silver and mercury salts of amido-benzothiazol.—F. Feigl and E. Chargaff: The reactivity of iodine in organic solvents.—G. Machek and A. Graf: The course of the Friedel and Craft reaction in anthraquinone—1, 2-dicarboxylic acid anhydride.—V. F. Hess and O. Mathias: Atmospheric electricity (70). Researches on oscillations in the cosmic ultra-gamma-radiation on the Sonnblick (3100 metres) and in the Tyrol.—E. Guth: Maxwell's equations and Dirac's quantum theory of the electron.—F. Heritsch: Tectonic questions in the Carnic carboniferous.—F. Heritsch: Notes on the lower Permian in the Carnic Alps.—F. Werner: Contributions to the knowledge of the fauna of Greece, especially of the Aegean Islands.—R. Ebner: Coleoptera, C. (Scientific results of the zoological expedition to the Anglo-Egyptian Soudan undertaken by F. Werner, 1914, No. 24).—A. Rollett: The acid constituents of sandarac resin.—M. Kuban: Potassium and rubidium radiation.—M. Blau: Photographic intensity measurements of polonium preparations.—S. Wolff: The ultra-violet spectrum of radium emanation. More than 100 new lines between 3600Å. and 2400Å. are recorded.—R. Schumann: Some new investigations on fluctuations of polar altitude.—V. Oberguggenberger: Contribution to the establishment of a standard system of effective wave-lengths.—A. Steuer: A new *Paracinet* from the South Atlantic.—K. Ehrenberg: *Ursus Deningeri* and *Ursus spelaeus*. A comparison of skull, jaw, and teeth of the Mixnitz cave bears with Reichenau's specimens in the Mainz museum.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 14, No. 5, May).—J. R. Oppenheimer: On the quantum theory of the autoelectric field currents. An expression obtained for the field necessary to make an electron leave the nucleus leads to very low values of the ionising potential for electrons in metal (the work function).

It is concluded that the 'autoelectrons' are only given off from a wire at points where the field strengths are abnormally high. This is in agreement with the experimental finding that craters surrounded by protuberances of the necessary order of magnitude occur on the wire.—Edwin H. Hall: (1) The Fermi statistical postulate; examination of the evidence in its favour. While Pauli's 'equivalence principle' as applied to the electrons within an atom may be accepted, Fermi's extension of it to all the molecules of an ideal gas is regarded as not yet justified.—(2) Sommerfeld's electron-theory of metals. A critical discussion of the theory as applied to various electrical effects.—(3) Electron 'free path' and supra-conductivity in metals. A special meaning is given to the so-called mean free path of the electron-gas particles in a metal; it is assumed that the path of an electron is not necessarily a straight line and that it is terminated by collision and capture by a positive ion. This leads to reasonable explanations of specific heat and the relation of conductivity to temperature using classical formulæ.—Elmer Dershem: Dispersion of long wave-length X-rays in platinum and calcite. The spectrograph and other apparatus were mounted in a large evacuated bowl, thus permitting of great wave-length resolution. The beam of X-rays was collimated by two slits, reflected from a mirror surface of platinum or calcite and on to a gypsum crystal, the effect being recorded on a photographic plate. The maximum angle at which reflection occurred was measured. With the wave-lengths used, dispersion for platinum increases with wave-length; calcite showed anomalous dispersion near a *K*-absorption limit.—L. DuSault and Leonard B. Loeb: Mobilities of gaseous ions in SO_2 and SO_2 — H_2 mixtures. Mobilities were observed in sulphur dioxide at atmospheric and lower pressures; they appear to decrease slightly with pressure, but this is probably due to higher purity of the gas used in the low pressure experiments. In mixtures with hydrogen, the negative mobility is always less than the positive; positive mobilities so high as 22 cm./sec. per volt/cm. were observed with low concentration of the purer sulphur dioxide.—R. Cumming Robb: Is pituitary secretion concerned in the inheritance of body-size? Comparison of the weights of the pituitary bodies in giant (Flemish) and dwarf (Polish) male rabbits and their hybrids shows no characteristic difference which can be correlated with differences in growth rate. In common with other organs, the pituitary maintains a rectilinear logarithmic relationship to body weight, suggesting that all these organs are regulated by a common growth reaction.—Cecilia H. Payne: On the contours of stellar absorption lines, and the composition of stellar atmospheres. The *H* and *K* lines of ionised calcium and the Balmer lines of selected stars show differences from class to class and from super-giant to dwarf within the same spectral class. The observations are in general agreement with Unsöld's formula, which can therefore be used virtually to weigh the atmospheres of individual stars.—George R. Putnam: (1) Regional isostatic reduction of gravity determinations. The departures from complete local compensation must be considered in a complete reduction of gravity observations. A regional reduction gives anomalies in better accord with observations and may be represented as a warped surface lying between the earth's surface and the average level of the region. Regional compensation extends 100 miles from a station and further for great mountains.—(2) Proof of isostasy by a simple gravity reduction method. The computation is based on the attraction of indefinitely extended horizontal plates and gives a fair approximation to the value of gravity

reduced to sea-level. The method was used by the author in 1895.—Marston Morse: Singular points of vector fields under general boundary conditions.—E. T. Bell: Remark on the number of classes of binary quadratic forms of a given negative determinant.—Harry Merrill Gehman: (1) Concerning certain types of non-cut points, with an application to continuous curves.—(2) Concerning irreducible continua.—Julian Coolidge: Criteria for the simplification of algebraic plane curves.

Official Publications Received.

BRITISH.

Harper Adams Agricultural College, Newport, Salop. Pp. 80. Report of the Advisory Department, 1927-1928. (Advisory Report No. 3.) Pp. 24. The National Institute of Poultry Husbandry. Pp. 48. (Newport, Salop.)

Ceylon Journal of Science, Section A: Botany; Annals of the Royal Botanic Gardens, Peradeniya. Edited by A. H. G. Alston. Vol. 11, Part 1, May 28th. Pp. 111. (Peradeniya: Department of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the year 1927. Pp. 11. (Cape of Good Hope.)

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1927. Pp. 18. (Salisbury.)

Proceedings of the Society for Psychical Research. Part 107, Vol. 38, July. Pp. 49-101. (London: Francis Edwards, Ltd.) 2s.

Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees in the University of Cambridge for the Academic Year 1926-1927. Published by Authority. Pp. 90. (Cambridge: At the University Press.)

Hull Museum Publications. No. 153: Hull and the Fishing Industry. By T. Sheppard. (Commercial Museum Handbooks, No. 2.) Pp. 15. No. 154: Early Means of Transport in the East Riding. By T. Sheppard. Pp. 36. (Hull.)

Speech delivered by Marcus Garvey at Royal Albert Hall, London, England, on Wednesday evening, June 6th, 1928, in setting forth 'The Case of the Negro for International Racial Adjustment' before the English People. Pp. 31. (London: Universal Negro Improvement Association.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1115 (Ae. 288): The Importance of 'Streamlining' in relation to Performance. By Prof. B. M. Jones. (T. 2519.) Pp. 15+2 plates. 9d. net. No. 1134 (Ae. 304): Wind Tunnel Tests with High Tip Speed Airscrews. The Characteristics of Airscrew Section R. and M. 322, No. 4 and R.A.F. 32. By W. G. A. Perring. (T. 2563.) Pp. 8+3 plates. 6d. net. (London: H.M. Stationery Office.)

Annual Report of the Auckland Institute and Museum for 1927-28, adopted at the Annual General Meeting held on 21st May 1928. Pp. 39. (Auckland, N.Z.)

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1927 May 19-1928 May 18. Pp. 3. (Cambridge.)

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 6, 1925-1926. Pp. xi+240+24 plates. (London.) 20s.

Loughborough College, Leicestershire. Calendar, Session 1928-29. Pp. xiv+238+71 plates. (Loughborough.) 2s. 6d. net.

University of Cambridge: Solar Physics Observatory. Fifteenth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1927 April 1-1928 March 31. Pp. 6. (Cambridge.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1928. Pp. xii+60. Bulletin No. 35: Trials of Weed Killers on Garden Paths. By Alfred Hill. Pp. 6. (Aberdeen.)

University College of Wales, Aberystwyth. Reports submitted to the Court of Governors, October 19th, 1927. Pp. 114. (Aberystwyth.) 1s. The Institute of Chemistry of Great Britain and Ireland. Register of Fellows, Associates and Students, corrected to 30th April 1928. Pp. 388. (London.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute, to be presented at the Yearly Meeting in May 1928. Pp. xlix+78. (London: Gresham College.)

The British Institute of Philosophical Studies. Annual Report and Statement of Accounts for the Year ended 31st March 1928, to be presented at the Third Annual General Meeting of the Members to be held at the Royal Society of Arts, 18 John Street, Adelphi, London, W.C.2, on Monday, 16th July 1928, at 5.30 o'clock. Pp. 20. (London.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 16, Technological Series No. 11: Technological Reports on Standard Indian Cottons, 1928. By A. James Turner. Pp. vi+118. (Bombay.) 2 rupees.

City of Norwich. The Report of the Castle Museum Committee to the Council, 1927. Pp. 22. (Norwich.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1120 (Ae. 293): Analysis of Experiments on an Airscrew in various Positions within the Nose of a Tractor Body. By C. N. H. Lock. (T. 2507.) Pp. 20+8 plates. 1s. net. No. 1135 (Ae. 305): The Effect of Compressibility on the Lift of an Aerofoil. By H. Glauert. (T. 2518.) Pp. 8+1 plate. 6d. net. (London: H.M. Stationery Office.)

British Empire Cancer Campaign. Annual Report of the Grand Council presented at the Meeting held at the House of Lords, 9.7.28. Pp. 141. (London.)

Board of Education. Prospectus of the Royal College of Art, S. Kensington, London. Session 1928-1929. Pp. v+28. (London: H.M. Stationery Office.) 4d. net.

International Geographical Union. Programme for the International Geographical Congress, London, July 14-17, and Cambridge, July 18-25, 1928. Pp. 16. (Cambridge.)

FOREIGN.

Annuaire de l'Observatoire Royal de Belgique. Par P. Stroobant. 96^{me} année, 1929. Pp. iii+160. (Uccle.)

Bibliothèque de l'Observatoire Royal et de l'Institut Royal Météorologique de Belgique à Uccle. Catalogue alphabétique des livres, brochures et cartes, préparé et mis en ordre par A. Collard. Tome 3: Accroissements de 1913-1922. Pp. 432+xlvi. (Uccle.)

Unione Astronomica Internazionale. Immagini spettroscopiche del bordo solare osservate a Catania, Zurigo e Zö-Sè negli anni 1923 e 1924 pubblicate per Cura del R. Osservatorio astrofisico di Arcetri. Pp. 10+14 tavole. (Firenze.)

Publications of the Washburn Observatory of the University of Wisconsin. Vol. 15, Part 1: Photo-Electric Photometry of Stars, by Joel Stebbins; Vol. 15, Part 2: Photo-Electric Studies of Four Variable Stars, by Charles Morse Huffer. Pp. 135. (Madison, Wis.)

University of California Publications. Publications of the Lick Observatory, Vol. 16: Stellar Radial Velocities. Pp. v-xlv+399+plates. (Berkeley: University of California Press; London: Cambridge University Press.)

Proceedings of the United States National Museum. Vol. 73, Art. 4: New Helminth Parasites from Central American Mammals. By Emmett W. Price. (No. 2725.) Pp. 7+2 plates. Vol. 73, Art. 7: A new Fossil Reptile from the Triassic of New Jersey. By Charles W. Gilmore. (No. 2728.) Pp. 8+3 plates. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Bulletin 788-F: Topographic Instructions of the United States Geological Survey. F: Map Compilation from Aerial Photographs. By T. P. Pendleton. Pp. iii+379+419. 15 cents. Bulletin 796-D: Geology and Oil and Gas Prospects of North-Eastern Colorado. By Kirtley F. Mather, James Gillyly and Ralph G. Lusk. (Contributions to Economic Geology, 1927, Part 2.) Pp. iv+66-124+plates 14-18. 20 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 577: Plants as Indicators of Ground Water. By Oscar Edward Meinzer. Pp. v+95+12 plates. 25 cents. Water-Supply Paper 596-G: Chemical Character of Waters of Florida. By W. D. Collins and C. S. Howard. (Contributions to the Hydrology of the United States, 1927.) Pp. iv+177-233. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1927. (Publication 2957.) Pp. iv+188. (Washington, D.C.: Smithsonian Institution.)

United States Department of Agriculture. Technical Bulletin No. 61: Wild Birds introduced or transplanted in North America. By John C. Phillips. Pp. 64. 10 cents. Farmers' Bulletin No. 1561: The Porto Rican Mole Cricket. By W. A. Thomas. Pp. ii+9. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 73, Art. 11: A Prehistoric Pit House Village Site on the Columbia River at Wahluke, Grant County, Washington. By Herbert W. Krieger. (No. 2732.) Pp. 29+7 plates. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 139: The Photogalvanic Cell furnished with Silver Iodide Electrodes, and its Application to Photometry and Illuminometry. By Satoyasu Iimori and Toshimasa Takebe. Pp. 131-160+plate 15. 45 sen. No. 140: Über die Stereoisomerie des 8-Oxydekahydrochinolins und seiner Derivate. Von Shin-ichiro Fujise. Pp. 161-171. 20 sen. No. 141: Quantitative Determination of Hemoglobin by means of the Silver Iodide Photogalvanic Cell. By Koichi Uchiyama. Pp. 173-184. 20 sen. (Tokyo: Iwanami Shoten.)

University of Illinois: Engineering Experiment Station. Bulletin No. 177: Embrittlement of Boiler Plate. By Prof. Samuel W. Parr and Frederick G. Staub. Pp. 67. 40 cents. Bulletin No. 178: Tests on the Hydraulics and Pneumatics of House Plumbing, Part 2. By Prof. Harold E. Babbitt. Pp. 62. 35 cents. (Urbana, Ill.)

Physikalisch-chemisches Institut der Universität Zürich. Physikalisch-chemische Übungen. Von Dr. W. Kuhn. Pp. 102. (Zürich und Leipzig: A. G. Gebr. Leemann und Co.)

University of California Publications in American Archaeology and Ethnology. Vol. 23, No. 8: Pottery-making in the South-west. By E. W. Gifford. Pp. 353-373. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 25 cents.

Berichte der Naturforschenden Gesellschaft zu Freiburg i. Br. Band 28, Heft 2. Pp. ii+93+43+24+45+6. (Freiburg i. Br.: Speyer und Kaerner.)

Proceedings of the American Academy of Arts and Sciences. Vol. 63, No. 1: Magnetostriiction Oscillators. An Application of Magnetostriiction to the Control of Frequency of Audio and Radio Electric Oscillations, to the Production of Sound, and to the Measurement of the Electric Constants of Metals. By George W. Pierce. Pp. 47+3 plates. 90 cents. Vol. 63, No. 2: A Dynamic Study of Magnetostriiction. By K. Charlton Black. Pp. 49-66. 45 cents. (Boston, Mass.)

Annalen van de Sterrewacht te Leiden. Deel 14, Vierde Stuk: Measures of Double Stars made with the 264- and 9-inch Grubb Refractors of the Union Observatory at Johannesburg, 1925.6-1928.2. By W. H. van den Bos. Pp. x+143. Deel 16, Derde Stuk: The Motion of Hyperion. By J. Woltjer, Jr. Pp. vii+139. (Leiden.)

Department of Education: Bureau of Education. Bulletin, 1927, No. 41: Accredited Higher Institutions. Pp. v+40. (Washington, D.C.: Government Printing Office.) 10 cents.

CATALOGUE.

Recent Work on Absorption Spectrography: a Bibliography selected by Dr. Wallace R. Brode. Pp. 8. (London: Adam Hilger, Ltd.)