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The Coal Position.

TWO national coal strikes within six months have rudely forced upon the British public the appreciation of the fact that our national economic system is entirely based upon our coal production. We are dependent upon coal in a way that no other nation is; we are living in a country that cannot grow sufficient food to supply the population, and we exist only by virtue of being able to import food to make up the deficiency in our home production, and, needless to say, we can pay for this importation only by our exports. Now coal is practically the only material product that we do export; apart from the relatively small quantity of coal exported as such, we indirectly export coal on a vast scale; when we import Spanish iron ore and export steel rails, or when we import American cotton and export piece goods, we are indirectly exporting coal—the coal that has been used in converting the raw materials into the finished articles that we sell; when a steamer, bunkered in this country, carries goods from any part of the world to any other part, the freight paid to the shipowner is in part payment for coal exported from this country. In its manifold applications coal is the only asset that we possess which enables us to liquidate our indebtedness to other nations, and thus it is that our coal supply is of vital importance, not only to our prosperity, but even to our very existence.

The factors that have contributed to place us in the premier position (until recently) amongst the world's coal exporters are well known and sufficiently obvious. Until last autumn we maintained that position; when, however, a general coal strike was declared, those countries which had hitherto been dependent upon us for their coal supplies decided that they could not risk being dependent upon the continued disturbances in the coal mining industry of this country with winter coming on apace, and hence made haste to cover their coal requirements wherever they could, and that was, of course, mainly from the United States. Thus, to take France as an example, that country imported in the first eleven months of 1920 about 1,982,000 tons of American coal, of which 1,309,000 tons were imported in October and November. It is far easier to lose a market than to regain it, and the first condition for controlling a market is the ability to supply it steadily as required. This second coal strike is scarcely likely to inspire in our customers abroad any confidence in our ability to fill orders whenever they need coal, and will certainly cause them to look for more trustworthy sources of supply. Our only chance of regaining our leading position would appear to be if we had such pre-eminence both in the quality and in the quantity of our coal resources as would ensure us an advantage over our competitors. This is, however, far from being the case. As regards quality no doubt we hold the first place; no country produces coals equal to ours on the average, and in this respect Nature has dealt generously with us. The question of the quality of coal is, however, not one of very great importance; modern inventions have shown us how to utilise inferior coals for practically any purpose, and it seems quite certain that the limits of the resources of science in this direction have by no means been reached.

It is, after all, more a question of cost than of anything else; the purchaser of coals buys potential thermal units, and he will naturally buy that coal, whatever be its quality, which will give him the maximum number of thermal units at a given price. It is impossible to discuss the coal question in any way adequately without taking the cost of the coal into serious account. Nature has favoured us not only in the quality of our coal, but also in its mode of occurrence and in the comparative ease with which it can be produced; a comparison between, for example, the magnificent, thick, flat-lying seams of Yorkshire and the steep-lying, contorted, and crushed-up seams of Belgium will illustrate this point, and will incidentally bear tribute to the skill of Belgian engineers and to the steady, hard-working powers of the Belgian coal miners that have enabled them to sustain competition with the odds so much against them. Again, we have the advantage that most of our important coalfields are within easy access of the seaboard and of first-class harbours; had it not been for this fact, it is doubtful whether our coal industry would have maintained its position so long as it has done.

The official estimate of the cost of production of coal in this country for the last quarter of 1920 is 39*s.* 9·82*d.* per ton, exclusive of interest on capital, amortisation, depreciation, and similar book charges. There are at least three great countries in the world—India, China, and South Africa—where coal can be sold at 6*s.* per ton, or, say, about one-seventh of what it can be sold at in this country at the pit's mouth. Seeing that these three countries contain nearly one-sixth of the total coal resources of the world, they are obviously formidable competitors potentially, and once they have organised their means of transport so as to distribute economically their cheaply gotten coal, it is surely obvious that our only chance of holding our own is to reduce drastically the cost of coal production in this country. No one needs to be told that this end cannot be attained by ceasing work and drowning out pits; it can only be the result of close, cordial, and unfettered co-operation between miners, technologists, and employers, all directed towards securing the maximum possible output at the lowest possible cost. Unfortunately, our output has been going down steadily; for the last quarter of 1920 the average for the kingdom was only 41·15 tons per person employed, and it is significant that South Wales, where coal is perhaps more easily gotten than in any of our other coalfields, is amongst the lowest in the list. Let it be borne in mind that the above quarterly rate of production corresponds to only 165 tons per annum; it, of course, includes a strike period, but, nevertheless, we may contrast this figure with 260 tons, the output per person per annum in 1913; with 320 tons, the output per person per annum for the decade 1883–92; or even more startlingly with 768 tons, the output per worker in the United States for the year 1917; and it is surely clear that a properly directed effort would enable us to produce coal at a far lower pithead price per ton than that prevailing at present without necessarily involving any very serious reduction in the miners' wages.

Again, it must be noted that our coal reserves are comparatively unimportant. According to the careful estimates made in 1913, the world's known coal resources amount to about 7,400,000 millions of tons; of this quantity the United States holds more than 3,800,000 millions, or above half. Great Britain's resources, which may be considered as fairly well known, are barely 190,000 millions, or, say, one-twentieth of those of the United States. The entire British Empire is credited with about 1,800,000 millions of tons, of which by far the greater portion, or 1,230,000 millions of tons, is in the Dominion of Canada. The coal in Great Britain constitutes, therefore, only about one-tenth of that in the British Empire. Whilst these figures indicate clearly enough in whose hands the ultimate control of the world's coal supply must rest, they are perhaps less important as regards the near future, with which we are at the present moment more directly concerned, than is the relative producing capacity of the world's chief actual producers. In this respect Great Britain occupies a far more important position. In 1919 the United States produced nearly 494 millions of tons, Great Britain more than 233 millions, and Germany 210 millions, these three countries together being responsible for 80 per cent. of the world's output. Seeing that Great Britain, with reserves amounting to only about 2½ per cent. of the world's total, is producing at the rate of about 20 per cent. of the world's annual output, it is manifest that we are encroaching upon our reserves far more rapidly than anyone else, and the supreme importance to us of not parting with our chief national asset, save at a fair profit, is self-evident.

In this light the complete economic unsoundness of the suggestion that the coal industry should be subsidised out of the national funds becomes glaringly evident, as it would amount to paying the foreigner out of the pockets of the taxpayer for taking from us the most valuable asset that we possess. Cheap coal has been the foundation of our national prosperity, and this prosperity will last only so long as we can produce coal at prices low enough to enable us to compete on fair terms with other nations in the markets of the world. Whenever we are no longer able to do this, our national supremacy, our prosperity, and our independence, for which so many thousands have sacrificed their lives, will have been lost for ever.

The Conquest of Venereal Disease.

Prevention of Venereal Disease. By Sir G. Archdall Reid. With an introductory chapter by Sir H. Bryan Donkin. Pp. xviii+447. (London: William Heinemann, Ltd., 1920.) 15*s.* net.

SIR ARCHDALL REID commences the preface to this volume with the following sentence, characteristic of a man with strong convictions and courage to express them: "If the evidence in this book be true, the public should know."

It is fitting that Sir Bryan Donkin should write an introductory chapter to this very important work, for it was he who first, by a letter to the *Times* in January, 1917, publicly championed the cause of self-disinfection, and set the ball rolling in favour of the only obvious practical method of prevention of venereal disease by the adoption of the scientific principles founded upon the discovery of Metchnikoff and Roux, published in 1906. This showed conclusively that syphilis could be successfully prevented by the prompt use of calomel cream "after the subjects of the experiments, both human and simian, had been carefully inoculated with the poison of this disease."

Sir Bryan rightly gives credit to Dr. H. N. Robson, who courageously advocated this method in a book entitled "Sexual Disease and its Medical Prevention," published in 1909. He also points out that Sir Frederick Mott, a member of the Royal Commission, had written (prior to the war), in an authoritative medical treatise concerning the application of Metchnikoff's experiments, that "it would be well if this were widely known and practised in the civil population," which, we might add, he has continued to advocate ever since.

This work of Sir Archdall Reid is issued under the auspices of the Society for the Prevention of Venereal Disease, and throughout we find evidence of the struggle which has taken place between the National Council for Combating Venereal Disease and the principle of self-disinfection advocated by the former society.

In chap. ii. "The Urgency of the Problem" is discussed, and we quote this very important statement of the author in support thereof: "After every great war a considerable increase of venereal disease has been recorded; the greatest of all wars is not likely to furnish an exception." The author roughly calculates that "some 2,000,000 men suffered during the five years of war."

Referring to his own experience in the prevention of venereal disease at Portsmouth, the author says: "Towards the end of 1917 it became known at the War Office that a method existed of protecting troops from venereal disease so effective that the rate of infection was reduced to 1·5 per thousand. Arrangements were made to apply this method to the whole Army." It looked at first as if the authorities were going to apply efficiently the simple sanitary instruction by medical officers, and thereafter to institute a vigorous inquiry if any medical officer failed to achieve success. But nothing was done to apply the method in a thorough and efficient manner, and, to quote the author's own words:—

"In the interval between the resolve to introduce the new method and the provision of the new apparatus an incredible thing had happened. At the time of the great German offensive there were, but need not have been, in the venereal hospitals or in depôts as convalescents British, French, and American soldiers, mature and trained men, otherwise fit for active service, sufficient not for an army corps only, but for a great army. All these men had become diseased after the authorities had learned how to prevent disease. They were put out of action, and the Allied cause brought to the verge of ruin by the fanaticism of a few 'influential people' and the complaisance or timidity of a few obliging officials."

The author goes on to say: "I am sure I have not exaggerated as to the effect that the failure to deal resolutely with venereal disease had in the fortunes of the British Army at the time of its greatest need."

We do not agree with all the author says regarding the Final Report of the Royal Commission on Venereal Disease, or with his deductions therefrom; he states that the evidence received indicated that the number of persons who have been infected with syphilis, acquired or congenital, cannot fall below 10 per cent. of the whole population in the large cities, and the percentage affected with gonorrhœa must greatly exceed this proportion. He assumes that, because cases of gonorrhœa are six or seven times as common as those of syphilis, 70–80 per cent. of the population of large towns have suffered from venereal disease. Such a deduction, in our judgment, is not warranted, for there is the obvious fallacy that a man may have several attacks of gonorrhœa, and we do not think he is right, therefore, in asserting that such a large proportion as 30–50 per cent. of the inhabitants of Great Britain have suffered from venereal disease. Sir Archdall Reid is probably correct when he states:—

"Venereal diseases are, in fact, by far the most prevalent of all the more serious diseases. Together they constitute a principal, if not quite the principal, cause of poverty, insanity, paralysis, blindness, heart disease, disfigurement, sterility, disablement, and the life of pain to which many women are condemned. Our hospitals, asylums, and homes for the broken are crowded with their victims. The cost in loss of efficiency, therefore in money, is incalculable. More than anything else they are responsible for the blunting of the moral sense, not only in the people who poison for private profit or pleasure, but also in those who, careless of this vast flood of misery, seek to obstruct the path of the reformer."

Venereal diseases, the author states in chap. iii., on "Instinct and Reason," would die out in a few years if all men and women were chaste; but he points out that sexual love is an instinct in that it is not learned. It develops infallibly as the individual matures, and without antecedent experience it manifests itself at the proper time. Can it, therefore, be hoped that preaching and teaching will make all men and women avoid promiscuous sexual intercourse when social conditions are such as they are?

This and the next chapters on "Development of Mind and Character" and "Inclination and Morality" show philosophic reasoning, and are interesting as embodying the opinions and judgments of an original-minded man of wide knowledge and with experience of human character. The author discusses the moral side of the question, and says: "No one could, or would, be moral unless he had learned to be moral." The instinct, always the same in kind if not in degree, is passed from generation to generation by Nature from the most remote times. He shows how sexual morality changes with religion and racial traditions; he points out that "good teaching by adults in matters sexual is hopelessly out of reach in England"; and, "because the country is not of one mind as regards morals, venereal disease therefore is not likely to be banished or even checked by an improvement in public morality. The only conceivable alteration is sanitation."

A very important statement is the following:—

"There is a terrible superstition very current among the ignorant that venereal disease may be cured by 'passing it on.' Above all, fear of infection causes many men to seek satisfaction of their desires from 'decent' women, as many an unhappy girl has found to her ruin. It is from the ranks of these unfortunates that the whole army of prostitutes is recruited, for no woman voluntarily begins a career of immorality as a prostitute. On the whole, then, as far as I am able to judge, venereal disease does not check immorality, but tends vastly to increase it."

Chap. vi. is an interesting account of "Microbic Diseases" and how they have been efficiently dealt with by the application of scientific methods. In chap. vii., "Metchnikoff," the author gives an interesting historical account of the origin of venereal disease and its prevalence.

Chap. viii. deals with "The Report of the Royal Commission." The author criticises it most severely, and, we think, unfairly, for not recommending the application of Metchnikoff's discovery as a means of preventing venereal disease, but it must be remembered that the evidence appeared to show that salvarsan treatment in the primary stage would lead to a cure. The author gives the Commission no credit for creating a new public opinion upon the hitherto "hidden plague" and the urgent necessity of preventing it.

We can, however, understand that a reformer like Sir Archdall Reid, with the courage of his convictions, must be forgiven if he attacks relentlessly all who differ, or seemingly differ, from him, because willing to compromise in the hope that public opinion may be more easily changed and brought round to a sensible view.

The National Council was formed to promote the recommendations of the Royal Commission, and it comes in for severe criticism—rightly so, we think—for a number of its medical experts left the National Council to found the Society for the Prevention of Venereal Disease because they felt convinced that the policy of moral suasion, teaching, and fear of the serious consequences of contracting the disease had not had any marked deterrent effect upon promiscuous sexual intercourse and the incidence of venereal disease.

Chap. ix. deals with "Venereal Disease in the Army." This is a very interesting chapter, because the author tells how he successfully dealt with venereal disease. Every man joining was medically examined within twenty-four hours, and instructed by lecture and poster how to avoid infection: first, to avoid exposure to infection; secondly, by self-disinfection immediately after exposure. For this purpose the soldier must carry in his waistcoat pocket a small flat bottle containing 1 in 1000 of solution of permanganate of potash and a swab of cotton-wool. Instructions were given to swab the parts exposed to infection with the disinfectant immediately after intercourse. This simple method, thoroughly carried out, had the effect that venereal disease vanished from his unit. "In two years and four months, during which time 20,000 men must have passed through my hands, only seven men were infected" (p. 130). Does not the author, having regard to the following sentence from p. 132, mean 2000? At the end of this chapter the author states that "200 men belonging to one unit who came for demobilisation from the Continent, and arrived at our barracks one evening in the last week of April, 1919, furnished thrice as much disease as 2000 in two years and four months."

In chap. x., "Quick Disinfection," the author attacks the policy of the National Council of preaching and treating, and the Army authorities for not adopting the one thing necessary for success—to insist on, and enforce, the careful instruction of the men in the use of the disinfectant.

In chap. xi. the author gives "Comparative Statistics," and he quotes some remarkably satisfactory results of Surgeon-Commander P. H. Boyden: "Amongst 496 men employing this method, one case of syphilis is recorded, but in this case the treatment was used six hours after exposure."

Civilian early-treatment centres were advocated by the National Council, but, as might have been expected, both borough and county councils rejected them as impracticable and costly, and Manchester alone has made a trial of this means of preventing venereal disease. There are 183 treatment centres, and where these are necessary prophylactic measures are more necessary, and it is to be hoped that the Ministry of Health will now see that the simple and inexpensive measure of self-disinfection is the only practical method of dealing with this problem—a procedure which, in the hands of Sir Archdall Reid, has proved so eminently successful, and which the Society for the Prevention of Venereal Disease has consistently advocated.

In chaps. xv. and xvi. Sir Archdall Reid gives an adequate explanation of a misapprehension that might have arisen from the evidence he gave before the Inter-Departmental Committee regarding the trustworthiness of his figures and the value of his work, and it is not surprising that he should make and prove charges of misrepresentation of facts by officials through the mouth of Lord Sandhurst when the latter took part in a debate upon a motion by Lord Willoughby de Broke in the House of Lords. The author in chap. xvii., "Lord Sandhurst's Apologetics," vindicates his position regarding his statistics of venereal disease in Portsmouth Town, which is not the Portsmouth area that was quoted.

The report of a Committee appointed by the Birth Rate Commission to take evidence upon the prevention of venereal disease found in favour of immediate self-disinfection; but the only *sure* method they advised is to avoid promiscuous sexual intercourse. Having regard to the composition of this Committee, Sir Archdall Reid has therefore the satisfaction of knowing that he is a pioneer who has convinced those whom he thought were irreconcilable to his views.

We can cordially recommend this work to all readers of NATURE, on account of its philosophic and scientific character and the fearless courage with which the author has successfully resisted and attacked the authorities who stood in the way of the adoption of scientific methods for the prevention of disease at a critical period of the nation's history.

Plant Evolution.

Studies in Fossil Botany. By Dr. Dukinfield H. Scott. Third edition. Vol. i. *Pteridophyta.* Pp. xxiii + 434. (London: A. and C. Black, Ltd., 1920.) 25*s.* net.

IN the preface to the first edition of his "Studies," Dr. Scott stated that his object was not to write a manual of fossil botany, but to present to the reader "those results of palæobotanical inquiry which appear to be of fundamental importance from the botanist's point of view." The fact that the third edition of vol. i., which deals with the Pteridophyta, needed as thorough a revision as the second edition shows that recent palæobotanical research has not been barren of results. "The only direct evidence which is possible in questions of descent among plants is from the ancient plants themselves." The interpretation of the evidence is the difficulty; not only did many of the types preserved in the rich plant-bearing beds of the Carboniferous period greatly exceed in size their modern representatives, but they were also more complex in structure. Generalised or synthetic types are common enough, and the inference is usually drawn that these extinct genera indicate the common origin of groups or families now comparatively remote; ancestral stocks are imagined, not discovered. Even the oldest known land plants, though in some respects simpler than those which followed them, appear to be far advanced in their anatomical differentiation, and the mechanism of the plant machine is essentially similar to that of existing plants.

We have, it must be admitted, not progressed very far towards "the completion of the natural system." The farther we penetrate into the past, the more fascinating becomes the search for origins. Lines seem to converge; but it may be that, with our imperfect vision, we see parallel lines of evolution as though they converged. The author, in speaking of Asteroxylon, one of the most ancient of terrestrial plants, with his usual caution suggests that the characters of the genus are indicative of a union of the fern and lycopod groups, but he adds that these characters "may, after all, admit of a different explanation." It may be that he has less faith in common ancestors than he once had, and if this surmise be true he is not alone in this sceptical attitude. Dr. A. H. Church believes that ferns and lycopods represent separate lines of evolution from unicellular flagellates, and, as Dr. Scott remarks, it would be rash to reject Dr. Church's hypothesis of transmigration simply on the ground of the synthetic nature of such a plant as Asteroxylon.

Few additions have been made to the earlier chapters of the volume. To that on Sigillaria and allied genera an account has been added of a remarkable heterosporous lycopodiaceous cone from the Coal Measures, the genus Mazocarpon, described by Dr. Margaret Benson. The section devoted to the ferns, which has been in part rewritten, is a particularly welcome contribution to a puzzling subject. It is now recognised that the ferns did not hold the dominant position in the Palæozoic period formerly assigned to them; there were tree ferns and simpler herbaceous genera exhibiting a wide range in their morphological characters, in some features strikingly similar to modern forms, in others very different. Their origin is an unsolved problem. The admirable work of Dr. Kidston and the late Prof. Gwynne-Vaughan on the fossil Osmundaceæ is briefly summarised, and the recent researches of Dr. Gordon, M. Paul Bertrand, and others on the Botryopteridaceæ are described and correlated with conspicuous success.

In the last chapter Dr. Scott gives a very good account of the already famous genera Rhynia, Hornea, and Asteroxylon, founded on exceptionally well preserved material from a bed of Middle, or possibly Lower, Devonian chert discovered in 1913 by Dr. Mackie, and thoroughly investigated by Dr. Kidston and Prof. Lang. These plants, admirably described and illustrated in Prof. Bower's lectures, published in NATURE for July 29 and August 5, 1920, afford us glimpses of what, so far as we know at present, is the oldest land vegetation; though separated by an interval of several hundred millions of years from existing plants, they exhibit anatomical characters wonderfully similar to those of certain recent types. In some respects these Devonian genera are more primitive than any living Pteridophytes, and, like so many extinct plants, they appear to have attributes of phyla that are now widely separated. What was their history? Do they bring us within sight of the transition from algæ to vascular plants suggested by Dr. Arber (in a posthumous book,[1] to which Dr. Scott refers), and advocated with much ability and ingenuity by Dr. Church in a recent memoir? Whatever the significance of the older Devonian plants may be, botanists have now an opportunity of reading an excellent account of the facts.

It is superfluous to commend Dr. Scott's book to botanists familiar with the earlier editions, but one may express the hope that this up-to-date survey of the field selected for treatment, presented in a form which reflects the greatest credit upon author and publisher, may lead many botanical students to appreciate at their true value the older records of the rocks, and to endeavour to form an unbiassed opinion on the bearing of palæobotanical evidence on the general question of the method by which the plant world has been evolved. As Prof. Bateson says, "we have got to recognise that there has been an evolution." Is it true, as we are often assured, that the study of fossil plants confirms the orthodox views on progressive development, or do the results of modern research into the floras of the past compel us to admit greater ignorance of the course of plant evolution than is generally allowed? The great value of the volume under consideration is that it gives us a well-proportioned statement of the more trustworthy results of palæobotanical inquiry, and provides the student with the means of forming his own conclusions.

A. C. SEWARD.

[1] This volume, entitled "Devonian Floras," was published in January last.

A Modern Inorganic Chemistry.

A Text-book of Inorganic Chemistry for University Students. By Prof. J. R. Partington. Pp. xii + 1062. (London: Macmillan and Co., Ltd., 1921.) 25*s*.

THE general arrangement of this book is logically worked out on a well-ordered plan, and the author has a straightforward and easy style. The result is a very readable volume, which is, in our opinion, the best of its kind in the language.

The introductory chapters are excellent, as also are those sections dealing with the development of fundamental chemical theories during the nineteenth century. In fact, the historical aspects of the subject are well emphasised throughout. (We must, however, dissent from the desirability of referring atomic weights to the standard H = 1. The difficulties from the point of view of the student caused by the use of the oxygen standard seem to us to be exaggerated, and the present moment is a particularly unfortunate one for such a departure.) With this broad historical treatment is happily combined an essentially modern outlook when dealing with the details of the subject. The new lines of advance opened up by the development of physical chemistry receive their full meed of recognition, and short chapters are devoted to explaining the principles on which these methods of investigation are based. Some of these chapters are less satisfactory than others. That on voltaic cells, for example, comprising eleven pages, deals with a great range of topics in what is necessarily a compressed and scrappy fashion, and will not convey much to a reader new to the subject.

The descriptive portions of the book have been critically compiled, though we think that more scepticism might have been displayed in assigning definite formulæ to such classes of compounds as basic salts, hydrated oxides, etc. Much recent work is included, and the same applies to the sections dealing with technical processes, where it is pleasant to find an up-to-date treatment of such subjects as sulphuric acid concentration and the Deacon process, and a mention of electrostatic precipitation, flotation processes, and electro-magnetic separation. The relative importance of a process is not, however, always reflected by the amount of space it occupies in the text. Blast-furnace copper smelting is less adequately treated than the Welsh process, and electrolytic alkali processes are represented by one obsolete and one obsolescent cell.

Mistakes appear to be very few. Attention may, however, be directed to the fact that in practice calcium cyanamide is not produced in an arc furnace (p. 544); also that Alfred, not Alphonse, Werner was the author of the co-ordination theory of valency (p. 1011).

The only criticism of the book, as a whole, that we are inclined to make is that the author has perhaps been too loath to omit details of minor importance, or, as already indicated, subjects the adequate treatment of which would demand considerably larger space. The volume is large in size, and the price correspondingly high. It contains more material than is required for the average Pass degree, but not enough for the average Honours degree; and these circumstances may adversely affect the use made of it by university students, for whom it is professedly designed. But the book is so good that one must hope that this will not be the case.

It remains to congratulate the publishers on their share of the work.

A. J. A.

Our Bookshelf.

The Subject Index to Periodicals. 1917–19. *B–E. Historical, Political, and Economic Sciences.* 496 cols. (pp. 248). (London: The Library Association, 1921.) 1*l.* 1*s.* net.

THIS section of the "Subject Index to Periodicals," indexing papers on historical, political, and economic sciences, contains above 12,000 entries taken from more than 400 English and foreign periodicals published during the years 1917–19. Though it is not a catalogue of science, the economic problems affecting the development of industrial science are indexed. Folk-lore is no longer included in this list, but has been transferred to List A: Theology and Philosophy. Headings relating to Prehistoric Man and to local Topography are to be included in List G: Fine Art and Archæology. Among the subjects indexed in the present list are "Commercial Aeronautics," "Agriculture," "Chemicals: Manufacture and Industry," "Coal Trade," "Industrial Efficiency," "Electric Industries," "Ethnology," "European War," "Factories," "Fisheries," "Forestry," "Food Supply," "Iron Industry," "Labour," "League of Nations," "Military Art and Science," "Railways," and "Sociology."

Those who are interested in problems connected with the changed economic conditions brought about by the war will find in this list the titles of most of the papers that have been published on these subjects during the three years indexed. The catalogue will also have an historical interest as showing what we were all thinking about during the second half of the war period.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-seventh Annual Issue. Pp. vi+354. (London: Charles Griffin and Co., Ltd., 1920.) 15*s.*

WE welcome the thirty-seventh edition of this useful annual, which is invaluable as a guide to the many scientific societies, of local as well as of more general interest, in the United Kingdom. In it will be found a record of the work done in science, literature, and art during the academic year 1919–20, and it is gratifying to note that the small increase in price is balanced by an increase in size of nearly twenty pages, which testifies amply to the further activities of our men of science. The volume is divided into a number of sections dealing respectively with science generally; astronomy; mathematics and physics; chemistry; geography and geology; biology; economics; mechanical sciences; naval and military science; agriculture; law; literature and history; psychology; archæology; and medicine. A noteworthy feature is the inclusion of particulars from scientific institutions and departments connected with Government service. Among these are the Meteorological Office, the National Physical Laboratory, the Geological Survey, the Natural History Museum, the Ministry of Health, the Medical Research Council, the Royal Observatory, and the Imperial Institute. That the work is up to date is shown by the inclusion of the Institute of Physics, which was incorporated during the past year. We have so far noted one omission only—the Imperial Mineral Resources Bureau.

The World of Sound: Six Lectures delivered before a Juvenile Auditory at the Royal Institution, Christmas, 1919. By Sir William Bragg. Pp. viii + 196. (London: G. Bell and Sons, Ltd., 1920.) 6*s*. net.

THOUGH the original purpose of these lectures was to arouse the interest of juveniles in the phenomena of sound and their applications, they must have appealed with equal force to those adults who were so fortunate as to hear them. Here the lectures are put into book form, with necessary diagrams and additional dainty illustrations which add much to the attractiveness of the text. Even to the student who is conversant with the ordinary text-books, much of the information must be new; this is particularly the case in the lecture on "Sounds of the Country," in which are described the methods by which sound-waves are generated by insects and by the passage of wind through the foliage of trees. In the following lecture on "Sounds of the Sea" the most attractive subject is the gradual development of the human ear from the simple rudimentary ear of the fish. The interest of the subject culminates in the last lecture on "Sounds in War," where Sir William Bragg's first-hand knowledge is applied to the description, in the simplest language, of the ingenious devices used in locating submarines, enemy guns on land by "sound-ranging," and the direction of enemy mining operations by the geophone.

The Wild Unmasked. By F. St. Mars. Pp. 376. (London and Edinburgh: W. and R. Chambers, Ltd., 1920.) 6*s*. net.

THE author has a gift of picturesque vision and delineation. There is no mistaking a strong imaginative power. We see this in the very first sketch of the interior of a wasp's nest and in the life-history of an intrusive parasitic beetle. The day's work of a sparrow-hawk, a water-vole's flitting, a fight between a big rat and a stoat, the adventures of an otter, a fight between a wild cat and a fox—such are some of the subjects of this romantic book. Prominence is given to the competitive side of the struggle for existence, which is one side of the truth, and many pages, like some in Nature's book, are lurid. We are not prepared to accept everything Mr. St. Mars infers, such as the shrew's death from a sudden noise, but the whole book expresses personal observation. What is first-class in the book is its vividness—it is not a study in still life, but in strenuous, palpitating endeavour. What is dubious is the extent to which the author pushes his anthropomorphism. With big-brained animals it seems a legitimate hypothesis, but in regard to sea-anemones it palls. What is more than dubious, in our judgment, is the occasional use of phraseology like "Mr. Passer," "Mrs. Hare," and pet names for wild animals. They strike a false note. The book would have been finer if it had been less facetious.

An Introduction to the Structure and Reproduction of Plants. By Prof. F. E. Fritch and Dr. E. J. Salisbury. Pp. viii + 458 + 2 plates. (London: G. Bell and Sons, Ltd., 1920.) 15*s*. net.

THE two parts of this work deal respectively with the anatomy and the life-histories and reproduction of plants. A large number of the anatomical figures are original, and although they vary in quality, many of them are excellent for their purpose. A few, however, show evidence of hasty sketching. As a reference book for first-year university students, it is the most useful we have seen. Although its treatment is fuller in many respects than an average first-year student can compass, yet this is perhaps an error in the right direction. Of special interest may be mentioned the chapters on cell contents, secretory organs, and anatomy in relation to habitat, as well as the final chapter on heredity and evolution. The book will form a very useful addition to the introductory text-books on structural botany.

Annuaire pour l'An 1921, *publié par le Bureau des Longitudes.* Pp. viii + 710 + A 42 + B 17 + C 69. (Paris: Gauthier-Villars et Cie, n.d.) 8 francs net.

THIS widely used handbook contains all the old well-known features, and in addition some new ones. The astronomical, physical, and political tables are very full; there are useful maps of the magnetic declination, inclination, and horizontal force in France in 1911, also full instructions for constructing sundials, and a set of star maps, with directions for their use. M. G. Bigourdan contributes a useful and lucid article on the proper motions and radial velocities of the stars, addressed to readers who have little previous knowledge of the subject. Gen. Bourgeois contributes a biographical notice of Gen. Bassot (1841–1916), whose name is well known among workers on geodesy. The civil day (commencing at midnight) is used throughout this handbook; this system will become universal at the beginning of 1925.

Lectures on the Principle of Symmetry and its Applications in all Natural Sciences. By Prof. F. M. Jaeger. Second (augmented) edition. Pp. xii + 348. (Amsterdam: Publishing Company "Elsevier," 1920.)

THAT a second edition of this inspiring treatise on crystallography has been issued so soon—the first edition was reviewed in NATURE for June 6, 1918—is sufficient guarantee of its worth. Substantially, the volume is the same as the earlier edition, but the author has taken the opportunity to correct a number of minor errors and to make a few additions which the passage of time has shown to be desirable.

Letters to the Editor.

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

"Space" or "Æther"?

YOUR readers are indebted to Mr. Bonacina's letter in NATURE of April 7 for a very clear statement of a fundamental point in the relativity controversy, and it is important that the views held with regard to it should be clearly understood. The issue is stated concisely in the sentence "the relativists seem now . . . to indicate that space, instead of being conditioned by matter, is itself the foundation of matter and physical forces." Now it seems clear that if any relativist expresses himself in terms like these he cannot be regarding space as mere emptiness or as the arbitrary co-ordinate system of the pure mathematician; for him it is the substitution of matter, light, and electric force—that is to say, it is the thing which most of us call æther. Since it is not matter, it has not (and we ought not to expect it to have) the material properties of density, elasticity, or even velocity; but it has other dynamical attributes, measured by tensor-expressions, which stand in much the same relation towards it that mass and strain do towards matter. It is, in short, a physical medium. It is sometimes stated that the relativity theory does away with the æther; the defence of this statement must be left to those who make it; I do not think it is the view of Prof. Einstein. It seems more reasonable to say that relativity has added to the importance of the æther by enlarging its functions.

But it must not be thought that the whole issue reduces to a question of terminology. It will naturally be asked: How can those who believe in a physical æther regard gravitation and electromagnetic phenomena as the "outcome of the geometry of the universe"? The phrase is Prof. Weyl's, and reference to his book, "Raum, Zeit, Materie," shows that he believes in a physical æther, and does not mind saying so. "We shall use," he says, "the term 'condition of the world-æther' as synonymous with 'metric' in order to intimate the *real* character of the metric." We must recall that the geometrical quantity called "distance" is none other than the material or æthereal attribute of "extension," as Mr. Bonacina admits. Thus experimental geometry, which comprises the study of distances, is the science of the æther so far as its attribute of extension is concerned. The sentence then means that not only the phenomena immediately recognised as spatial, but also mechanical and electrical phenomena, fall into place in a complete development of the theory of extension—a truly remarkable discovery. They do not introduce any other attribute of the æther. I think it is because physical science is confined to this one attribute of the substratum of the universe that such qualities as beauty lie outside its scope.

The statement that the phenomena of mechanics are the outcome of the geometry of the world implies the complementary statement that the phenomena of experimental geometry are the outcome of the mechanics of the world. Either form expresses the central truth of the generalised relativity theory, but the great advance lies not so much in the conception of the idea as in the discovery of the key to this unification of geometry and mechanics. The unification leaves us with a redundancy of names, and apparently there is some divergence of view as to the right name for the fundamental substratum of everything. Since it is the medium the condition of which determines light and electromagnetic force, we may call it *aether*; since it is the subject-matter of the science of geometry, we may call it *space*; sometimes, in order to avoid giving preference to either aspect, it is called by Minkowski's term *world*.

A. S. EDDINGTON.

Observatory, Cambridge, April 11.

"Absolute" Temperatures in Meteorological Publications.

IN a note in NATURE of March 31 referring to one of the publications of the Meteorological Office occurs the remark: "The normal constant for absolute temperature given is 200°. With a normal constant of 273° the resulting values would be in ordinary degrees Centigrade, a system adopted by many meteorologists on the Continent and by some at home. To the uninitiated it gives a reading more easily comprehended, although . . . some of the values would be given with the negative sign." Whatever may be the meaning of the "normal constant" for any scale of temperatures, may I express my disagreement with the opinion, and give a reason for doing so? Premising that, when dealing with the upper air, it is not the few, but the great majority of readings that have the negative sign on the Centigrade thermometer, my reason is that, to the uninitiated, negative values are not an aid, but a terrible obstruction to comprehension, because their use implies a process of thinking in two directions, upwards and downwards, at the same time, and keeping the two trains of thought distinct.

Looking into a well-known historical work a few days ago, I came across a perfect analogy of that imperfect system of measurement, one which expresses the difficulty very clearly. The author wrote of something as taking place "at the end of the third century B.C." He was counting time as your annotator would have us count temperature. I understand the time-reference to mean "towards 200 B.C.," the end of the third century being the beginning, not of the fourth, as the ordinary process of measurement would suggest, but of the second. If you substitute "the third degree Centigrade below zero" for "the third century B.C.," you have the same difficulty. It is obvious that in dealing with a single degree, as for a single century (for purposes of estimation of a fraction, for example), you may have to think upwards; but in dealing with a number of degrees or centuries you think downwards. This does not make for easy comprehension, and the only possible excuses for exposing an uninitiated reader or observer to the risks of such a system are either that there is no alternative—or that fractions of a degree do not really matter anyway.

In order to make comprehension easy you have, in fact, to become initiated in the practice of standing on your head; and no doubt after years of practice it becomes easier to stand on your head than to alter the zero of your own thermometer. But the uninitiated ought not to be prayed in aid of the practice. They will not find it anything like so easy as a hoary initiate like myself.

Incidentally, let me say that I know no meteorologists at home who habitually use the Centigrade scale. Many physicists do so; but, being "initiated," they skip quite lightly into the absolute scale when they want to deal with thermodynamics or radiation or any other of the applications of physics that go beyond the mere quotation of a temperature; they skip back again just as easily to Centigrade when the job is done. Skipping from one system of units to another is recognised as splendid exercise in the process of "initiation"; but for the uninitiated there should be only one system of units, and that the very best there is. Comprehension soon follows when principles are really sound and scientific in the best sense. That is the real advantage of "a normal constant" of 200, which means in this case counting degrees upwards continuously from $-273°$ C.

In order to meet the objection that temperatures expressed in this way are not, strictly speaking, in the absolute scale, I suggested in NATURE some years ago that the scale of Centigrade degrees measured from -273 should be called "tercentesimal."

April 2. NAPIER SHAW.

Isotopes: Their Number and Classification.

ONE of the most remarkable characteristics of atoms is their predilection for the number 2 or for even numbers. The nuclei of atoms are now considered to be built up from hydrogen nuclei, which may be called positive electrons or protons. Suppose these to be P in number. Combined with these are N negative electrons. Since these N negative electrons may for most purposes be considered to neutralise the charge of N protons, the net positive charge on the nucleus is equal to P–N or M, the Moseley or atomic number. Now it is most remarkable that in about 97–98 per cent. of all atoms N is even; in 90–95 per cent. P is even; and M or P–N is also even in 89 per cent. of the atoms in the surface of the earth and in 98 per cent. of the atoms in the meteorities.

According to the theory of nuclear building published by the writer in 1915 and 1917, not only are the above facts to be expected, but also, as was pointed out specifically by N. F. Hall in the latter year, the number of isotopes should be considerably greater for elements of even than for those of odd atomic number. The recent remarkable positive-ray work of Aston, together with the investigation of magnesium by Dempster, show that eleven elements of even number consist of about three isotopes each, while those of odd number average only 1·44, or more than twice as many when the atomic number is even. The contrast should be very marked in the region of abundant isotopes between atomic numbers 28 and 83, or from nickel to bismuth. Keeping in mind this distinction between odd and even numbers, it may be predicted that nearly three hundred atomic species will be found when all the ninety-two elements are investigated fully, using methods of the present delicacy. An increase in the delicacy of the method of detection will naturally increase the number of isotopes discovered.

The number 2 occurs in another fundamental connection, since in no known permanently existing species of atoms in which the nucleus is *complex* is the number of protons more than twice the number of electrons, or *the ratio* N/P *is never less than* 1/2. This fundamental law was fully discussed in an earlier paper by the writer ("The Stability of Atoms as Related to the Positive and Negative Electrons in their Nuclei," Journ. Amer. Chem. Soc., vol. xlii., pp. 1956–97, 1919). It is of great interest that for 85 per cent. of the atoms of the earth's crust and 80 per cent. of those in the meteorites N/P *is neither less nor more than* 1/2. Thus most atom nuclei have the formula $(p_2e)_M$, and for such atoms M is almost always a multiple of 2 or an even number, but is odd in the very rare lower isotopes of lithium, boron, and also in nitrogen, which is a moderately rare element on earth, since it makes up only a very small fraction of the material of the earth's crust.

Let us specify the atoms of this important class as those of *isotopic number* 0. Then the isotopes of magnesium of atomic weights 24, 25, and 26 will have isotopic numbers 0, 1, and 2, and may be specified as Mg 12_0^{24}, 12_0^{25}, and 12_0^{26}, where 12 is the atomic number. It is easily seen that the isotopic number n is the number which, when added to twice the atomic number, gives the atomic weight (P). The Harkins-Wilson equation for atomic weights is $P=2M+2f$, where f has values 0 to 27 for complex nuclei and $-1/2$ for hydrogen. It is now proposed to change this classification of atoms by their f values (*loc. cit.*) into a classification according to their n values, where n, the isotopic number, takes the place of $2f$ in the above equation. The isotopic number of uranium is 54, the isotopes of krypton are 6, 8, 10, 11, 12, and 14, those of chlorine are 1 and 3, that of arsenic is 9, those of bromine are 9 and 11, that of

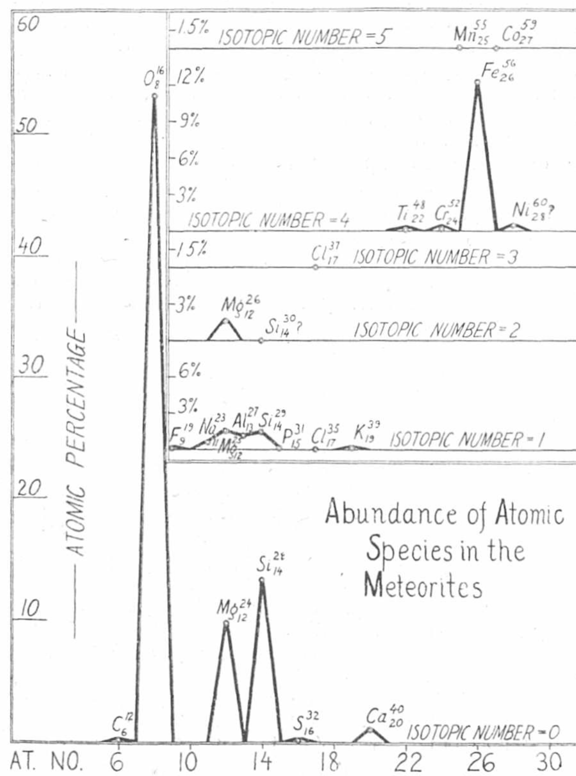

FIG. 1.—The abundance of isotopes as a function of the isotopic number, and as a function of the atomic number. While this figure exhibits the relations in the meteorites, the similar figure for the earth's crust is almost identical, except that the peak for aluminium is higher, and those for magnesium lower.

iodine is 21, etc. It is of interest to note that the isotopic numbers of elements of even atomic number are mostly even, while those of odd atomic number are mostly odd.

The isotopic number may be defined as the number of neutrons (pe) which would have to be added to the atom of the same atomic number, but of zero isotopic number, to give the composition of the nucleus. Thus the formula of any nucleus would be $(p_2e)_M(pe)_n$.

It is of interest to note that most atoms have an isotopic number 0, but that their abundance decreases rapidly to isotopic number 1, which includes sodium, aluminium, and silicon, decreases again to isotopic number 2, and becomes almost zero in isotopic number 3. With isotopic number 4 the abundance rises again to a secondary maximum, and then decreases again (Fig. 1). Thus there is a certain correspondence between isotopic numbers which differ by 4, or by the formula p_4e_4, which may be assumed to represent an α-particle *plus* two cementing or β-electrons. The relations of the light atoms are thus very similar to those of the radio-active atoms.

It may be of interest to note that during an α-change there is no change in the isotopic number; in a β-disintegration the isotopic number decreases by 2. Of these two units one is due to the decrease of the number of negative electrons in the nucleus by one, and the other to the resultant increase of the atomic number (M) by one. The addition of a proton to a nucleus would increase the atomic number and decrease the isotopic number by one each. Thus the addition of a positive electron to the nucleus of Mg 12_2^{26} would give 13_1^{27}, which is ordinary aluminium.

The negative electrons in atom nuclei seem to be usually associated in pairs. Thus in the β-disintegrations of the radio-active elements two electrons escape in succession. This pairing may explain the fact that while most atoms have the formula $(p_2e)_M$, with M an even number, extremely few have the same formula when M is odd. Thus if p_2e should prove to be the primary group in atom-building, nevertheless the most abundant group in existing nuclei would be expected to have the formula (p_2e) or that of an α-particle. WILLIAM D. HARKINS.

University of Chicago, February 4.

Light and Electrons.

WITH reference to Sir Oliver Lodge's letter in NATURE of April 7, some few weeks ago I fitted a flat speculum mirror to a centrifuge capable of being run at 150 revolutions per second. The other arrangements—not yet completed—are as follows:—The image of a brightly illuminated slit is focussed on the mirror; a second slit is placed at a distance of about 10 metres.

(1) The eye is placed behind the second slit and the centrifuge increased in speed until the flash is no longer seen. If the slits are 1 mm. wide a duration of flash of 10^{-7} sec. is attainable. If necessary, the radius of the rotating beam may be increased.

(2) The eye is replaced by a photographic plate. This is a test for electrons released from the sensitiser. Below a certain duration of flash there should be no latent image formed, however often the flash is repeated.

(3) A light-sensitive photo-electric cell is also tested. In this manner Mr. J. H. Poole and I have planned to test the very point raised by Sir Oliver Lodge, and also to seek for evidence respecting the quantum theory of vision.

At present there is only this much to go on. It is stated (Halliburton's "Physiology") that a flash of $1{\cdot}25\times10^{-7}$ sec. duration is still visible. This (if it is the limit) affords a length of 4×10^3 cm. for the length of the train of waves activating an electron in the retina. If it is allowable to go further we find the energy of a single wave (of green light) to be about 6×10^{-20} erg. J. JOLY.

Trinity College, Dublin, April 8.

Molecular Structure and Energy.

THE question which Prof. Partington raises in his letter under the above title in NATURE of April 7, p. 172, is an important one which I would prefer should be answered by others more qualified to do so than myself. I intervene principally to correct the impression given in the letter that the structures of the various molecules with which I have dealt in recent communications have been proposed by me. This is not so. All that I have done is to show that the structures of certain polyatomic molecules, including some halogen gases, carbon dioxide, and nitrous oxide, postulated by Lewis and Langmuir are consistent with viscosity data and X-ray crystal data taken together. The procedure deals with the *external* shapes of the molecules only, and not with the internal energy of their nuclei; and it appears to be justified by the calculations of Prof. S. Chapman (Phil. Trans., vol. ccxvi., p. 347), who says: ". . . the internal energy which prevents the application of our formulæ to the conductivity of polyatomic gases hardly affects viscosity."

Prof. Partington's views appear to be open to criticism even if we leave out of account entirely the necessity for revising earlier ideas of energy partition on the basis of the quantum theory. For example, Langmuir's proposed structure for the nitrogen molecule is not spherically symmetrical in the same sense as are the atoms of the inert gases. There are *two separate* massive nuclei instead of one, and this involves the possibility of rotational internal energy of the same type as in the oxygen molecule, so that the ratio of the principal specific heats could not be expected to be so high as 1·667. Also, is it not possible, indeed probable, that the nuclei of all polyatomic molecules are capable of vibration to and fro? Such motions are, I believe, known to exist in the gaseous hydrogen halides, as well as the rotations to which attention has recently been directed by Prof. W. L. Bragg and Mr. H. Bell (NATURE, March 24, p. 107). A. O. RANKINE.

Imperial College of Science and Technology, April 7.

The Normal Orbit of the Electron in the Atom of Mercury.

RESEARCHES on ionisation and resonance potentials of mercury vapour and on its ultra-violet absorption in a non-luminous state, together with considerations from the serial type of the mercury spectrum, lead to the definite conclusion that in the absence of exciting agencies the spectral electron remains on the orbit 1S, the normal orbit of the atom of mercury. On the other hand, R. Dearle has shown the presence of a strong infra-red absorption band at $\lambda=10140$, and this fact has suggested the possibility of a second normal orbit in the mercury atom, namely, the orbit 2P. The corresponding ionisation and resonance potentials have, however, never been observed. This problem induced us to make an absorption experiment with non-luminous mercury vapour in the infra-red region, using a photographic method which enabled us easily to reach $\lambda=11300$ Å. All the photographs showed complete absence of a marked absorption at $\lambda=10140$, although the pressure of mercury vapour reached 1 atm. The efficiency of the method having been established, the absence of a strong and characteristic absorption of $\lambda=10140$ by mercury vapour has been shown and the necessity for a second normal orbit is avoided. A. TERENIN.

Optical Institute, Petrograd, December, 1920.

Doublets in Spectral Series.

THE physicists of Petrograd have recently become acquainted with a paper by Wood and Mohler (*Phil. Mag.*, April, 1919) on resonance in sodium vapour.

When the excitation is produced by D_1, the ratio of intensities of the two resonating lines D_2 and D_1, which is very small when the temperature and density are low, rapidly increases to its normal value 2 with the number of atomic collisions per second. This number is thus given statistical significance. Until now there has been no strong evidence (Wood, 1914) as to its invariability at higher temperatures and pressures.

Special investigations on this subject made in 1915 and 1917, and published in Russia, appear to be unknown abroad. The dispersion of the vapour of alkali metals was studied in 1915. For all the first doublets of Na, K, Rb, and Cs the same value 2 was obtained, and it remained constant in spite of a hundredfold density variation; for the second doublets the numbers are simple, but different: 2 (?), 2, 2·5, 4. The numbers 3 and 7 (?) were measured for the third doublets of Rb and Cs. Mr. Touroverow (1917) found the same number 2 for the first sodium doublet at the temperature of the arc. There is, therefore, no doubt now as to the constancy of all the above numbers. The experiments on resonance thus show that the statistical value in question first grows rapidly with the temperature and approaches a limiting value, essentially constant. This behaviour has a certain analogy to that of specific heat as caused by departure from equipartition.

D. ROGESTVENSKY.

Petrograd University Physical Institute,
March.

The Resonance Theory of Hearing.

THE discussions which appeared in NATURE in 1918 (vol. cii., pp. 124, 164, 184) on the theory of hearing showed that the opinion has been gaining ground lately that the resonance theory can no longer be regarded as unassailable. The following observation, which is readily explicable if there are resonators in the internal ear, would appear to be inexplicable if there are not:

If the phase of a continuous musical note be suddenly altered by suitable means by π, then the observer hears the sound rapidly die away, to return a moment later with its former intensity. The experiment was performed as follows:

A De la Tour siren was so modified that the wind-chest could be given suddenly a small rotation about the same axis as that of the siren disc. The rotation was limited by fixed stops, so that the angle turned through was equal to one-half the angle between two of the air-holes. In the writer's instrument there were eighteen holes arranged on the circumference, *i.e.* 20° between two of the holes, and the wind-chest was therefore arranged to rotate through 10°. If, then, this rotation is suddenly effected with the siren in action, a change in the phase of the note of π will be introduced; since, if the rotation of the wind-chest be in the same direction as that of the disc, the time-interval between the puffs of wind through the disc will be $1\frac{1}{2}$ times as great as the normal, because the disc has to rotate through $20^\circ + 10^\circ$; if, on the other hand, the rotation of the wind-chest be in the opposite direction to that of the disc, the time-interval will be one-half the normal, since the disc has to rotate through $20^\circ - 10^\circ$. Each time, then, that this change of phase of π is brought about by rotation of the wind-chest of the siren the observer hears a beat in the musical note. The sound intensity first falls to a low value, then rapidly rises somewhat above the original level (possibly due to successive contrast), and then returns and stays at the normal intensity. To show that the beat is not of mechanical production the following tests may be applied:

(*a*) No beat is produced if the wind-chest is rotated slowly.

(*b*) No beat is produced if, with the disc in rotation, the air-supply be quickly turned off and the wind-chest then rotated suddenly in either direction.

(*c*) The beat can be heard as clearly at a considerable distance from the instrument as it can quite near to it.

(*d*) If the rotation of the wind-chest is less than that required to change the phase by π, the beat or temporary waning of the note is correspondingly smaller in intensity.

This temporary waning of the note is readily explained by the resonance theory, because the change in phase will put the later vibrations exactly out of step with those that preceded, and therefore the resonators of the internal ear which are set in vibration by the note will on change of phase first be brought to rest and then be set going again. The temporary waning of the note is therefore readily explained on the resonance theory. Can any of your readers advance an explanation on any of the displacement (*e.g.* Wrightson's) hypotheses of hearing?

H. HARTRIDGE.

King's College, Cambridge, March 21.

Sexual Organs of Phytophthora.

ATTENTION was directed in NATURE of April 30, 1914 (vol. xciii., p. 226), to the discovery of a rather remarkable mode of development of sexual organs which occurs in certain species of Phytophthora, and was first found in *P. erythroseptica* and then in *P. infestans*, the "potato-blight" fungus. Several other species of the genus are now known to produce sexual organs in this novel fashion, in which the oogonial incept penetrates the antheridium at an early stage, traverses it, emerges, and then swells to form the oogonium proper within which the oospore ultimately develops. It was suggested then that those previously well-known species (such as *P. cactorum*, etc.) in which the antheridium and the oogonium lie side by side, and penetration of the latter by the former occurs laterally, should be excluded from the genus Phytophthora and be placed in a new one, Nozemia. A species (from decaying apples) has now been isolated by Mr. H. A. Lafferty, working here, in which the sexual organs are developed mainly according to the Nozemia type, but occasionally and simultaneously in the same individual according to the Phytophthora type, with amphigynal antheridia. This species, therefore, forms a connecting link between the two groups; and it would seem no longer necessary or desirable to retain the generic name Nozemia.

The object of this letter is to suggest to the various mycologists who are now working with Phytophthoras that they should keep a very careful look-out in cultures of species of the *Cactorum* or *omnivora* (Nozemia) type for the occasional occurrence of sexual organs with amphigynal antheridia; for it seems quite possible that these may be present in such species and have merely been overlooked by previous observers owing to their relatively infrequent occurrence.

I should be very grateful for sub-cultures of any species of Phytophthora that mycologists who have them could spare for further study of this point, and happy to send any I possess in exchange if desired.

GEO. H. PETHYBRIDGE.

Royal College of Science, Dublin, April 7.

Stellar Magnitudes and their Determination.[1]

By H. SPENCER JONES, Chief Assistant, The Royal Observatory, Greenwich.

III.—ABSOLUTE MAGNITUDES.

THE absolute magnitude of a star is a measure of its intrinsic luminosity. In order to determine it, the distance of the star must be known. Star distances are so great that it is customary and convenient to express them in angular measure by means of the angle (ϖ) subtended at the star by the radius of the earth's orbit, supposed viewed broadside on from the star. If I is the apparent luminosity of a star at its actual distance, then the apparent luminosity when placed at any definite fixed distance from the sun will give a true relative measure of its intrinsic luminosity: its apparent luminosity being then I/ϖ^2, its absolute magnitude must differ by a constant from

$$-2{\cdot}5(\log I - 2 \log \varpi),$$

or from $m + 5 \log \varpi$. There is not entire uniformity amongst astronomers as to the constant distance to which stars must be considered as placed in order to obtain a definite measure of their absolute magnitude; this non-uniformity is not serious, provided the convention adopted is always explicitly stated. The most common practice is to define the absolute magnitude as the value of the apparent magnitude when the star's parallax (ϖ) is one-tenth of a second of arc. If, then, ϖ is expressed in seconds, the absolute magnitude, M, is given by

$$M = m + 5 + 5 \log \varpi.$$

If, on the other hand, a distance corresponding to a parallax of $1''$ is adopted as the standard, the absolute magnitude is given by

$$M = m + 5 \log \varpi.$$

The magnitude m may be either the visual or the photographic apparent magnitude, although it is more general to use the former. There will be a relative difference in the absolute magnitudes of two stars of different colours according to which apparent magnitude is used. To define absolute magnitudes without any ambiguity, it would be necessary to use a bolometric magnitude which would take account of all the energy emitted by the star, whatever its wave-length might be.

The intrinsic luminosity of a star may also be expressed in terms of the luminosity of the sun as a unit, a means of expression which conveys more meaning to the average person. Various measures have been made of the apparent magnitude of the sun, on the scale used for the stars, and the most probable value is now accepted as $-26{\cdot}5m$. This corresponds to an absolute magnitude for the sun of $5{\cdot}1M$ or of $0{\cdot}1M$, according as the distance used in defining absolute magnitude corresponds to a parallax of $0''{\cdot}1$ or $1''$ respectively. These values are uncertain to the same extent that the value of the apparent magnitude is uncertain, and are, therefore, liable to future revision. As it is not advisable that the value of a star's luminosity, in terms of the sun's luminosity as a unit, should be liable to frequent change, it would be preferable to adopt a value $-26{\cdot}6m$ as the apparent magnitude of a hypothetical sun, nearly equal in brightness to our sun, and having the same position in space, and then the absolute magnitude of this hypothetical sun becomes $5{\cdot}0M$ or $0{\cdot}0M$, according to the unit of distance adopted. If a distance corresponding to $1''$ (called by general acceptance a *parsec*) is adopted as the unit, then the absolute magnitude will give a direct measure of luminosity in terms of the sun's luminosity as unit, the luminosity being then simply the antilogarithm of $-0{\cdot}4M$. The convenience of having the zero of absolute magnitude to agree with the brightness of the sun is so great that, in spite of the much more general acceptance hitherto of the scale of absolute magnitudes based on a distance of 10 parsecs ($\varpi = 0''{\cdot}1$), the time does not seem too late to change the convention. The matter is one which deserves the attention of the International Astronomical Union.

Since the determination of absolute magnitudes necessarily involved, until recently, the determination of the distance of a star and also of its apparent magnitude, and since the former of these quantities is small and liable to a relatively large error in its determination, it follows that absolute magnitudes could be determined only with a much greater uncertainty than attached to determinations of apparent magnitude. Fortunately, we are not dependent for our knowledge of absolute magnitudes simply and solely upon direct trigonometrical determinations of stellar distances; methods have been devised of recent years by which the problem may be attacked by somewhat indirect means.

One particularly interesting method has been worked out at the Mount Wilson Observatory, mainly by Adams, who succeeded in detecting differences in the relative intensities of certain lines in the spectra of various stars of a given spectral type. These spectral differences within the same spectral type are due to differences in density or in surface brightness or both, and indicate differences in absolute magnitude. By using the best determined trigonometrical parallaxes, Adams was able to standardise these relative intensity differences in terms of absolute magnitudes; and using the standardised basis so found, it becomes possible to determine the absolute magnitudes of stars simply from an examination of their spectra. Since the basis of these determinations is the collective results of direct parallax measures, the result for any given star is liable to a much smaller uncertainty than would be the result derived from a direct determination of the parallax of that star, provided the star is at such a distance that the

[1] Continued from p. 176.

uncertainty in the parallax determination begins to become comparable with the value of the parallax (say, $\varpi < 0''.025$ in the case of modern photographic determinations). Adams, therefore, has replaced the determination of each single parallax by a collective result, and has, in effect, reversed the former procedure, so that now, from a determination of the absolute magnitude and the apparent magnitude, the parallax may be derived with a high order of accuracy.

Another indirect method, discovered independently and almost simultaneously by Hertzsprung and Russell, enables a hypothetical value to be derived for the parallax of any physical double star of which the components show even a trace of relative motion. If w is the observed relative motion in seconds of arc per year and s the observed separation of the components in seconds of arc, then the parallax is given by $\varpi^2 = sw^2/14{\cdot}6m$, where m denotes the combined mass in terms of that of the sun as a unit. The masses of the stars do not show a wide variation, and Russell finds that, assuming the mass of the binary system to be double that of the sun, the resulting error in the absolute magnitude deduced from this hypothetical parallax will not exceed $\pm 1{\cdot}0$M in 89 per cent. of all the cases.

A third method of some interest may also be briefly referred to. There is a type of variable star the light variation of which is characterised by certain peculiarities which seem to indicate that the variation is due to an actual pulsation in the star. Such variables are termed Cepheids, after the typical example, δ Cephei. In the Magellanic clouds is a large number of these variables, and it was discovered by Miss Leavitt that there is a definite relationship between the periods of these Cepheids and their apparent magnitude, or, since they are all at appreciably the same distance, between their period and absolute magnitude. Their absolute magnitude, however, is not *a priori* known, but the near Cepheids may be used to fix a point on the curve, and then the absolute magnitude of any Cepheid can at once be found if its period is determined. This has the following important application: the large majority of the variables which occur in stellar clusters are of the Cepheid type, and this relationship, therefore, provides a basis for the determination, with a relatively small uncertainty, of the distances of stellar clusters. The result is the more valuable because the clusters are at such great distances that there is, at present, no reasonable expectation of the possibility of their direct determination. With the aid of the large reflectors at Mount Wilson, much valuable work has been done in determining the apparent magnitudes of cluster stars and, the parallax of the clusters

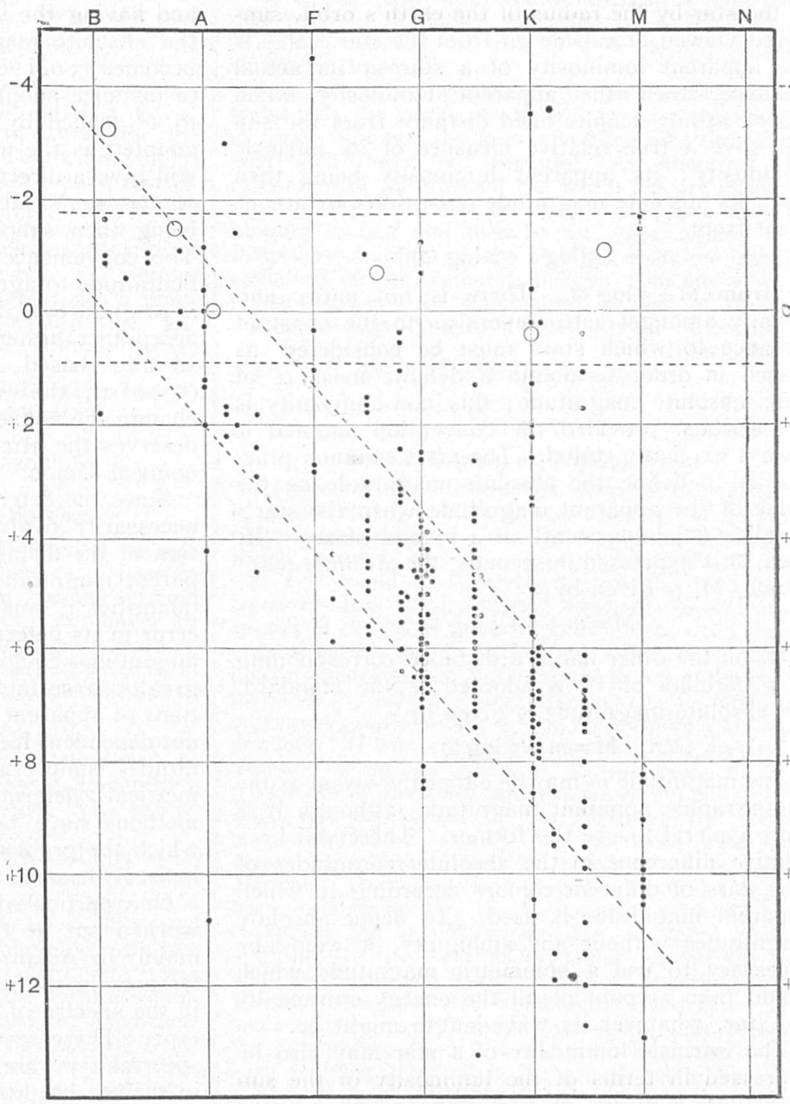

FIG. 6.—Absolute magnitudes of stars in relation to spectral type.

having been determined, these can at once be turned into absolute magnitudes.

It will be evident from the preceding remarks that our knowledge of the absolute magnitudes of stars has within recent years increased very rapidly. What are the absolute magnitudes of the stars in the neighbourhood of the sun? The values show a very marked dependence upon the spectral type of the star. It was shown by Russell that for any given type there is a limiting absolute magnitude below which, in general, stars of that type do not occur. The redder the star, the fainter may its absolute luminosity be. One of Russell's diagrams, in which the absolute magnitudes are referred to a distance of 10 parsecs, is reproduced in Fig. 6. In this diagram the small dots represent individual stars, the large circles mean values for bright stars of small proper-motion and parallax. It will be seen that the general distribution of the dots is along two lines inclined at an acute angle and intersecting at type B; that this distribution is not the result of the selection of stars for parallax determination on the ground of brightness or size of proper-motion was conclusively shown by Russell. It will also be seen that for the red stars there is a complete separation between the two classes, so that a very red star is intrinsically either very bright or very faint. These facts have given rise to the "giant" and "dwarf" hypothesis, and have led to a recasting within the last few years of the ideas as to stellar evolution which were formerly generally accepted.

The following results emerge from Russell's investigation: (1) Stars of all types occur brighter than zero absolute magnitudes,[2] and mostly between 0 and −2M—say, about 150 times the luminosity of the sun. These are called "giant" stars. (2) There are no B-type stars, and very few A-type stars, fainter than zero absolute magnitude, or, in other words, all the white stars are intrinsically very bright. (3) All the faint stars, less than, say, 1/50 the luminosity of the sun, are red and of types K and M. These are called "dwarfs," and comprise all the near stars of large proper-motion. (4) In the intermediate classes, F and G, there is no separation between the giants and the dwarfs. Our sun (5·0M) is a typical G-type star. In view of these remarks, it is obvious that no precise meaning attaches to a statement such as "The average absolute magnitude of all stars is +2·7M."

[2] The unit of absolute magnitude used here is that which corresponds to a parallax of one-tenth of a second of arc.

Shapley's work on the magnitudes of stars in clusters, combined with his determination of the distances of clusters, has shown that the giant stars in clusters, which are the only ones sufficiently bright to appear on the photographs, are of about the same magnitude as the giant stars in our more immediate neighbourhood. Two further points of interest emerge from the investigation: one is that in all the clusters examined in detail the intrinsically brightest giant stars are red stars; this may also be true for the stars near the sun, although the determinations of their absolute magnitude are probably not sufficiently accurate to show it; the other point is the apparent importance of an absolute magnitude of about −0·2M. Shapley finds that all Cepheid variables and cluster variables exceed this brightness; moreover, in the luminosity curve which connects the number of stars of any given absolute magnitude with the magnitude, there is a maximum in the curve corresponding to the same magnitude. In Shapley's opinion, this magnitude—corresponding to a luminosity of about 100 times that of the sun—indicates a critical stage in stellar evolution, and, in all probability, is of significance in the theory of a gaseous star. It seems, in fact, probable that by the new methods recently discovered for estimating great distances, combined with the advantages afforded by the large reflecting telescopes at Mount Wilson, we may learn more about absolute magnitudes from a study of clusters at distances corresponding to parallaxes of the order of 0″·00005 than from the study of the stars which immediately surround us.

Dynamics of Golf Balls.

THE physical principles underlying the flight of a golf ball were clearly laid down by the late Prof. Tait between the years 1890 and 1896.[1] In view of the present agitation over the standardising of the golf ball, it may be of advantage to reconsider some of the problems attacked by Tait and largely solved by him. The investigation led him into a series of researches on impact so as to obtain data for measuring the resilience of the material of which golf balls were then made. Also, by means of a specially constructed ballistic pendulum, measurements were made of the speed of a golf ball impinging on the pendulum placed at a distance of about 6 ft. from the tee. By attaching a tape to the ball, Tait was able to obtain direct measurements of the amount of underspin communicated to the ball at the instant of striking it. Outside observations were also made of the heights of the trajectories of well-driven balls, and of the ranges and times of flight. All these data were skilfully introduced into the mathematical discussion of the form of the trajectory, a problem so difficult as to be capable of solution only by approximate methods. This was done before the days of the rubber-cored ball, and the steady improvement in the manufacture of the golf ball has enabled even very ordinary players to exult in lengths of drive which in Tait's days were beyond the powers of the mightiest exponents.

[1] "On the Path of a Rotating Spherical Projectile," Trans. R.S.E., 1893 and 1896; "Some Points in the Physics of Golf," NATURE, vols. xlii., xliv., and xlviii.; "Long Driving," *Badminton Magazine*, 1896.

What Tait established beyond all controversy was that the range of the trajectory of a properly driven ball depended as much upon the underspin as upon the speed of projection. The combined effect of the linear speed and the rotation about a horizontal axis brought into play a force perpendicular to the direction of motion of the ball. Tait gave sound reasons for regarding this force as being proportional to the product of the velocity and the spin. Thus, although the possibility of a long trajectory depends primarily upon the velocity of projection, the range actually attained in any particular case will be governed by the amount of underspin communicated to the ball. If this is too great, the ball will rise too high, and the range will be correspondingly diminished. If the underspin is too small, gravity will predominate and pull the ball more quickly down to earth, with resulting diminution of range. For every velocity of projection of the ball which leaves the tee in a horizontal direction there will be a best value of underspin enabling it to attain the greatest range in still air. The art of the golfer is to manipulate his club so as to give this necessary amount of underspin.

It is probably not realised by many efficient golfers how much this underspin may be varied by small changes in the position of the line of stroke of the club as it hits the ball. Let us take Tait's maximum estimate of 120 revolutions or about 750 radians per second as the value of the underspin, and consider how far below the centre of mass of the ball the line of impulse must be so as to send the ball off with this spin and a speed of 300 ft. per second. The ball is supposed to be hit horizontally off the tee without any reactionary upward or backward impulse acting on it. The distance x below the centre of mass at which the line of impulse must act so as to give this combination of linear speed and spin has the value $x=k^2\omega/v$, where k is the radius of gyration of the ball, and v and ω are the speed and spin respectively. With $k^2=0{\cdot}276$ in.^{2}, and $v=3600$ in./sec., we find $x=0{\cdot}054$ in. A variation of one-hundredth of an inch in this value will change the spin by nearly 20 per cent. Such variations may easily be effected by very slight changes in the lie of the club head.

With a given ball the velocity of projection and the spin are the only factors which are under the control of the player. Once the short time of impact between the club face and the ball is completed, nothing the player can do can influence the flight of the ball. Thereafter all is determined by the combined influence of gravity and the air.

So far as the player is concerned, the velocity of projection depends mainly upon the velocity of the club at the moment it strikes the ball. The weight behind the stroke no doubt has a secondary influence, but the great thing is the *swiftness* of the stroke. For this reason experience has evolved a weight of club which is found most serviceable for the strength of the average man. In an ordinary driver, weighing (say) 1 lb., probably one-third of the weight is in the club head; and if we were to think of the problem as one of simple impact between two masses of which one is at rest, we might work out the relative velocities of club and ball after impact for an assumed value of the coefficient of restitution. But the conditions of the problem are not so simple. The player, by the swing of his body and arms and well-timed effective wrist play, not only imparts a rapid acceleration to the club head up to the moment of impact, but in all probability imparts, unconsciously, perhaps, but none the less effectively, an acceleration *during the time of impact*, short though that be. In spite of the back impulse on the club as it is striking the ball, its velocity is kept up by the unconscious knack of the player. The relative velocity with which the ball leaves the club is e times the momentary velocity of the club, where e is the coefficient of restitution, and hence the velocity of projection will be $(1+e)$ times the velocity with which the club is moving at the instant club and ball separate.

Outside the factors over which the player has some control, the most important is the resilience of the ball, and the steady improvement in this quality is, of course, at the root of the great increase in lengths of drive. It was this question of resilience which, indeed, started Tait on his investigations on impact. The apparatus designed by him for the purpose was nicknamed the "guillotine." It consisted fundamentally of a weight which, guided by upright parallel slots, was dropped on the ball or other body the elastic properties of which were under investigation. The heights reached by the weight after successive rebounds were recorded automatically on a rotating disc $2\frac{1}{3}$ ft. in diameter. From the record all the facts of the impact could be derived more or less directly, such as the compression of the ball, the duration of the impact, and the value of e, the coefficient of restitution. The weight was made of wood, but its lower face could be, when required, shod with an iron plate.

The recording part of the apparatus has long been dismantled, but the "guillotine" part is still serviceable. In order to compare the values of e for modern golf balls with the values obtained thirty years ago by Tait, impact experiments were recently carried out on sixteen balls of recognised merit—namely, various types of Avon ball, Challenger, Clincher Cross, Dunlop, Silver King, and Spalding. Thanks are due to the Avon India Rubber Co., Ltd., J. P. Cochran, Ltd., North British Rubber Co., Ltd., Dunlop Rubber Co., Ltd., and A. G. Spalding and Bros., Ltd., for their kindness in supplying specimens of balls of the best quality. With the exception of five, all were of greater diameter than the new standard minimum, and only two exceeded the maximum standard weight. Their specific gravities varied from 1·07 to 1·29. On each of these balls the weight of 4·75 lb. was allowed to fall from a height of 9 ft., and the height of the first rebound was noted. The square root of the ratio of these heights gave an approximate value for e, and this was corrected by comparison with Tait's results, which showed that under the conditions of the experiment the ratio of the speeds immediately after and immediately before the impact was greater than the estimate from the corresponding heights by about one-ninth. The average value of e for the sixteen balls mentioned was 0·72, the lowest being 0·71, and the highest 0·75. Tait obtained for the balls he experimented with the value 0·66. He estimated 300 ft. per second as a fairly probable value for the velocity of projection. On the assumptions indicated above, this would imply a velocity of projection of 311 ft./sec. for the ball with coefficient of restitution equal to 0·72.

This does not seem to indicate any very marked superiority in the modern ball—at least, it cannot explain the greatly increased length of drive attainable in these days. The reason is to be sought in the fact that the conditions of constraint under which the impact experiments are made are essentially different from those under which a golf ball is compressed and distorted as it is propelled freely in its flight. Everyone knows that the high resilience of the rubber-cored ball is derived from the fine rubber thread which is wound on under considerable tension. Before the outer covering is put on, these balls, when dropped from a height of 6 ft. or 7 ft., rebound from stone or metal to a height which indicates that the coefficient of restitution exceeds 0·8. When we consider the manner in which this complex of tightly wound rubber resists any sudden distortion produced by a short-lived blow, we shall probably be prepared to admit that such an elastic complex will resist compression more powerfully than an equal sized ball of vulcanised india-rubber, which Tait found to have a coefficient of restitution greater than 0·8. Any impulse brought to bear upon one part of the rubber-wound ball will produce in every strand of the rubber thread an immediate tightening with corresponding resistance to change of shape.

Let us suppose, then, that, under these conditions, the coefficient of restitution approaches the value unity, say 0·95. If the old gutty with coefficient of restitution 0·66 was propelled with an initial velocity of 300 ft./sec., then this ball, with coefficient of restitution 0·95, will be projected with initial speed of 356 ft./sec. This by itself will not account for an increase of 70 or 80 yards in the length of drive, for, as pointed out by Tait, a greater initial speed means a greater air resistance; and (other things being the same) to add 83 yards to the length of a drive means double the velocity at start. But here, again, we may invoke the influence of the underspin. As already stated, there is for every velocity of projection a definite value of underspin which will enable a given ball to travel its farthest range. Since the upward force produced by the combined action of the linear velocity and spin depends on both these factors, an increased velocity of projection will have to be associated with an increased rate of spin if its greatest range is to be attained. The problem is one which would well repay working out in detail.

If great length of drive is a desideratum in the game of golf, then undoubtedly the "floater" must give way to the heavy ball. This is a simple illustration of the well-known law of atmospheric resistance, the effect of which upon a sphere passing through the air is directly proportional to the surface, and inversely proportional to the mass. The accurate driver finds by experience that a heavy small ball travels farthest through the air. For example, if we make a floater of density unity and of the maximum weight, its diameter will be 1·75 in. The retarding effect of the resistance of the air on this floater will be 17 per cent. greater than the retardation experienced by the new standard ball of minimum size and maximum weight. Again, if we make a floater of the minimum size, its weight will be only 1·28 oz., and it will experience a retardation due to atmospheric resistance which will be nearly 27 per cent. greater than that experienced by the standard "minimax," to use a word introduced long ago by Kelvin in a different connection. The "minimax" itself experiences slightly less atmospheric resistance than most of the balls mentioned above, being excelled in this respect only by Dunlop 31, Spalding Midget, small Avon de Luxe, and Silver King; but the difference never reaches 2 per cent. It is therefore not surprising that long driving is also attainable with the standard "minimax" ball.

A reference has been made to the radius of gyration of a golf ball as a factor influencing the amount of spin communicated to the ball. The square of the radius of gyration of a uniform sphere is $\frac{2}{5}r^2$, where r is the radius of the sphere. By means of oscillatory experiments, in which the golf ball was supported by a ring-shaped disc hung by a tri-filar suspension from three fixed points, the moments of inertia and radii of gyration of all the golf balls used were determined to an accuracy of about 1 per cent. The moments of inertia expressed in grams and centimetres varied from 86 for the Large Heavy Avon to 66 for the Standard Clincher Cross, and yet the mass of the latter was slightly the greater, being 45·4 grams (1·60 oz.), as compared with 44·6 (1·57 oz.). This great difference in the moments of inertia depends on the distribution of matter within the ball. The value of k^2 for the larger balls was practically the same as the value $\frac{2}{5}r^2$ for the uniform sphere of equal size; but in the case of the small balls k^2 was markedly less than $\frac{2}{5}r^2$, being in some cases as much as 8 per cent. smaller. The reason is that the small balls have a very dense core. It is obvious that with the larger moment of inertia a greater moment of impulse must be given to obtain the same spin. But this is automatically effected, since with the same club the larger ball is struck along a lower line relative to the centre of mass, so that the moment of the impulse is of necessity greater. During the flight of the ball the larger moment of inertia will enable the ball to conserve its spin the better, which will probably have a beneficial effect on the range or carry.

It appears, then, that the length of drive attainable depends on several factors, and of these the most effective are the resilience of the ball and the underspin given at the instant of impact. To drive a long ball is one of the delights of golf, and the ball which travels farthest will be the favourite. By almost all young and vigorous players the floater, because of its lightness, is regarded unfavourably. It lacks, comparatively speaking, steadiness in the air and accuracy on the greens, and cannot possibly be driven so far. It is little wonder that the heavy ball has ousted it in all serious play.

It is not the purpose of this article to touch on the question of standardisation of the golf ball. Its aim is to discuss the physical principles which govern the flight of the ball through the air. But the physiological and psychological powers or weaknesses of the player are of equal importance. There is a limit to the weight of club which can be most efficiently used by the average man, and there must also be a limit to the weight of the ball. From the point of view of atmospheric resistance, the ratio of the surface to the weight must be kept as low as possible; but too small a surface will diminish the lifting power of the underspin, just as too large a weight will cut down the velocity of projection. The one quality which must be as perfect as possible is the resilience of the material; but no ball can have a higher coefficient of restitution than unity, and therefore no ball can start on its flight with a velocity greater than twice that of the club head at the instant of impact. Physical and physiological considerations necessarily fix a limit to the range of flight attainable, and probably that limit is now being approximated to. Which, then, is simpler—to standardise or to re-arrange our golf courses?

C. G. K.

Nature in a Himalayan Valley.[1]

By LT.-COL. J. H. TULL WALSH.

WE have here the notes made by an officer of the Indian Medical Service in the Hazara valley of the foot-hills, during the years 1914–16. These observations are wide in their range, and were, no doubt, a relief to more serious work. The author is an amateur naturalist, far from works of reference and museum specimens, and the opinions are strictly personal. No man can possess full knowledge in all the branches of science alluded to—for there is compilation as well as observation in this book—but Capt. Hingston has acknowledged his borrowings. The ordinary lover of Nature, who likes a pleasantly written account of geology and animal life in an area not well known to many, will enjoy this book, ignoring opinions with which he may not agree, and errors which the technical naturalist would claim as serious. The general features of the Hazara valley are shown on the map facing p. 4. It is a "slender wedge of British soil" about 120 miles long, its width varying from 56 miles at the base of the wedge to 15 miles at the apex. "To the south its foot-hills sink into the plains of the Punjab; to the north it rises into massive peaks 17,000 ft. in height that blend with the still loftier summits of western Kashmir."

The first five chapters are devoted to ants, harvesting ants, a species placed in the genus Mymecocystus, and others. Habits, etc., are freely discussed, and a great deal is written concerning instinct. The author asks too much from instinct, and "folly" (p. 41) is scarcely the correct word to apply to mistakes which are not provided for among instincts inherited by insects. Two plates (facing pp. 13 and 60) are given of certain ants commonly found in the Hazara valley. While on the subject of plates, we think it would have been better to give them numbers. The illustrations themselves are excellent, as our examples prove.

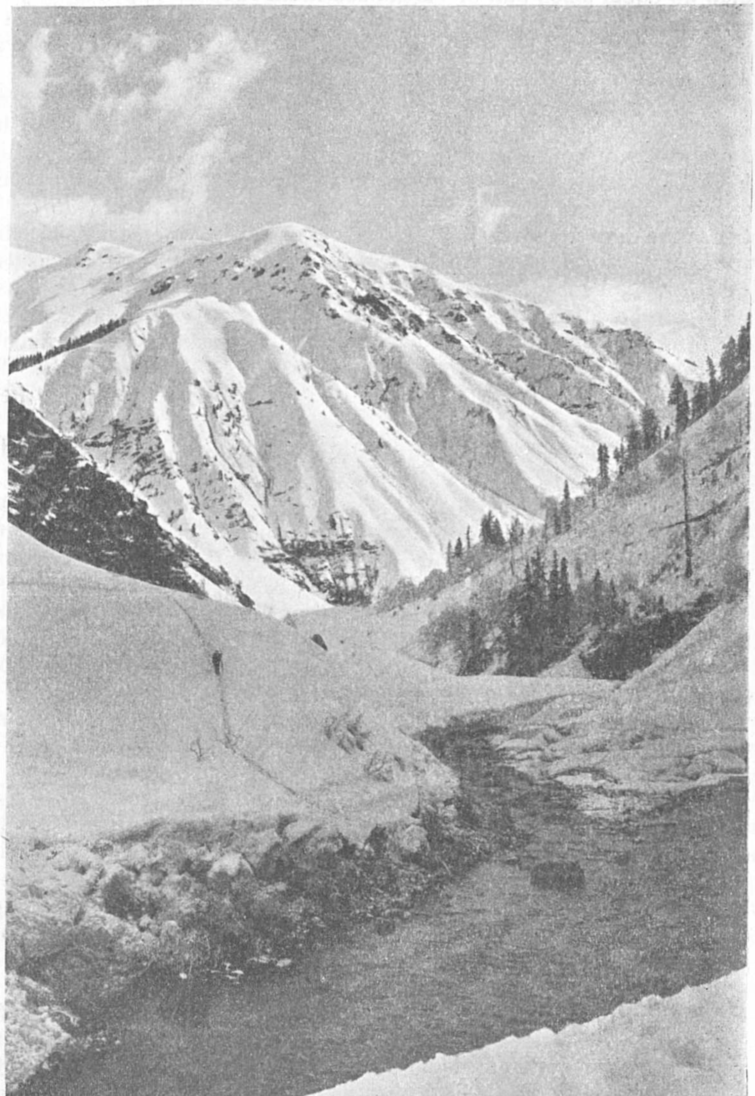

FIG. 1.—In the Himalaya. From "A Naturalist in Himalaya."

[1] "A Naturalist in Himalaya." By R. W. G. Hingston. Pp. xii+300+plates. (London: H. F. and G. Witherby, 1920.) 18s. net.

Chaps. vi.–x. deal with geometrical and sheet-building spiders, their work and habits. The miscellaneous contents of chap. x. include "water-boatmen" and "mentality of fishes," as well as the habits of wasps and bees. Interesting observations on mimicry in butterflies—chap. xi.—include *Kallima inachus* and a Melanitis, which, like Kallima, resembles dry leaves blown by the wind; and these are compared with *Dophla patala*, which, "coloured a rich green," blends with the fresh foliage; "the Dophla alights where it is lost upon the branches, the Melanitis seeks concealment on the leaf-strewn ground; the Dophla rests with wide-open wings . . . Melanitis with wings tightly closed." Glow-worms, termites, and shells receive attention in chap. xii. Few will agree that the male glow-worm is "not even capable of perceiving a light" given out by the female; and on the pages where the massacre of a flight of winged termites is described there is much repetition of the names of various birds taking part in the orgy. We do not like the somewhat Teutonic view that in Nature "all is war and carnage, greed and cruelty." Animals, including man, must destroy life for food, and no doubt there is even unnecessary killing by some of the carnivora; but, on the whole, Nature is fairly peaceful, and among many orders the unfit are removed in honourable battles between males, while bloodless competition by dance or song governs selection in others.

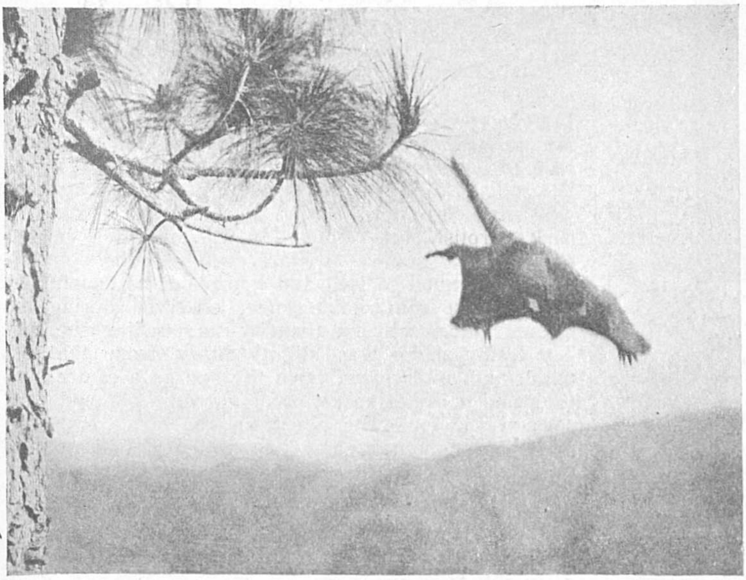

FIG. 2.—The Flying Squirrel (*Petaurista inornata*). From "A Naturalist in Himalaya."

Among the observations of mammals, that concerning the flying squirrel is very interesting, and the author gives us a beautiful picture—here reproduced (Fig. 2)—of *Petaurista inornata*. The only comment necessary is upon the statement (p. 243) that "the tail of a bird cannot be used as a rudder." Most readers will take the opposite view. Chap. xiv. contains the best account of soaring we have ever read, and the explanation will be welcomed by many who may not be able to observe the phenomenon for themselves. The book ends with a sketch of the geology of the Himalaya based on the work done by the Geological Survey of India. The author acknowledges his indebtedness to the labours of Mr. C. S. Middlemiss.

The Annular Eclipse of April 8.

By DR. A. C. D. CROMMELIN.

FINE weather in most parts of the country favoured observation of this phenomenon. Great public interest was taken in the search for stars. Venus was seen with ease nearly everywhere, Mercury was also undoubtedly observed, and Vega was suspected at Oxford, though not seen by Mr. Mitchell at Mallaig, which is inside the zone of annularity. The lowering of temperature was marked, amounting to as much as 9° F. The diminution of light was striking, probably more so than if the sky had been partially covered with cumulus clouds. The light had the purplish hue that so often prevails in large eclipses; it doubtless arises from the absorption of the solar atmosphere, which is more noticeable in the region near the limb. Successful spectroscopic observations of the reversing layer and chromosphere were made by Profs. Fowler, Newall, and Sampson at Kensington, Cambridge, and Edinburgh respectively.

At Greenwich efforts were made to improve the determination of contact times by Mr. Innes's method of making a number of rapid measures of the distance between the cusps near the beginning and end of the eclipse. The measures are not yet fully reduced, but it is probable that each contact will be determined within 2 sec. by the combined results.

It can already be stated that the Hansen-Newcomb right ascension of the moon needs to be corrected by about +0·80 sec., which is just double the correction that was applied in the Nautical Almanac eclipse elements. Several photographs were taken near the beginning and end of the eclipse, also near the greatest phase. One of the last, exposed at 8h. 48m. 2s., Greenwich mean time, is reproduced by kind permission of the Astronomer Royal. The second exposure on the plate was made in order to render a greater length of the reference wires visible; it was found very difficult to orientate the plates of the 1912 eclipse,

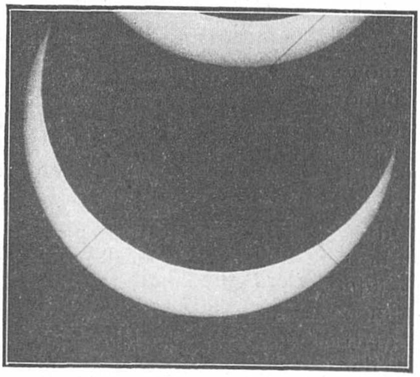

FIG. 1.—Partial solar eclipse one minute after greatest phase. Reproduced by permission of the Astronomer Royal.

owing to the small amount of the wires that was registered.

It is curious that the writers of many of the popular accounts of the eclipse speak of it as the only large eclipse visible in London in the last forty years, in forgetfulness of the still larger eclipse of 1912, for which also the weather conditions were favourable.

MR. ELBORN, one of the assistants in the Botany School at Cambridge, has made some interesting observations on the behaviour of leaves during the eclipse on April 8.

It is well known that the stomata (which are minute apertures in the leaves) are open in daylight and shut in darkness. These facts are demonstrable by means of a little instrument called the Horn hygroscope described in my paper "Observations on Stomata" (Phil. Trans., B, vol. cxc., 1898, pp. 531–621). It will be seen that as the eclipse came on the readings fell from 3·5 at 8.40 a.m. to 1·5 at 9.38—that is, the stomata closed considerably—and by 11.45 a.m. they had returned to their original condition, as shown by the reading of the hygroscope, viz. 3·4.

The plant used for the experiment was the common Tropæolum; the behaviour of its leaves is shown in the following table, the second column giving the readings of the Horn hygroscope:

A.M.		A.M.	
8.40	3·5	9.50	1·5
9. 5	3·2	10. 4	1·7
9.19	2·4	10.20	2·0
9.21	2·3	10.34	2·8
9.27	1·9	11. 1	3·0
9.32	1·7	11.45	3·4
9.38	1·5		

FRANCIS DARWIN.

Brookthorpe, Gloucester, April 11.

THE partial annular eclipse of the sun was well seen in a clear sky in Herefordshire (N. lat. 51° 56′, W. long. 2° 38′). The darkening of the landscape was marked, and the sky in the north assumed a dark purplish-blue colour. It was not dark enough to show any planets or stars even with field-glasses. Birds continued to feed and hop about as usual.

The most remarkable effect observed during the darkest phase was on the sky surrounding the sun. The atmosphere was slightly hazy from the east wind, and on the sky, from the sun as a centre, was projected a radiating series of narrow light and dark rays visible for quite 20° from the sun. It was a pretty phenomenon, and one which I had not observed before.

ELEONORA ARMITAGE.

Dadnor, Herefordshire, April 8.

DURING the maximum phase of the eclipse on April 8 the shadows thrown by trees on a footpath had a strange appearance, the details of boughs and twigs being broken up more or less completely into parallel crescents. At first sight the appearance suggested a modification of the dappled effect of sunlight falling through trees in summer; but the shadows of bare twigs were broken up in the same way, and such scanty foliage as the trees bore was far too thin to give rise to ordinary pin-hole images. Moreover, quite detached shadows were affected. The shadow of a narrow window-bar thrown on a floor was tagged out at each side so as to look like the shadow of a ragged feather from a pheasant's tail.

E. LEONARD GILL.

Hancock Museum, Newcastle-upon-Tyne, April 9.

Obituary.

PROF. S. W. BURNHAM.

PROF. S. W. BURNHAM, whose death is announced, was born on December 12, 1838, at Thatford, Vermont, U.S.A. His early profession was that of journalist and stenographer at Chicago. Burnham was, however, soon filled with a zeal for astronomical research, in particular double-star observation, in which department he was one of the greatest and most successful workers of all time. In 1870 he became the possessor of an excellent 6-in. refractor by Alvan Clark. In spite of his arduous professional work, he observed with this instrument nightly "till daylight drove him to bed." He discovered 451 pairs with it, nearly all difficult, and some of special interest, being faint, close companions of naked-eye stars (for example, ν Scorpii, mags. 4 and 8, dist. 0·3″). Burnham had a marvellously acute eye, some of the pairs discovered with the 6-in. taxing the powers of the largest telescopes to separate. His next work was done with the 18½-in. refractor of the Dearborn Observatory, Chicago, from 1877 to 1879; with this he discovered 413 pairs, many of which are recorded in vol. xliv. of Memoirs of the Royal Astronomical Society.

Burnham was selected in 1879, on Prof. Newcomb's recommendation, as Prof. Holden's colleague for testing the atmospheric conditions at Mount Hamilton preparatory to the founding of the Lick Observatory. He remained there to observe the transit of Mercury in 1881, and was afterwards on the staff of the Lick Observatory, making still further discoveries and observations, so that in 1894 he had discovered more than half of the known pairs of which the distance was less than 1″.

Burnham afterwards returned to Chicago as professor of practical astronomy at the University. The first volume of the Publications of the Yerkes Observatory consists of his great "General Catalogue of Double Stars," which has become the standard work of reference on the subject. He continued the work of discussing measures and orbits, and of drawing up lists of stars that needed observation, until within a few years of his death.

Burnham was elected a fellow of the Royal Astronomical Society in 1874 on the nomination of the Rev. T. W. Webb, whose "Celestial Objects" had first directed his attention to double stars. He was elected an associate in 1898, having received the gold medal in 1894.

A. C. D. C.

WE announce with regret the death on Thursday, March 31, of MR. T. E. GATEHOUSE at the age of sixty-six years. Mr. Gatehouse was for some forty years associated with our contemporary, the *Electrical Review,* of which he had become editorial and technical director. As a young man he was a pupil of Robert Sabine, one of the most able pioneers of electrical industry, and later he worked with Sir Charles Wheatstone and Sir Samuel Canning. From these he obtained a broad knowledge of electrical engineering in all its aspects, and especially of telegraphy, both on land and by submarine cable. As a young engineer he also took great interest in schemes for electric lighting, and himself held a number of patents for improvements in both the arc and incandescent lamp systems. In 1881 Mr. Gatehouse joined forces with a fellow-pupil under Sabine, Mr. R. H. Kempe, who was proprietor, with Mr. H. Alabaster, of the *Telegraphic Journal and Electrical Review* (afterwards the *Electrical Review*), and Mr. Gatehouse was made editor, a post which he held until a few years ago. Failing health compelled him to give up active work as editor, but as editorial and technical director he kept in touch with the journal, and lent his aid in a consultative capacity until a few days before his death occurred.

THE death is announced of MR. SYDNEY FISHER, one of the leading authorities on agriculture in Canada. Mr. Fisher was born in 1850, and educated at McGill University, and later at Cambridge. At the age of thirty-one years he entered the Dominion Parliament, and, with the exception of an interval lasting from 1891–96, was a representative in it continuously until 1911. He made a study of the principles of agriculture, and when Sir Wilfrid Laurier came into power in 1896 was appointed Minister of Agriculture, an office which he held for fifteen years. During his tenure of office Mr. Fisher initiated a progressive agricultural policy, the most important part of which was the establishment, in various parts of the Dominion, of experimental farms, where careful and profitable research has been undertaken. Mr. Fisher will also be remembered as the first vice-president of the International Institute of Agriculture convened at Rome in 1908.

THE death is announced of MR. ALEXANDER WYNTER BLYTH, which occurred on April 1 at the age of seventy-six years. Mr. Blyth was for forty years public analyst for the county of Devon and the borough of St. Marylebone, and a past-president of the Incorporated Society of Medical Officers of Health. He will be best remembered as the author of a number of books on public health, among which are "Foods: their Composition and Analysis," "Poisons: their Effects and Detection," and "A Manual of Public Health." He also communicated a number of papers to the Royal Society, the Chemical Society, and the Royal Sanitary Institute.

Notes.

AT the meeting of the Royal Society on May 5 the Croonian lecture will be delivered by Dr. Henry Head on "Release of Function in the Nervous System."

PROF. J. NORMAN COLLIE, professor of organic chemistry in the University of London, and Sir W. Morley Fletcher, Secretary of the Medical Research Council (Privy Council), have been elected members of the Athenæum under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

THE Institute of Physics will be inaugurated at a meeting to be held on Wednesday, April 27, at 6 p.m., in the hall of the Institution of Civil Engineers, Great George Street, Westminster. Sir Richard Glazebrook, the president, will preside, and Sir J. J. Thomson will deliver an address. Mr. A. J. Balfour is expected to be present and to extend a welcome to the institute. Non-members of the institute or of the societies associated with it may obtain tickets of admission on application to the Secretary, 10 Essex Street, Strand, W.C.2.

A GOOD deal of attention has been devoted in the medical, pharmaceutical, and general Press to the provisions of the Draft Regulations drawn up by the Home Office under the Dangerous Drugs Act of 1920. The drugs specified in the draft regulations are opium, morphine, diamorphine, cocaine, and ecgonine, and, with certain exceptions as regards pharmacists, medical men, dentists, and veterinary surgeons, the manufacture, possession, purchase, or sale of any of these drugs is prohibited except to persons duly licensed or otherwise authorised by the Home Office. Apparently a chemist successfully synthesising one of these drugs, such as morphine, without previously securing a licence for himself and the premises he works in, might be regarded as "manufacturing" the alkaloid, and thereby infringing the regulations. Similarly, he would require a licence before he could acquire and keep any of these drugs in his laboratory, and he would have to produce his stock for the inspection of any constable who desired to see it, and, if any of it had been used or otherwise disposed of, satisfy the constable that a record of the transaction had been kept in the proper form in the appropriate book. The regulations appear to have been prepared without consideration of the fact that drugs of this kind are in common use for purely scientific purposes, and it behoves chemists and others concerned to bring pressure to bear on the Home Office to ensure the exemption of scientific workers from the operation of the regulations when they come into force.

THE half-yearly meeting of the council of the National Union of Scientific Workers was held at the University of London Club on Saturday, April 9, the president, Prof. L. Bairstow, in the chair. It was resolved unanimously that the council views with misgiving the subordination of scientific workers controlling scientific staffs to non-scientific officials in Government Departments; deplores the growing tendency of public bodies to reduce expenditure on education, particularly in neglecting to provide for further institutions for the study of science and technology, and by threatening existing institutions with closure, irrespective of their national utility; and will take steps to oppose the tendency to discriminate, solely on account of sex, between the salaries of scientific workers of the same grade and professional standing. The following two resolutions on secret research in universities were also adopted:—"That this council is of the opinion that it is neither practicable nor desirable that research for Government Departments or other bodies, demanding the maximum privacy in its pursuit and the greatest strictures on publication, should be undertaken under the auspices of a university or of one of its departments"; and "That the executive committee of the union be instructed to direct the attention of university authorities throughout the kingdom to the danger of undertaking (except in a national emergency) research under the Official Secrets Act or similar conditions in university buildings, as the pursuit of such research is hostile to the university tradition of freedom of teaching, research, and intercourse, the freedom of the university scientific worker, and the best interests of education."

IT is announced that the biological expedition to Spitsbergen organised in Oxford University is to set out in June. Financial difficulties have been partly overcome, but, according to the *Times*, funds are still inadequate to allow the whole programme to be followed. The expedition, comprising ten or eleven members, will be under the leadership of the Rev. F. C. R. Jourdain, and will devote its attention principally to ornithological work on the west coast, although it is hoped that ice conditions will allow a visit to New Friesland. The promoters have been well advised, in view of their inexperience in Arctic conditions, to make use of Norwegian hunting sloops, and so have the assistance of expert seamen. If the ice conditions are normal this year, as they promise to be, the expedition should have an interesting time and do some useful biological work, especially on Prince Charles Foreland.

IN commemoration of the quatercentenary of the death of Ferdinand Magellan on April 27, Mr. E. Heawood read a paper to the Royal Geographical Society on April 11 on the world-map before and after Magellan's voyage. Mr. Heawood showed the influence on cartography before Magellan's voyages of the misrepresentations, largely dating from Ptolemy, which reduced the circumference of the globe and extended land areas longitudinally. Thus the voyage across the Pacific did not promise to be so long as it was in reality. One result of Magellan's voyage was to give greater appreciation of the width of the Pacific Ocean, and another, curiously enough, was to bring into renewed prominence the conception of a great southern continent—an idea which dated from high antiquity and was revived by the discovery of Fuegia. Mr. Heawood is not inclined to believe that Magellan Strait was known previous to the Magellan voyages, and thinks that earlier indications of it on maps were prompted by the hope, rather than the knowledge, of its existence.

THE second Herbertson memorial lecture of the Geographical Association was delivered by Dr. H. R. Mill in the map-room of the Royal Geographical Society on April 6. After references to the growth of geographical research in this country and to the career of the late Prof. Herbertson, the lecturer developed the theme of regional geographical study, and illustrated it by a detailed discussion of the problem of mapping the average rainfall of a region on a large scale. The steps by which the relation of average rainfall to the configuration of the land had been established were described, and stress was laid on the practical importance of such maps in planning waterworks and in developing water-power. The importance of amplifying such researches as had been made by establishing a hydrometric survey was insisted on, and the plan of a geography of inland waters laid down. For such work the river-basin was the natural unit, and the Ordnance Survey maps should be adapted to it by the insertion of watershed lines separating the valleys and by a series of levels along the stream-beds. The full description of the river system and *régime* would require the consideration of geological, botanical, and economic conditions as well as of meteorology.

AN account of the twenty-fifth annual Congress of the South-Eastern Union of Scientific Societies was printed in NATURE of June 24, 1920. The *South-Eastern Naturalist*, which has just been received, contains the proceedings and transactions of the union during 1920 under the presidency of Sir Edward Brabrook; the papers read at the congress are printed in full, and the reports made by the various committees and sections are given. The annual congress for 1921 will be held at Reading on June 8–11, and the president for 1921–22 is Prof. E. B. Poulton.

IN accordance with the provisions of the will of the late Dr. R. T. Nichols, the Royal Society of Medicine will offer triennially a prize of the value of 250*l*., open to any British subject, for the most valuable contribution towards "the discovery of the causes and the prevention of death in childbirth from septicæmia." The society is open to receive competing essays for the first award until, at latest, June 30, 1924. The works submitted must be typewritten or printed in English, marked "Nichols Prize," and accompanied by the name and address of the author. Work already published will be eligible provided it appeared not earlier than June 30, 1921. Further particulars of the prize are obtainable from the Secretary of the Royal Society of Medicine, 1 Wimpole Street, W.1.

AT the fourth annual meeting of the National Association of Industrial Chemists, held at Sheffield recently and presided over by Mr. A. B. Searle, the general secretary's report on the activities and progress of the association during 1920 was read. At present there are nearly 1100 members on the register, and a slight gain in membership has been made. The economic status of the members has been considered by a special committee, and a scale submitted to, and approved by, the national council. These endeavours to obtain better remuneration were upset by unforeseen circumstances, but the experience gained shows that the association has prospects of doing good work in this direction when trade is more normal. Another committee discussed preliminaries with the British Association of Chemists in order to try to bring about an amalgamation, and negotiations are still proceeding. In the interests of the industrial chemist it is regarded as essential that every effort should be made to obtain an organisation strong both numerically and financially, and one that is fully representative of the industrial chemists of Great Britain. It is possible that much headway may be made in this direction by amalgamation with the British Association of Chemists, and possibly by affiliation with the Non-manual Workers' Federation. All communications with reference to the association should be addressed to the General Secretary, The White Building, Fitzalan Square, Sheffield.

UNDER the title of "La Dame de l'érable" in *L'Anthropologie* (vol. xxx., Nos. 3-4) M. L. Siret publishes an elaborate, fully illustrated paper on the cult of trees in Druidism. The author reviews the occurrence of tree cults in ancient France, with comparative illustrations from the East as far as Nineveh, and certain allied questions such as the extension of Eneolithic commerce towards the north and the exportation of precious metals to the west.

THE myths of the Alsea Indian tribe of Oregon are collected, with the original texts, by Mr. L. I. Frachtenberg in Bulletin No. 67 of the Bureau of American Ethnology. Generally speaking, this mythology is characteristic of that area of the north-west which embraces northern California, Oregon, and Washington. It is typical of the north-west in so far as it is lacking in migration myths such as are found among certain tribes of the south-west and east. On the other hand, it is intimately connected with the mythology of the tribes of northern California, and it exhibits special points of contact with the folk-lore of their neighbours to the north, especially the Salish. These points of resemblance and contrast are carefully worked out in the introduction to the present volume.

IN the March issue of *Man* Mr. Ainsworth Dickson describes the only survivals of the regalia of the Wa-Vumba tribe in the delta of the Umba River, which formerly marked the coastal boundary of German and British East Africa. They are descendants of a party of Persians who migrated about A.D. 1200 to this district from the plains of Sheraji. About A.D. 1700 the country was swept by a horde of cannibals from the south, and many of the people removed for safety to the adjacent Island of Wassein, where they founded a city. The objects now described consist of drums, horns, and cymbals used at the enthronement of a sultan, and with the ruins of a few mosques and some Durbar customs they form the only material evidence of a once-flourishing Persian colony on African soil.

SOME interesting notes made on a cuckoo during the deposition of its eggs appear in *British Birds* for March. The author, Mr. Edgar Chance, kept a single female under observation throughout the whole of this time, which lasted until no fewer than twenty-one eggs had been laid. All were dropped, at intervals of forty-eight hours, into the nests of meadow pipits, save in the case of the fifteenth egg, for which the nest of a tree-pipit was selected, there being no meadow-pipit's nest available. Deposition always took place in the afternoon, and an egg was never left in a nest until after the first egg of the foster-parents had been laid. On each occasion, after dropping her egg into the nest, she removed one of her dupe's eggs, and this was either swallowed at the nest-side or borne away and disposed of. Apparently only when forced by dire necessity will she leave an egg in a nest in which incubation has commenced.

THE value of the statistics of variation for the study of fossils is discussed at great length by Dr. Hans Klähn in the "Berichte" of the Natural History Society of Freiburg im Breisgau (vol. xxii., part 2, 1920). Numerous tables of measurements of brachiopods, ammonites, and species of Helix are given, and various mathematical treatments are attempted to determine the limits of species and varieties. Part of the memoir is a criticism of Wedekind's work on the principles and methods of biostratigraphy.

WE have received some parts of the seventh volume of *Iberica*, a weekly review of the sciences and their applications published in Tortosa. The periodical is well illustrated and written in an attractive manner, containing general articles and summaries besides the usual news and reviews of recent publications. In Spain it cannot fail to spread an interest in the progress of science, while to other countries it affords a means of obtaining news of Spanish scientific work. One original article gives an account of the Medusæ found on the coast of Catalonia, and another describes the geology of the country between Tortosa and Castellón. There is also an illustrated article on the National Museum of Natural History at Madrid.

AMONG recent publications on mineral oil may be mentioned Bulletin 652, U.S. Geol. Survey, on "The Cushing Oil and Gas Field, Oklahoma," and Bulletin 656 on "Anticlines in the Bighorn Basin, Wyoming." The Cushing field has been opened up since 1912 with such rapidity and success that considerable waste occurred. Its describer, C. H. Beal, believes that the oil and gas have collected from the broad gathering-ground provided by the gentler slope of the anticlinal to the west, the gas arriving first into the crest of the fold, and banking up a following oil-pool west of it. The field in southern Wyoming is in Cretaceous strata, and here again it is pointed out, by D. F. Hewett and C. T. Lupton, that there is most likelihood of oil where upfolds occur near large areas of gently rising beds. The area of supply controls the quantity in the anticlines. In the "Summary of Progress of the Geological Survey of Great Britain for 1919" (1920, 2*s.* 6*d.*) some details are given of the recent borings for oil in Derbyshire and Staffordshire. The Lower Carboniferous shales, and not the limestone, are regarded as the probable source of such oil as has been found.

WE have received the fifth list (for 1917) of the earthquakes registered at the observatory of De Bilt, Holland. This station is provided with a pair of Galitzin seismographs, a Wiechert astatic seismograph, and a pair of Bosch horizontal pendulums. The catalogue, which is one of the most complete issued, gives for each of the 394 earthquakes recorded the time, period, and amplitude of every phase, with a summary of the times of the principal phases at other observatories and the position of the epicentre when that is known. The munitions explosion in the north of England on October 1, 1917, was manifested in Holland by the rattling of windows, etc., while that of East London on January 19, 1917, apparently passed unnoticed.

THE Danish Meteorological Institute has published the issue for 1920 of the annual report on the state of the ice in the Arctic seas. The year showed several peculiarities in amount and distribution, although information was lacking from many regions. In the Barents Sea ice was much scarcer than usual, and there was open water as far east as Novaya Zemlya all the summer, while even the Kara Sea offered fewer difficulties than in normal years. On the west coast of Spitsbergen the condition differed little from the normal, but Storfjord was exceptionally free from ice in late summer. There is little information from the east coast of Greenland, but more ice than usual passed round Cape Farewell into Davis Strait. This meant that the ice must have been packed close against the east coast, since the shores of Iceland were practically free from ice throughout the year. On the Newfoundland Banks icebergs were numerous, and drifted somewhat further south than usual during the first half of the year. In Davis Strait and Melville Bay the ice was more abundant than usual during the spring and early summer.

THE index-numbers of vols. xxiii. of the Physics and Electrical Engineering Sections of *Science Abstracts* complete the volumes for the year 1920. As compared with the volumes for 1919, the Physics Section with its 750 pages shows an increase of about 90 pages, and the Electrical Engineering Section with 633 pages an increase of 150 pages. The number of physics abstracts has increased from 1580 to nearly 1670, and that of the electrical engineering abstracts from 940 to nearly 1120. These changes bring the two volumes back to pre-war dimensions, although the number of articles abstracted is still considerably below the pre-war number. Unless there is a marked change in the importance of the articles abstracted, this increase in the average length of an abstract cannot be regarded as altogether satisfactory. Apart from this tendency, the volumes retain their positions as annual records of the progress of physics and electrical engineering, with which no worker who requires accurate and up-to-date information can afford to dispense.

AN interesting paper by Mr. G. Stead was read to the Institution of Electrical Engineers on March 16 in which the effect of electron emission on the temperature of the filament and anode of a thermionic valve was investigated. It was found that the temperature at any point on a tungsten filament which was emitting electrons was altered by the passage of the emission current through the filament and by the latent heat of evaporation of the electrons. Direct measurements were made with an optical pyrometer of the temperature along the emitting filament. It was found that the distribution of temperature was unsymmetrical, the negative limb being hotter than the positive limb. An account is also given of measurements of the temperature of an anode undergoing electron bombardment. The curve obtained, which shows the relation between the anode temperature and the number of watts dissipated by the anode per sq. cm. of surface, will prove useful to manufacturers.

ON March 17 Sir William Noble read a paper to the Institution of Electrical Engineers on "The Long-distance Telephone System of the United Kingdom." It deals mainly with the improvements that have been made in line-plant design during the last ten years. The recent expansion of long-distance telephony has led to a congestion of the pole lines along roads, railways, and canals. Improvements, however, in underground long-distance telephone cables have led to a solution of the difficulty, and practically all the new trunk lines are, in consequence, underground. The three-electrode thermionic amplifier can be used as a telephone repeater, and its general introduction has revolutionised long-distance communication schemes. Amplifiers can also be used to obtain duplexing—that is, both-way working of the line. "Wired wireless" or, as it is better called, "high-frequency carrier-wave telephony" was also discussed, but its practical use in this country would be very limited.

THE sensitising of photographic emulsions for green has always presented difficulties The well-known "gap in the green" of orthochromatic plates, which caused certain natural greens to be rendered too dark, is perhaps the most notable of the irregularities. We learn from a communication of Dr. König's in this month's Colour Supplement of the *British Journal of Photography* that Dr. Robert Schuloff, of the Höchst dye works, has prepared a new dye, "pinaflavol," which Dr. Eder finds to be "the long-required green sensitiser, having a maximum at about the line E, falling sharply to D, and extending without gaps to F. . . . It yields a strong, even, spectrum band over the whole of the green, blue, and violet." The rapid fall of sensitiveness at D is of especial advantage in three-colour photography, as the green record can be taken with a yellow filter which can easily be obtained of great transparency to green. Hitherto it has been necessary to cut off the red as well as the blue by means of a green filter, and all green filters reduce very notably the very colour that it is desired that they should transmit. Pinaflavol is used in the same manner as the cyanine and isocyanine sensitisers.

THE salving of the Italian battleship *Leonardo da Vinci* forms the subject of an illustrated article in the *Engineer* for March 18. This ship was blown up at anchor at Taranto in 1916, the rent in the hull measuring more than 500 sq. ft. and extending up both sides. The vessel settled down by the stern, capsized to port, and sank in six fathoms of water. She is 650 ft. long, the displacement is 22,380 tons, and she is armed with thirteen 12-in. guns. Being extremely valuable, a committee was set up to report on different schemes of salvage and to arrange for carrying out the work. It was finally decided to refloat the ship upside down by means of compressed air, to tow her into the Taranto dry dock, and there to repair the damage so that she could afterwards be righted at sea. The superstructure, turrets, guns, etc., were detached and left provisionally at the bottom of the sea in order to permit the vessel to enter the dry dock in an inverted state. The whole of the projected work has now been accomplished, and the ship was righted on January 24 last. The salvage of this vessel constitutes a most remarkable and unprecedented feat. It is also notable from the engineering point of view, since it has proved possibilities for the use of compressed air which had not previously been put to the test.

A VERY useful catalogue (New Series, No. 1) of second-hand books and journals dealing with zoology has just been received from Messrs. Wheldon and Wesley, Ltd., 38 Great Queen Street, W.C.2. It contains the titles of no fewer than 2481 works (many from the library of the late F. Du Cane Godman) in the departments of Pisces, Reptilia and Batrachia, Aves, Mammalia, Anthropology, Domestic Quadrupeds and Birds, General Systems and Early Treatises, and General Faunas; also text-books and miscellanea. The catalogue can be obtained free of charge upon application to the publishers.

ON p. 85 of our issue for March 17 we referred to Mr. A. C. Kinsey's papers on American Cynipidæ or gall-wasps. Owing to an oversight they were attributed to the Proceedings of the U.S. National Museum, whereas they were published in Bulletin 42 of the American Museum of Natural History.

Our Astronomical Column.

DISCOVERY OF PONS-WINNECKE'S COMET.—The comet Pons-Winnecke was detected by Prof. Barnard on April 10d. 21h. 17·0m. G.M.T., R.A. 15h. 54m. 38s., N. decl. 36° 38′. Daily motion 50′ in north following direction. The indicated date of perihelion is June 11 or 12. There will be a fairly close approach to the earth, but no collision. Meteors are very probable about June 27.

REID'S COMET.—This comet is brightening and coming into a more convenient position for European observers. Many observations are reported, the latest being made at Copenhagen by Miss Vinter-Hansen: G.M.T. April 4, 14h. 47·9m., apparent R.A. 20h. 26m. 31·40s., apparent S. declination 2° 38′ 5″.

On April 2 the comet was described as small and bright, about 8th magnitude, with strong central condensation, no tail seen, but moon bright. It remained visible in the dawn as long as 9th magnitude stars. The orbit and ephemeris given in NATURE for March 31 are not much in error, and there is every reason to anticipate that the comet will attain faint naked-eye visibility. It will pass close to the North Pole in mid-May.

DOUBLE STARS.—Mr. J. Jackson contributes an article on this subject to the *Observatory* for March, in which he examines the criteria for distinguishing physical pairs from optical ones. It is pointed out that two stars of the 9th magnitude, or brighter, within 5″ of each other are likely to form a physical pair. Wide pairs with appreciable relative motion are in most cases optical; without appreciable relative motion their state is doubtful unless there is a considerable common proper motion.

If the relative motion of a pair of stars is less than P.M./10, they are probably binary. Some observers have been very reluctant to admit the first principle, and have questioned the binary character even of such obvious pairs as 61 Cygni.

Mr. Jackson applies his principles to selected portions of Burnham's General Catalogue, classifying several stars as obviously binary, others as almost certainly optical. He passes on to consider the hypothetical parallax, on the assumption that the mass of each system is twice that of the sun. He shows that this may often be estimated, even if only a small portion of the orbit has been observed; where its value is large the star should be put on the list of parallax stars. If the observed parallax is not very different from the hypothetical one, the star is probably a physical binary. Thus β 4972 and β 7514 are shown to be respectively physical and optical.

The Internal Physics of Metals.

THE general discussion on the failure of metals under internal and prolonged stress, held on Wednesday, April 6, was of special interest for several reasons. In the first place, being arranged jointly by the Faraday Society, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Institute of Metals, the Institute of Shipbuilders in Scotland, and the East Coast Institution of Engineers, it constituted a symposium which united the physicist, the metallurgist, and the engineer in the discussion of a problem which can be solved only by the co-operation of all three. The problem itself, also, is of no small interest, whether viewed from the practical point of view of the engineer who is concerned with the adequate safety and permanence of his works, or from the scientific point of view as a question of the internal physics of metals and of solids in general.

Briefly, we have first the long-known phenomenon miscalled "season-cracking" in brass. A cold-drawn rod or tube, or a spinning such as a cup, may appear to be perfectly sound and good when first made, but after a time, which may be a matter of hours or of years, it breaks, seemingly spontaneously. Such fracture we now know is the result of the prolonged operation of an internal stress which existed in the finished article as the result of undue deformations applied to the metal during manufacture, and this stress has in time proved sufficient to pull the constituent crystals apart. This is a type of fracture quite different from that which the same metal undergoes if broken in the ordinary way in a tensile test, when fracture occurs through the crystals themselves, and not through their junctions.

Until 1919 this phenomenon stood as an isolated, but important, fact in connection with brass, but then it was discovered that other metals, such as certain aluminium alloys, lead, and even steel, could undergo similar inter-crystalline fracture after the lapse of time if left, under suitable conditions, exposed to a sufficiently severe and continuously acting stress. In view of these discoveries Rosenhain and Archbutt put forward the suggestion that inter-crystalline fractures of this type arise as a consequence of the existence of an amorphous layer between adjacent metallic crystals; such a layer is regarded as consisting of a highly viscous, under-cooled liquid, and should, therefore, be subject to a minute amount of movement—either true viscous flow or visco-elastic displacement—under the action of long-continued stress. If, then, the form of the crystal boundaries is such as to favour easy relative displacement, inter-crystalline fracture will ultimately result, while if the boundaries between crystals are irregular or rough, displacement will soon be checked and no fracture occur. Rosenhain and Archbutt found that in their aluminium alloy they could produce at will a micro-structure with smooth boundaries in which failure under stress might occur within an hour, while in another condition the same material would resist failure for many years, and probably indefinitely. Similar results were obtained with lead, and in the case of steel also indications of a powerful effect arising from the nature of the crystal boundaries were found.

More recently Moore and his collaborators at Woolwich have shown that the selective action of certain chemical reagents, such as mercury salts and ammonia on inter-crystalline material, in the case of brass, plays a most important part in the process of "season-cracking"; indeed, they go so far as to say that, in brass at all events, such chemical action is essential to the occurrence of the phenomenon. In reply to this contention Rosenhain and Archbutt have recently shown that while even in their special alloy, in which the phenomena are most strictly analogous to those in brass, but more rapid, and therefore more readily studied, chemical action—in that case by air or water vapour, or both—also affects the process, yet it serves, not as the prime cause, but as an accelerator. Specimens of their alloy which fail, when left in the air, in a few hours, withstand the same stress for several days when kept in a high vacuum or in hydrogen; yet they ultimately fail even in the total absence of chemical action, and it is suggested that severely stressed brass will do so also, given time enough.

The main discussion, however, did not turn upon the relatively minor differences between the views of Moore and of Rosenhain, but rather upon the general question of the existence of the supposed inter-crystalline amorphous layer and its properties. Here it seems that some of the metallurgists who wished to dispose of this theory on *a priori* grounds—that the existence of such a layer in "highly crystalline" materials like metals was not possible—adopted a somewhat unintelligent and unscientific attitude. They cannot surely claim to have so intimate a knowledge of the behaviour of atoms during crystallisation as to entitle them to say that when two growing crystals approach each other the process of crystallisation *must* continue until the last layer of atoms is in some way forced to assume some orientation common to both the adjacent space-lattices. Nor can they dispute that a highly viscous liquid may behave as a hard and brittle quasi-solid under forces as ordinarily applied, *i.e.* at relatively rapid rates, and may yet undergo flow or visco-elastic displacements if sufficient time is allowed.

It is not, perhaps, possible to say that the actual existence of amorphous inter-crystalline layers in metals is proved, but it must be admitted that there is more than a strong *prima facie* case for the theory, and, further, that it serves to explain and unify a very large range of phenomena which otherwise lack explanation or correlation. The theory of an amorphous inter-crystalline layer must at least be regarded as an extremely helpful hypothesis which has been gaining steadily in strength from the accumulation of experimental evidence during the past ten years. Whether it will ever be possible to place it on a surer foundation it is difficult to predict, but our methods of studying the internal structure of matter have made such great progress in recent years that more is to be anticipated. Meanwhile, so far as inter-crystalline fracture under prolonged stress is concerned, it remains the only tangible explanation which was put forward during the discussion.

Mongolian Imbecility.

DR. F. C. CRUIKSHANK read a paper on March 22 at a meeting of the Royal Anthropological Institute entitled "The Ethnological Significance of Mongolian Imbecility." He pointed out that Robert Chambers eighty years ago directed attention to the occurrence in England of persons who in adult life are yet a "kind of children" and "of the Mongolian type." In 1866 Dr. Langdon Down definitely described a type of idiocy that he called Mongolian, and that has been recognised ever since by physicians. The homologies of these imbeciles have been discussed by medical men from various points of view, but it is generally held that their resemblances to racial Mongols are only "accidental." Dr. Cruikshank, however, maintained that many of the characteristics of these children are really Mongoloid, while others are definitely simian and exhibit convergence towards the orangoid rather than the chimpanzoid or general type of great ape. It was pointed out that "Mongolian imbeciles" adopt the *horizontal* disposition of the lower limbs in sitting that is characteristic of racial Mongols and of orangs, in contradistinction to the *vertical* disposition adopted by negroes and other non-Mongoloid races, chimpanzees, and gorillas. The correlation of the "habitual posture" with various structural peculiarities was insisted upon and discussed.

An attempt had been made to explain away these homologies by reference to the hypothesis of gland-balance influence on racial peculiarities, first put forward by Dr. Cruikshank in the *Lancet* in 1912. He maintained, however, that this hypothesis was by itself inadequate, and that it was necessary to invoke the notion of a line of common descent, even though in consequence it became impossible to avoid acceptance of some such polyphyletic scheme of human origin as that of Klaatsch. While there was abundant evidence, both historic and prehistoric, making it impossible to exclude the persistence in Western Europe of sufficient "Mongolian" blood to account for the Mongolian characteristics of these unfinished children we call "Mongolian imbeciles," the orangoid homologies were not thus explained. Further precise anatomical study was required, not only of the Mongolian imbeciles, but also of the many Western "Mongoloids" who are not actually imbecile and of the Mongolian races themselves.

Finally, it was shown that while "Mongolian" imbeciles converge towards the orang, there is another type of mental defect recognised in Europe whereof the subjects converge markedly in respect of their simian homologies towards the chimpanzee and away from the orang. There was need then for the co ordination of the observations of the physicians and the anthropologists in the free discussion of their observations.

In the course of the discussion which followed the reading of the paper, Prof. Keith, while congratulating the author on his work as a pioneer in this subject, maintained that the homologies to which he had directed attention were superficial. Mongolism, he held, was pathological, and arose out of some defect in the working of the complicated internal mechanism which was a common inheritance of man and the anthropoids. Of this working we knew little except that in certain obscure conditions it gave rise to such abnormalities as acromegaly, cretinism, Mongolism, and the like. Dr. Langdon Down directed attention to certain peculiarities in "Mongolian" imbeciles which had not been mentioned by the author. The iris was frequently spotted and lacking in colour, the hair grew further down the back of the neck than in the normal, and the sides of the face were often covered with a down. Prof. Elliot Smith expressed the view that Mongoloids were purely pathological specimens, and directed attention to the recent investigations of certain Dutch physicians which indicated that these abnormalities were due to an interference with pre-natal growth in the seventh week of intra-uterine existence, and occurred in the offspring of young or worn-out mothers. Dr. F. C. Shrubsall described a number of cases observed among defective children in the London area, and adduced statistics in support of the view that they occurred with greatest frequency in exhausted mothers. They were often followed by a miscarriage.

In his reply Dr. Cruikshank maintained that the view that the Mongoloid arose from a disturbance of the gland-balance or from an interference with pre-natal growth was not inconsistent with his theory of common descent.

The Alaskan Salmon.

In an article of exceptional interest contributed to the *Scientific Monthly* for February, Prof. Barton W. Evermann, an American ichthyologist of eminence, asks this question: Can the Alaskan salmon fisheries be saved? These Pacific salmon are of economic value for the whole world. The first cannery was erected and operated in 1878, and by 1918 the number had grown to 135. The pack was 8159 cases in 1878, and in 1914 about 2,500,000, the highest figure yet reached. In 1919 the total pack had been reduced to about 1,250,000 cases, and there is every reason to fear that the decrease is progressive. The most fertile fishery in the world is thus in danger of practical extinction (from the commercial point of view, at all events) owing to ruthless exploitation unchecked by legislation and almost unguided by State-directed investigation.

There are five species of Pacific salmon (Oncorhynchus spp.), all of which have much the same life-history. They are anadromous, the adults ascending rivers in order to spawn. They die, males and females alike, as soon as they have spawned; not one of them ever returns to the sea. For a brief period of a week or two in every year each varietal species is represented only by the developing eggs, and no parent ever sees its offspring—surely something quite unique in the vertebrate sub-kingdom! The young fish remain in the rivers for one to several years, and then descend to the sea. Each river contains one variety, or elementary species, recognisable to the fishermen and zoologists (this is the case for the sockeye, *O. nerka*, at all events), and it is the result of the "home stream" condition. The fry reared in one river are said invariably to return to the waters in which they have been reared. In all cases the sockeye seeks streams which have lakes as their head-waters, and the result is that the conditions under which they are reared are highly individualised. These conditions are most peculiar and of exceptional biological interest, demanding the fullest investigation. One would hesitate to believe in them were not the statements made so positively and on the authority of ichthyologists of distinction.

How to arrest the decline which seems to threaten the very existence of an industry of world-importance is, however, the author's chief concern. Restriction of the annual quantity of fish packed is, of course, the only practicable remedy, but so powerful are the interests involved and so hand-to-mouth are the great financial enterprises that any suggestion of the kind is certain to arouse intense opposition, and it can scarcely be expected in these days that any conceivable Government will have so much courage as to take the steps that the conditions obviously indicate. But investigation must precede any such restriction. It appears that hatching out fry artificially has had no apparent effect—at least, with the methods so far employed—and so restriction seems to be the only remedy, the productivity of each river being found and the rate of exploitation fixed at the highest point compatible with undiminished yield. In a river methods of investigation are possible that could not be followed in the sea. It is practicable to "rack" the rivers, permitting the ascent of the fish only through a narrow gap. It is even possible to count the fish that so pass during short sample times that can be averaged. Then the ratio of fish ascending to spawn to the run of fish four or five years later (when the hatched fry return from the sea) can be calculated. Comparisons over a number of years can so be made and a maximum degree of exploitation permitted. The method is, of course, much more complex than is here indicated, but it is all highly practicable. To such statistical investigation would, of course, be added a prolonged study of the spawning-beds in the head-waters, even the artificial improvement and control of the spawning and the elimination of the natural enemies of the very young fry. To some extent such investigations have been carried out —in spite, it is said, of the opposition of the Secretary of Commerce, whose non-appreciation of the value of scientific investigation was all that might have been expected.

Now, however, the commercial interests are threatened and the administrative attitude is likely to change—with results of value not only to the industry, but also to general biology. J. J.

Recent Applications of Interference Methods.[1]

PROF. MICHELSON said that since the armistice he had been interested in three questions: the measurement of the earth tides, a re-determination of the velocity of light, and the measurement of the diameters of fixed stars.

In the first of these problems the experiment reduced itself to the measurement of the difference in the movements of the free surfaces of water at the extremities of a long pipe submerged in the ground. Preliminary work was carried out with microscopes, but the final records were obtained from the movements of interference fringes. Records were taken at intervals of two hours on a kinematograph which worked continuously for a year. The results obtained were plotted, and found to agree very closely with those calculated from theory.

In the re-determination of the velocity of light the arrangement ultimately to be employed was the same as that previously used by Prof. Michelson, except that a much longer distance—say, twenty-five miles—was contemplated. This was to permit a larger angular movement of the rotating mirror, which in this case consisted of an octagon of glass rotating at about 1000 revolutions per second. If the speed were so adjusted that the octagon described 45° during the time taken by light to pass to the distant mirror and back, the returning beam would be undeviated. This condition could be determined to a much higher degree of precision than was possible for the angular measurements involved in previous determinations. The application of interference to this work lay in the method of making the angles of the octagon very accurately equal.

The third problem, that of measuring the diameters of the stars, was solved on lines which Prof. Michelson had applied many years ago to the measurement of the separation of double stars. The method consists in varying the separation of two slits in front of the object-glass of a large telescope until the visibility of the parallel diffraction fringes seen in the focal plane of the telescope is a minimum. No existing telescope is of large enough aperture for this condition to be reached in the case of single stars; but by attaching an arrangement of mirrors in front of the large 100-in. telescope at Mount Wilson Observatory, which in effect increased its aperture to 20 ft., it had been possible to obtain a result for the star α Orionis, the fringes from which disappeared when the slits were separated by about 10 ft. This corresponded to an angular diameter of just under a twentieth of a second.

[1] Abstract of the Sixth Guthrie Lecture, delivered before the Physical Society of London on March 11 by Prof. A. A. Michelson, of the University of Chicago.

University and Educational Intelligence.

PROF. G. ELLIOT SMITH is delivering two lectures, one at Groningen University on April 14 and the other at the University of Utrecht on April 16, entitled "Vision and Evolution." These lectures are being given under the auspices of the Dutch Royal Academy of Sciences, and form part of the scheme for the exchange of lecturers between this country and Holland which has been referred to recently in these columns.

THE Summer School of Civics, organised by the Civic Education League, is to be held this year at Guildford (Surrey) on July 30–August 14. Courses on economics, anthropology, social biology, maternity and child welfare, sociology, civics, and social psychology will be among those offered; while practical training in the presentation of civics (through public speaking, etc.) and in the regional approach to civics will also be provided. Full particulars may be had from the secretary, Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

THE governing body of Emmanuel College, Cambridge, is offering a research studentship of the annual value of 150*l.*, which will be tenable for two years and renewable in exceptional circumstances for a third year. The studentship is offered to a research student commencing residence at the college in October next, and applications should reach the Master of Emmanuel not later than September 17. The award, which will be made on the evidence submitted by the candidates, should include two certificates of good character, an account of their career with the names of professors or teachers under whom they have studied, a statement of the proposed line of research, and evidence of ability to undertake that particular class of work.

WHEN the closing of the Finsbury Technical College was announced by the City and Guilds Institute in July last the many friends of the college began to take steps to avert the threatened disaster. A defence committee, consisting principally of old students, was formed, and it presented a petition to the governing body signed by many workers in all branches of science and by others connected with industry and with some of the City Companies who felt that all possible steps should be taken to continue the college. The professional institutes and learned societies presented a memorial signed by their presidents, and other bodies, including the National Union of Scientific Workers, took such other action as seemed likely to help. The strong hope that, with the assistance of the London County Council and the Board of Education, the future of the college might be assured for the next five years was recently expressed by the governing body to the defence committee and the institutions concerned. The success of the negotiations is now announced, and it may be hoped that the permanence of the college will in the meantime be assured without its distinctive character being in any way impaired.

THE annual report, covering the period February, 1920–February, 1921, of the University College (London) Committee has just been issued. During the year 2833 whole-time students were enrolled, of whom more than 40 per cent. were women; for evening and vacation courses there were 389 and 287 enrolments respectively, and in each case there were more than twice as many women as men. The figures quoted for whole-time students include 383 who are engaged on post-graduate and research work. The report contains a record of the principal activities of the college during the year, and also the annual financial statements, according to which the expenditure has been nearly 119,000*l*. The revenue from fees was 45,000*l*., and a further sum of about 71,000*l*. was provided by income from endowments, donations, and grants, leaving a deficit for the year of some 2600*l*. The most important benefaction which has been received is the Rockefeller gift for medical education. By the terms of the trust deed the Rockefeller Foundation has offered to give 400,000*l*. to University College Hospital Medical School to assist in building and equipping a clinical unit such as the college authorities may consider desirable, and a further sum of 435,000*l*. will be given towards the support of clinical facilities and teaching; the University of London, on behalf of University College, is offered a sum of 190,000*l*. to assist in extending the anatomy and physiology schools at the college, and a further sum of 180,000*l*. to form an endowment for laboratory teaching. In every case the original plans of the college authorities will be the basis of all the changes made. The total sum of money which is being placed at the disposal of the college amounts to no less than 1,205,000*l*.

A SPECIAL luncheon was held on April 7 at the Royal Hotel, Bristol, in connection with the movement to re-establish the West of England in its former position of leadership in the new era of progress upon which the Empire is now entering. The Vice-Chancellor of the University of Bristol, Sir Isambard Owen, after referring to the proud record of the West of England from the fifteenth century until the period following the Napoleonic wars, pointed out that in the present period of reconstruction it still retains its dominant natural advantages, together with a relatively much greater increase of population than the rest of the country. In this new era, when exact scientific knowledge and the capacity to use it are the foundations of progress, the universities are the pivot of the educational system, in that they are directly and indirectly responsible for the training of the teachers in our schools, so that no class can remain indifferent to the welfare of the universities. The University of Bristol is fortunate in possessing an unencumbered site of 13½ acres near the heart of the city, and through the princely generosity of the late Mr. H. O. Wills and his sons, Messrs. G. A. and H. H. Wills, it is being housed in a pile of university buildings unsurpassed in this country outside Oxford and Cambridge. What is now required is money for endowments, for staff, and for working capital, and an appeal is to be made for public support. In common with the other English universities, Bristol is overcrowded with students in every faculty, whilst income has shrunk to less than half its pre-war value. Government support is increasing, the neighbouring counties are promising grants, but private benefactions are urgently required, and they are essential to ensure the freedom and independence of the University and to provide the highest knowledge and intellectual training for all who are capable of profiting by it. The universities are ready to rise to their privileges if only the people who can will aid them financially.

Calendar of Scientific Pioneers.

April 14, 1895. James Dwight Dana died.—Professor of natural history and geology at Yale, Dana, like Darwin, laid the foundation of his work during scientific voyages in the southern seas. He had a world-wide reputation as a zoologist, geologist, and mineralogist.

April 15, 1894. Jean Charles Gallisard de Marignac died.—A native of Switzerland, Marignac was professor of chemistry at Geneva. To test Prout's hypothesis he determined with extreme care the atomic weights of twenty-eight of the elements. He also studied problems in physical chemistry.

April 16, 1788. George Louis Leclerc, Comte de Buffon, died.—As director of the Jardin des Plantes and as author of the "Histoire Naturelle," Buffon invested science with new dignity and interest. Fertile in ideas, he helped to pave the way for the modern theory of evolution.

April 16, 1888. Sigismund Wroblewski died.—Wroblewski spent six years as an exile in Siberia. Afterwards, when professor of physics at Cracow, he did important work in the condensation of gases at low temperatures.

April 16, 1901. Henry Augustus Rowland died.—Like Langley, Rowland began life as an engineer. In 1876 he became the first professor of physics in the Johns Hopkins University. He redetermined the value of the ohm and the mechanical equivalent of heat, and made fundamental studies of the solar spectrum. His diffraction grating was described in 1882. At his death his remains were cremated and buried beneath his famous ruling engine.

April 16, 1914. George William Hill died.—One of the greatest masters of dynamical astronomy, Hill was for thirty years connected with the American Nautical Almanac. Newcomb was his colleague.

April 17, 1905. Otto Wilhelm von Struve died.—In 1861 Struve succeeded his father as director of Pulkowa Observatory, adding greatly to the reputation of what Gould called the astronomical capital of the world.

April 18, 1873. Justus von Liebig died.—Born in 1803, Liebig at the age of twenty-three became professor of chemistry in the small town of Giessen, which by his teaching and discoveries and great personality he made the Mecca of young students of chemistry. One of the most illustrious chemists of his age, his work on agricultural chemistry raised him to the rank of a benefactor of mankind. He died at Munich, whither he had removed in 1852.

April 19, 1882. Charles Robert Darwin died.—Through Henslow, the Cambridge botanist, Darwin became naturalist to H.M.S. *Beagle* and spent five years exploring the South Seas. In 1842 he settled at Down, in Kent. His views, with those of Wallace, on natural selection were given to the Linnean Society in July, 1858, and the following year he published his "Origin of Species." Marking as it does a turning-point in the history of thought, this work was the first of a series which made Darwin the great inspiring leader of evolutionary biology.

April 19, 1906. Pierre Curie died.—The discoverer with his brother in 1883 of piezo-electricity, Curie with his wife, Marie Sklodowska, while studying pitchblende in 1898, announced the existence of polonium and radium. At the time of his death Curie was professor of physics at the Sorbonne.

April 20, 1786. John Goodricke died.—The son of a Yorkshire gentleman, Goodricke three years before his death, when only nineteen years of age, received the Copley medal for his discovery of the period and cause of the changes in the variable star Algol. E. C. S.

Societies and Academies.

LONDON.

Zoological Society, March 22.—Sir S. F. Harmer, vice-president, in the chair.—Prof. J. C. **Ewart**: The nestling feathers of the mallard, with observations on the composition, origin, and history of feathers.—E. T. **Newton**: Fossil bones of birds which had been collected by Dr. Forsyth Major from caves in Sardinia, Corsica, and Greece.—G. C. **Robson**: The molluscan genus Cochlitoma and its anatomy, with remarks upon the variation of two closely allied forms.—H. E. **Andrews**: The Oriental species of the genus Callistomimus (Coleoptera, Carabidæ).

Geological Society, March 23.—Mr. R. D. Oldham, president, in the chair.—E. B. **Bailey**: The structure of the south-west Highlands of Scotland. Evidence is given for allotting the south-west Highlands to three great structural divisions in descending order as follows:—Loch Awe Nappe, Iltay Nappe, and Ballappel Foundation. The two lower of these divisions are themselves structural complexes. All available evidence points consistently to movement from the north-west during the development of these structural divisions. In a general way there is a close relationship between depth of cover and degree of metamorphism. No metamorphic inversions have been noted, and it is clear that crystallisation continued until the close of the early nappe-movements. In Cowal a peculiar type of metamorphism reigned, both in pre-anticlinal and in anticlinal times, wherefore it would seem that the early and late movements of the south-west Highlands are but successive chapters of a continuous history of mountain-building.

PARIS.

Academy of Sciences, March 21.—M. Georges Lemoine in the chair.—MM. H. **Deslandres** and **Burson**: Researches on the atmosphere of the stars. The recognition of the upper layer in some stars and comparison with the sun. The H_3 and K_3 lines (hydrogen and calcium) have been found in the spectra of ϵ Geminorum and α Orionis, and have proved to be about five times larger than in the sun. Hence it is concluded that the upper atmosphere in these two stars has a greater density or a stronger electrical field than in the sun.—L. **Lecornu**: The experimental determination of the movement of a solid.—E. **Bouty**: The interpretation by dielectric cohesion of a celebrated experiment of Sir J. J. Thomson.—P. **Sabatier** and B. **Kubota**: Catalytic hydrogenation with copper. Experiments with copper prepared by reducing the hydroxide at about 200° C. as a catalyst. The substances reduced included benzaldehyde, acetophenone, benzoquinone, benzoylpropanone, and phthalic anhydride.—G. **Julia**: Two consequences of the functional differential equation deduced from the conformal representation.—G. **Valiron**: The zeros of integral functions of infinite order.—A. **Sartory**, L. **Scheffler**, P. **Pellissier**, and C. **Vaucher**: A method of evaporation, concentration, and desiccation of organic or mineral substances. A current of cool, dry air is passed over the material to be dried, and the moisture thus taken up removed from the air by freezing, the whole forming a circulating system. Some results are given.—M. and L. **de Broglie**: Bohr's model atom and corpuscular spectra. Some consequences of this theory of the atom are developed and compared with experiment. In some cases the results predicted are in agreement with the experimental results; in others, additional experiments are required.—F. **Michaud**: The energy of a system of currents. Conditions of stability of equilibrium.—H. **Chipart**: The mutual (apparent) actions of magnets and currents plunged in a magnetic liquid.—R. **Audubert**: The mechanism of the energy exchanges in the electro-chemical passage of an atom to the state of ion.—A. **Bigot**: The contraction on drying of kaolins and clays. The materials examined were moulded into briquettes, either as pastes of varying consistency or dry, then allowed to dry slowly, and the losses in weight and alterations in length determined. The results obtained with six substances are given in a diagram.—E. **Passemard**: The alluvial terraces of Nive and their relations with the Mousterian screen of Olha.—P. **Scherfschewsky**: Dry mist. A discussion of the difference between dry mist and fog and of the meteorological conditions peculiar to each, with special reference to the effects on aviation.—L. **Armand**: The nuclear phenomena of heterotypical kinesis in *Lobelia urens* and in some Campanulaceæ.—C. A. **Bey**: The utilisation of the stems of various annual plants in view of the production of mechanical energy necessary for agricultural work in the valley of the Niger. From a calculation of the amount of energy required for growing cotton it is shown that this could be obtained from a power gas plant manufacturing a weak gas, the raw material being plant products grown annually, timber being excluded.—H. **Herissey**: The hydrolysis of α-methyl-*d*-mannoside by soluble ferments. The most advantageous source of *d*-mannosidase is germinated lucerne seed.—G. **Bertrand** and R. **Vladesco**: The causes in the variation in the amount of zinc in vertebrate animals: the influence of age. The amount of zinc present is at its maximum in young individuals. This is opposed to the results obtained by S. Giaya, and the causes of this disagreement are discussed.—R. **Fosse** and Mlle. N. **Rouchelman**: The formation of urea in the liver after death. Proof of the formation of urea in the liver after death is given; this property of the liver is destroyed by heating to 100° C.—A. **Lumière** and H. **Couturier**: Pregnancy and the phenomena of anaphylactic shock. Guinea-pigs in a state of pregnancy are immune from anaphylactic shock.—J. **Pellegrin**: The subfossil otoliths of the fishes of the southern Sahara and their signification.—E. F. **Galiano**: The chemicotactic reactions of the flagellated Chilomonas.—Mme. Anna **Drzewina** and G. **Bohn**: The defence of animals grouped together against poisons. In an earlier communication on the poisonous action of colloidal silver on the Convoluta it was shown that isolated individuals were much less resistant than grouped individuals. Similar experiments on the larvæ of *Rana fusca* are now described, with results confirming the earlier work. The larvæ appear to emit a protective substance, and when the individuals are grouped the defence is efficacious.—MM. **Alezais** and **Peyron**: The mode of development of the so-called mixed tumours and cylindroma of the region of the face.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. vi., No. 7, July, 1920).—H. S. **Reed**: The dynamics of a fluctuating growth-rate. A detailed discussion of various formulæ proposed on chemical, biochemical, or empirical grounds for the representation of the rate of growth, with illustrative statistics obtained from measurements on young apricot-trees. There are three distinct intra-seasonal cycles of growth, in each of which the growth resembles the rate of autocatalytic reaction.—A. J. **Lotka**: Analytical note on certain rhythmic relations in organic systems. In cases hitherto considered on the basis of chemical dynamics, oscillations have been found to be damped instead of periodic. It is shown, however, that in certain special cases the oscillations may be undamped and the rhythm indefinitely continued. The results are suggestive of possible interpretations of rhythmic processes in physiology.—H. S. **Vandiver**: The class-number of the field $\Omega(e^{2i\pi/p^n})$ and the second case of Fermat's last theorem.—C. W. **Metz**: Observation on the sterility of mutant hybrids in *Drosophila virilis*. Sterility in the rugose-glazed and rugose-wax hybrids is accounted for by assuming dominance of sterility instead of an incompatibility, as was done previously when only rugose-glazed were known.—H. A. **Cheplin** and L. F. **Rettger**: Studies on the transformation of the intestinal flora, with special reference to the implantation of *Bacillus acidophilus*. I.: Feeding experiments with albino rats. *B. bulgaricus* is incapable of accommodating itself to intestinal conditions. *B. acidophilus*, however, submits readily to implantation, at least in the white rat. The beneficial results attributed to various forms of sour-milk products have in all probability been due to the milk as such.—R. **Pearl**: A single numerical index of the age-distribution of a population. The function here discussed gives a substantially accurate indication of the essential nature of the age-distribution.—M. M. **Metcalf**: An important method of studying problems of relationship and of geographical distribution. The author shows the value of the method of studying relationships between groups of animals and plants and their geographical distribution and migration routes by means of a comparison of the distribution of the hosts with that of their parasites.—F. V. **Coville**: The influence of cold in stimulating the growth of plants. The common beliefs that trees and shrubs become dormant because of the cold, and that warm weather is of itself sufficient cause of the beginning of new growth in spring, are both erroneous.—L. B. **Loeb**: The nature of the negative carriers produced in pure hydrogen and nitrogen by photo-electrons. In pure nitrogen and hydrogen gas the electrons do not attach themselves to the molecules to form ions in any appreciable quantities.—W. F. **Durand**: Shock or water-ram in pipe-lines with imperfect reflection at the discharge end, and including the effects of friction and non-uniform change of valve opening.

Books Received.

The Electronic Conception of Valence and the Constitution of Benzene. By Prof. H. S. Fry. (Monographs on Inorganic and Physical Chemistry.) Pp. xviii+300. (London: Longmans, Green and Co.) 16*s*. net.

How to Measure. By Prof. G. M. Wilson and Prof. Kremer J. Hoke. Pp. vii+285. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s*. net.

Chemical Technology and Analysis of Oils, Fats, and Waxes. By Dr. J. Lewkowitsch. Sixth edition, entirely re-written and enlarged. Edited by George H. Warburton. (In three vols.) Vol. i. Pp. xviii+682. (London: Macmillan and Co., Ltd.) 36*s*. net.

Agricultural Meteorology: The Effect of Weather on Crops. By J. Warren Smith. (Rural Text-book Series.) Pp. xxiv+304+viii plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 13*s*. net.

Map Reading. By G. H. C. Dale. Pp. ix+170. (London: Macmillan and Co., Ltd.) 7*s*. 6*d*. net.

The Heart and the Aorta: Studies in Clinical Radiology. By Prof. H. Vaquez and E. Bordet. Translated from the second French edition by Dr. James A. Honeij and J. Macey. Pp. xvii+256. (New Haven: Yale University Press; London: Oxford University Press.) 25*s*. net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. v., 1920. Pp. 626. (London: Society of Chemical Industry.) 15*s*.

Das Raum-zeit-Problem bei Kant und Einstein. By Dr. Ilse Schneider. Pp. 75. (Berlin: J. Springer.) 12 marks.

Die Quantentheorie ihr Ursprung und ihre Entwicklung. By Fritz Reiche. Pp. vi+231. (Berlin: J. Springer.) 34 marks.

Survey of India. Professional Paper, No. 19. Experiments in Aeroplane Photo Surveying. By Major C. G. Lewis and Capt. H. G. Salmond. Pp. iii+53+3 plates. (Dehra Dun: The Trigonometrical Survey.) 3*s*.

A Text-book of Electro-Chemistry. By Prof. Max le Blanc. Translated from the fourth enlarged German edition by Dr. W. R. Whitney and Dr. J. W. Brown. Pp. xiv+338. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 18*s*. net.

Diary of Societies.

THURSDAY, APRIL 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—C. T. R. Wilson: Thunderstorms (Tyndall Lectures).

ROYAL SOCIETY, at 4.30.—Prof. K. Onnes, Sir Robert Hadfield, and Dr. H. R. Woltjer: The Influence of Low Temperatures on the Magnetic Properties of Alloys of Iron with Nickel and Manganese.—C. N. Hinshelwood and E. J. Bowen: The Influence of Physical Conditions on the Velocity of Decomposition of certain Crystalline Solids.—Prof. H. Briggs: The Adsorption of Gas by Charcoal, Silica, and other Substances.—N. K. Adam: The Properties and Molecular Structure of Thin Films of Palmitic Acid on Water. Part i.—E. P. Metcalfe and B. Venkatesachar: The Absorption of Light by Electrically Luminescent Mercury Vapour.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. T. Lewis: Observations upon the Nature of Auricular Flutter and Fibrillation (Oliver-Sharpey Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—E. A. Watson: Magnetos for Ignition Purposes in Internal Combustion Engines.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 2 Furnival Street), at 7.30.—F. H. Barry: Indian Products of Interest to the Oil and Colour Chemist.

CONCRETE INSTITUTE, at 7.30.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—F. Twyman: An Interferometer for the Testing of Camera Lenses.—W. Shackleton: The Testing of Heliograph Mirrors

RÖNTGEN SOCIETY (at University College), at 8.15.

HARVEIAN SOCIETY OF LONDON (at Paddington Town Hall), at 8.30.—D. C. L. Fitzwilliams: The Nævi of Children and their Treatment.

FRIDAY, APRIL 15.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: Demonstration of the Contents of the Museum.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—E. A. Phillipson: The Increased Efficiency of the Locomotive.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—C. R. Sams: The Metering of Steam.

SATURDAY, APRIL 16.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. H. H. Dale: Poisons and Antidotes.

MONDAY, APRIL 18.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. S. J. Shattock: Demonstration on Pathological Specimens in the Museum.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—A. E. Munby: The Utility of Research on Building Materials

ROYAL SOCIETY OF ARTS, at 8.—Dr. S. J. Lewis: Recent Applications of the Spectroscope and the Spectrophotometer to Science and Industry.

CHEMICAL INDUSTRY CLUB (2 Whitehall Court), at 8.—Dr. A. Rule: India.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Brig.-Gen. Sir Percy Sykes: South Persia and the Great War.

TUESDAY, APRIL 19.

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

ROYAL HORTICULTURAL SOCIETY, at 3.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section) (Annual General Meeting), at 4.30.—Sir Leonard Rogers: Treatment of Leprosy and Tuberculosis with Sodium Gynocardate.—Dr. R. R. Walker: The Action and Uses of Kaolin in the Treatment of Asiatic Cholera.

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting

ROYAL STATISTICAL SOCIETY (at Surveyors' Institution), at 5.15.—R. J. A. Pearson: A Comparison of Pre-war and Post-war Production Costs in Engineering.—N. Crump: A Review of Recent Foreign Exchange Fluctuations.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Sir Murdoch Macdonald and H. E. Hurst: The Measurement of the Discharge of the Nile through the Sluices of the Assuan Dam.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—A. W. Davson: Education and Training of a Driller.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—The Secretary: Report on the Additions to the Society's Menagerie during the Month of March, 1921.—Mrs. J. Longstaff: Observations on the Habits of the Snail, *Cochlitoma zebra*, var. *fulgurata*, and *Cochlitoma zebra*, var. *obesa*, Pfeiffer, in Confinement.—R. I. Pocock: The External Characters and Classification of the Procyonidæ (Raccoons, etc.).—M. A. Smith: New or Little-known Reptiles and Batrachians from Southern Annam (Indo-China).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. Pereira: From Camera to Cinema: The Printing of a Film.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—S. H. Warren: Report on Excavations at the Stone Axe Factory of Graig-lwyd in 1920.

ROYAL SOCIETY OF MEDICINE (Pathology Section) (Annual General Meeting), at 8.30.—Sir Lenthal Cheatle: Parenchymatous Inflammation of the Breast.—A. T. Glenny, Miss K. Allen, and Dr. R. A. O'Brien.—(1) Schick Reaction; (2) Diphtheria Prophylactic Immunisation with Toxin Anti-toxin Mixture.—Dr. E. H. Kettle and Dr. Joan Ross: Study of the Endotheliomata.

WEDNESDAY, APRIL 20.

SOCIETY OF GLASS TECHNOLOGY (Annual General Meeting) (at University College), at 2.30.—Presidential Address.—G. Dowse and E. Meigh: Automatic Glass Feeding Devices.

ROYAL METEOROLOGICAL SOCIETY, at 5.—C. E. P. Brooks: The Evolution of Climate in North-West Europe.—Lieut. G. C. Steele: Discussion on A Brief Review of the Influence of Meteorology on Naval Warfare.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—Dr. T. Wilson Parry: The Prehistoric Trephined Skulls of Great Britain, with Description of Operations Performed.—Dr. F. G. Chandler: The History of the Diagnosis and Treatment of Empyema.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—J. A. Douglas: Geological Sections through the Andes of Peru and Bolivia; III. From Callao to the River Perene.—Prof. O. T. Jones: The Valentian Series.

ROYAL SOCIETY OF ARTS, at 8.—Sir James Cantlie: (1) Thomson's Apparatus for Armless Men. (2) X-ray Motor Ambulance Service for the United Kingdom.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Rev. J. S. Pratt: Mr. Fred. Enock's Method of Mounting Heads of Insects without Pressure.—F. Martin Duncan: The Presence of Two Spermathecæ in the Rare Mole Flea (*Hystrichopsylla talpae*), and the Flea as a Distributor of a Tyroglyphid.—H. Crowther: A Coal-dust Explosion as Seen through the Microscope.—Capt. F. Oppenheimer: Some Suggestions regarding the Mechanical Design of Microscopes.

THURSDAY, APRIL 21.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. S. Foxwell: Nationalisation and Bureaucracy.

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Prof. J. Joly: A Quantum Theory of Colour Vision.—Prof. A. V. Hill: The Energy involved in the Electric Change in Muscle and Nerve.—H. M. Kyle: The Asymmetry, Metamorphosis, and Origin of Flat Fishes.—T. L. Prankerd: Studies in the Cytology of the Statolith Apparatus in Plants, viewed in Relation to their Habit and Biological Requirements.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.

LINNEAN SOCIETY, at 5.—Prof. R. Newstead: Some Observations on the Natural History of the Upper Shiri River, Nyasaland.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.

INSTITUTION OF MINING AND METALLURGY (Annual General Meeting) (at Geological Society), at 5.30.—F. W. Harbord: Presidential Address.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. E. Borland: The Musical Training of Children.

THE CHEMICAL SOCIETY, at 8.—F. Challenger and C. F. Allpress: Organo-derivatives of Bismuth. Part iv.: The Interaction of the Halogen Derivatives of Tertiary Aromatic Bismuthines with Organo-derivatives of Magnesium and Mercury.—J. A. N. Friend: A Colloid Theory of the Corrosion and Passivity of Iron and of the Oxidation of Ferrous Salts.—G. T. Morgan and J. D. Smith: Researches on Co-ordination and Residual Affinity. Part iv.: The Constitution of Simple and Complex Cobaltic Quinoneoxime Lakes.—G. T. Morgan and H. Burgess: Non-aromatic Diazonium Salts. Part vi.: 3:5-Dimethyl*iso*oxazole-4-diazonium Salts and their Azo-derivatives.—E. de B. Barnett and J. W. Cook: Studies in the Anthracene Series. Part i.—J. B. Firth: Some Factors governing the Sorptive Capacity of Charcoal. Sorption of Ammonia by Coconut Charcoal.—N. V. Sidgwick and E. K. Ewbank: The Influence of Position on the Solubilities of the Substituted Benzoic Acids.—N. V. Sidgwick and W. M. Aldous: Influence of Position on the Solubility and Volatility of the Mono- and Di-nitrophenols.—N. V. Sidgwick and H. E. Rubie: The Solubility and Volatility of the Chloro- and Nitro-anilines and their Acetyl Derivatives.—G. A. R. Kon: The Formation and Stability of *spiro*-Compounds. Part iv.: The Formation of Ketones derived from Open-chain and Cyclic Glutaric Acids by the Thermal Decomposition of their Calcium Salts.—W. J. Jenkins: Interaction of Acetylene and Mercuric Chloride. Part ii.—J. Read and H. G. Smith: Researches on Piperitone. Part i.: The Occurrence, Isolation, and Characterisation of Piperitone.

INSTITUTE OF METALS (at Sir John Cass Technical Institute), at 8.—Dr. W. R. Ormandy: Refractories.

RÖNTGEN SOCIETY (at University College), at 8.15.—Prof. A. M. Tyndall and E. G. Hill: A New Form of Stereo-fluoroscope.—Descriptions and Demonstrations of New X-ray, Electrical, and Photographic Apparatus.

FRIDAY, APRIL 22.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—W. A. Millard: Green Plant Matter as a "Decoy" for Actinomycetes Scabies in the Soil.—E. H. Richards: The Action of Bacteria and Protozoa in Conserving the Nitrogen in Sewage.—G. P. Wiltshire: The Methods of Infection of the Apple Canker Fungus.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Lt.-Col. Sir Edward W. M. Grigg: The Common Service of the British and Indian Peoples to the World (Sir George Birdwood Memorial Lecture).

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof A. Keith: Demonstration on the Contents of the Museum.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—W. N. Bond: The Effect of Viscosity on the Flow through an Orifice.—Dr. A. Griffiths and Constance H. Griffiths: The Viscosity of Water at Low Rates of Shear.—G. F. Partridge and B. S. Smith: A Method of Measuring Frequencies.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Richard T. Glazebrook: Limit Gauging.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. W. M. Willoughby: Collated Experiences of Plague on Ships.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir James Walker: Electro-synthesis in Organic Chemistry.

SATURDAY, APRIL 23.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Y. Oldham: The Great Epoch of Exploration; (1) Portugal.

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