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Applied Chemistry in Peace and War.

In a recent issue of the official organ of the Society of Dyers and Colourists,[1] Prof. Gardner reviews impartially and judicially the present position of the British dyestuffs industry, more especially with regard to recent negotiations between the British Dyestuffs Corporation Ltd. (B.D.C.) and the Interessen-Gemeinschaft (I.G.). His article, which is written in non-technical language, should be read by all wishing to obtain a clear perspective of the dyestuffs problem in its national aspects.

It is essential in considering the merits and demerits of the proposed agreement to differentiate clearly between the British dyestuff industry and the B.D.C., a distinction which is daily becoming more pronounced in proportion as the independent dyemakers gain an increasing amount of the home trade in colours. An agreement which is mutually advantageous to the I.G. and the B.D.C. may nevertheless be ruinous to the British competitors of the latter organisation. A criticism frequently made against the recent report of the Dyestuffs Development Committee of the Board of Trade is, that this document emphasises the great technical advances made since the War by British colour chemists, and at the same time urges the need for a continuance of the protection afforded to the industry by the Dyestuffs Act. The two points of view are, however, not inconsistent.

The enormous improvement in manufacturing capacity cannot be gainsaid. It may be recalled that prior to the War, 80 per cent. of British requirements for dyes came from abroad, and principally from Germany; at present "something over 80 per cent." of our home needs are supplied by British makers. It is, however, to secure the remaining 16 per cent. that the directors of the B.D.C. are striving for an arrangement with the great German combine. It is argued, Why should we expend money on research when the results are ours for the asking? Not being chemists, the directorate forgets that there is no finality in chemical industry, and that even now investigations are on foot which may render obsolete many of these precious dyes and also the majority of the commoner ones. To ensure steady growth, the still infantile industry needs protection not only from competition outside but also from apathy and lack of knowledge within the nation.

At the same time, it should be conceded that, so far as the interests of his shareholders are concerned, the chairman of the B.D.C. has done a great work in internal reorganisation and retrenchment, and also, in

[1] W. M. Gardner, "The British Dyestuffs Industry," Journal of the Society of Dyers and Colourists, vol. 40, No. 6, June 1924. (Bradford: Pearl Assurance Buildings, Market Street, 1924.) 5s.

view of the possible repeal of the Dyestuffs Act, he has made a very good bargain with a foreign competitor against whom the home industry would be heavily handicapped if the existing restriction on foreign importation were removed.

While these acute discussions are in progress in Great Britain, five lectures delivered by Prof. Haber during the last four years, and recently published,[2] have the sombre significance of the writing on the wall, for the text of his discourses may be taken to be the national necessity of a self-contained chemical industry vital to the public welfare either in peace or war. As the recipient of a Nobel Prize, the lecturer naturally dealt with the more peaceful attributes of the industrial synthesis of ammonia from its elements. But the war-like aspects of chemical science are displayed in the address on "Chemistry in War," delivered to the officers of the Ministry of National Defence (1920), and in the lecture on "The History of Gas Warfare," given last October before the Parliamentary research committee of the German Reichstag. In the former discourse Haber refers to the larger problems of munitions which arose in Germany on the prolongation of the War, and also on the special requirements for chemical warfare. He compares favourably the comparatively humane nature of the casualties inflicted by chemical means with the ghastly and disfiguring wounds produced by flying shrapnel and the other older weapons, and points out that, in spite of the Washington Conference, the fervent wish expressed in England, as in America, for the establishment of an independent chemical industry is due to a recognition of the importance of this trade in the production of chemical munitions of war.

In the lecture to the Reichstag representatives, Prof. Haber traces the development of chemical warfare both before and since the surprise attack with chlorine made by the German army at Langemark on April 22, 1915. He concludes by asserting that the moral indignation displayed in the Entente press during the War was directed principally against German gas warfare, but not against the employment of similar weapons by the Allies.

It is doubtful whether the proposed agreement between the B.D.C. and the I.G. will restrict secret preparations for gas warfare being made by any nation holding a predominant and self-contained position as regards the chemical arts. Our path of safety is to encourage to the utmost the development of research and industrial expansion in an independent national dye industry. G. T. M.

[2] "Fünf Vorträge aus den Jahren 1920-1923: Über die Darstellung des Ammoniaks aus Stickstoff und Wasserstoff; Die Chemie im Kriege; Das Zeitalter der Chemie; Neue Arbeitsweisen; Zur Geschichte des Gaskrieges." Von Fritz Haber. Pp. v+92. (Berlin: Julius Springer, 1924.) 0·65 dollar.

Sir Archibald Geikie.

A Long Life's Work: an Autobiography. By Sir Archibald Geikie. Pp. xii+426. (London: Macmillan and Co., Ltd., 1924.) 18*s.* net.

FROM time to time Sir Archibald Geikie has interested his numerous readers by writing sketches or reminiscences of incidents in his long and busy life. In the volume now before us he has set out in orderly sequence the principal events of his career from early boyhood to a well-earned period of rest. Advancing years may have curtailed his activities, but his memories of friendly intercourse with many distinguished men in all parts of the world, of the almost innumerable functions in which he has taken a prominent part, and the charm of the literary style in which he tells his experiences, remain as fresh as ever.

Born in 1835, Geikie's earliest reminiscences relate to incidents which to many of us seem to belong to ancient history, as, for example, the gathering of the Elders at the Disruption of the Kirk of Scotland, when black coats swarmed like hiving bees in and out of St. Andrew's Church, or the opening of the first railway in Scotland. But interest centres chiefly on the early proclivities of the boy himself, inasmuch as he was destined to become a leader in geology, a noted man of letters and a distinguished public servant.

At the Edinburgh High School, Geikie acquired an appreciation of the Latin classics which has been a joy to him all his life, but a love of Nature was evidenced by a passion for collecting butterflies. It was while so engaged in a limestone-quarry that he first found a fossil. Enthusiastically he broke up block after block, disclosing delicately preserved plants, and realising, not without awe, that he was bringing to the light organisms that had never before been seen by human eyes. Thenceforward the rocks and their fossils became increasingly the subject of his thoughts. Through this incident he became acquainted with Robert Chambers, author (as it appeared later on) of "Vestiges of the Natural History of Creation." He read every book on geology he could lay hands on, but in the "Old Red Sandstone" of Hugh Miller found a greater stimulus than in any other, not so much from the information it supplied as from its revelation of the enthusiasm of a true lover of Nature. From the consideration he received at the age of seventeen from such men as Logan, David Forbes, and Sorby, it may be inferred that he had already shown unusual promise as a geologist.

The time had come, however, for choosing a profession, and to his parents, as to so many others before and since, it appeared that though geology might be

a pleasant pastime, it could scarcely provide a living. They decided therefore to put young Geikie into a bank after two years' instruction in law in the office of a Writer to the Signet. The work proved to be "unspeakably dull," and the two years' training was never completed.

During a holiday in London Geikie returned to his old love. He passed many happy and profitable hours in the galleries of the newly established Geological Museum in Jermyn Street, and about this time (1853) first heard of the Geological Survey, a branch of the public service which had been initiated by De la Beche some ten years before. An interview with Sir Andrew Ramsay, at that time local director, and a walk taken over Arthur's Seat at Ramsay's invitation (issued, as we may suppose, for the purpose of forming an opinion of the young geologist's capability), led to a suggestion that a post on the survey might be found. In the interval of waiting he wasted no time. Some geological work in Skye formed the basis of a communication to the Royal Physical Society of Edinburgh in 1854, his first appearance before a learned society. Determined to continue his literary studies, he matriculated at the University of Edinburgh as a student of the humanities, and though prevented by domestic circumstances from completing the course, he became one of the best scholars of his year and the best writer of English prose and verse. In 1855 he obtained a post on the Geological Survey, and commenced his long career as a professional geologist. Let it be well taken to heart that he had equipped himself not only as a geologist, but also as a scholar and man of letters.

In the next few pages Geikie describes the work of a field-geologist, the simple accoutrement required, and the difficulty country people felt in understanding how he could tell what lay below the surface of the ground without digging. The work was arduous, and according to official regulations occupied nine hours a day, in practice probably much more. He found time and energy, nevertheless, to pursue his classical studies, and even enlivened long tramps home by recitations from his favourite poems. "I look back," he says, "on this period of my life as perhaps the most studious and certainly one of the most delightful that I have been privileged to enjoy." New discoveries in geology quickly followed, notwithstanding MacCulloch's vainglorious boast that he had left nothing in the geology of Scotland that could not have been effected by a surveyor's drudge or a Scottish quarryman. A fossiliferous shale was detected under massive sheets of Old Red Sandstone lava, but the origin and age of igneous rocks began to take first place in Geikie's attentions. In touching upon such questions he conveys his information in language which is intelligible to non-scientific readers; modern scientific technicalities find no place in these pages, when good English serves. For some time Geikie was the sole representative of the Geological Survey in Scotland. On him alone lay the responsibility of mapping a region extending into several counties and calling for much sagacity in dealing with new problems.

In 1860, owing to the death of Prof. George Wilson, who had had it in hand, it fell to Geikie to complete the "Life of Edward Forbes." Some hesitation was felt in entrusting the work to so young a man, but the book was completed and published in 1861, forming the first of a number of charming biographies from the same pen. In the autumn of 1860, Geikie accompanied Murchison on a tour through the Highlands, and though the secret of the Highlands was not yet to be told, his accounts of the hospitalities extended by the many large landowners with whom Murchison was acquainted, make good reading. In the winter, Ramsay having been taken ill, Geikie was called upon to take over the lectures at the Royal School of Mines and the popular geological addresses to working men in the theatre of the Jermyn Street museum. These addresses were delivered by the most eminent men of the day on their respective subjects and were attended by crowded and intelligent audiences. I have myself seen the theatre full of working men listening spellbound to an exposition by Huxley of the elements of biology.

The relics of the Glacial Period, during which a large part of the British Isles was overridden by ice-sheets, now began to claim Geikie's attention. Boulder clays, sands and gravels, collectively known as "glacial drift," were spread over the country during this period in such quantity as to dominate the soil and often completely to mask the characters of the underlying "solid" formations. A holiday spent in quest of glacial drift led to a communication to the Geological Society of Glasgow in which Geikie reviewed the sequence of events in Scotland and showed the boulder-clay to be the product of an ice-sheet, and not, as was stoutly maintained by many, of floating ice. He obtained confirmation of this view by an exploration of northern Norway.

By this time Geikie's intimate knowledge of a large part of his native country, his appreciation of a landscape, and the geological training by which he was enabled to interpret the significance of the features of the ground, impelled him to the writing of "The Scenery of Scotland." The book, though in direct antagonism to Murchison's cataclysmic opinions, was dedicated to him. The compliment was accepted without demur.

In 1867 a separate branch of the Geological Survey was constituted for Scotland and Geikie was appointed

director. Suitable men for the posts on the new branch were scarce, and among the candidates one at least, who afterwards achieved a great reputation as a geologist, and was in fact an able algebraist, failed to add up correctly against time long columns of pounds, shillings, and pence, a test of the capability of a field-geologist which was insisted on then and for many years afterwards by the Civil Service Commissioners. Friendships with many eminent literary and scientific men continued to ripen. Alexander Macmillan was one of the earliest and most constant. Another old friend, Poulett-Scrope, a high authority on volcanic problems, being desirous that the volcanic regions of southern Italy should be examined by a competent geologist, contributed two hundred pounds for the expenses and suggested to Geikie that he should undertake the examination. The offer was accepted, but a severe fever, developed at Lipari, put an end to the project.

Provision for a chair of geology in the University of Edinburgh having been made by Murchison in his will, he desired to nominate Geikie as the first professor. The Home Office objected to this as an interference with the prerogative of the Crown, and the Science and Art Department objected to two posts being held simultaneously by the same man. The objections were, however, overcome, mainly through the influence of Lyon Playfair, Member of Parliament for the University, and Geikie was appointed in 1871. In this same year he married and travelled to the south of France to visit his wife's relatives, witnessing on the way some of the horrors of a successful Prussian invasion. He was summoned back to the deathbed of his old chief and friend, Sir Roderick Murchison.

The creation of a school of geology in a poorly endowed University was beset with difficulties; lecture-rooms were inadequate, and rocks and fossils were lacking. The exceptional advantages for field-work offered by the country round Edinburgh were therefore utilised to the full. The field took the place of a lecture-room, and Nature supplied the specimens. In his second year the professor lectured to the Ladies' Educational Association and conducted geological excursions of ladies. Mixed classes, however, were not yet tolerated, and the male students were returned to their homes before the ladies appeared, a mistake in the opinion of the good lady who kept the inn where they stayed. Later, he lectured to the lunatics at the Morningside Asylum, and, by the help of an official, to the inmates of a Deaf and Dumb Institution.

These varied activities were not allowed to interfere with literary work. The third edition of Jukes's "Student's Manual of Geology" was completed by Geikie in 1871; in 1873 two science primers were written, and "The Life of Murchison" was in hand. In the same year, also, obituary notices of two old and valued friends, Logan and Lyell, were gratefully undertaken. At this time, what was perhaps the most onerous task in a busy life began to occupy his mind, namely, the preparation of an advanced text-book of geology. This work, a monument of research, of matured judgments and of lucid statement, was published in 1882. It is interesting to hear that the author of such a work found the writing of the little primers the most difficult task he had ever undertaken. The preparation of a classic memoir on the Old Red Sandstone, and a study of the weathering of marble and other rocks, as evidenced by tombstones, helped to consume what surplus energy was left after the performance of official duties.

An engagement to lecture to the Lowell Institution in Boston in 1879 led to an extended tour in the United States, in the course of which the Yellowstone Park and Salt Lake City were visited. While at Boston, Geikie dined at Lowell's house and sat between Longfellow and Oliver W. Holmes. The poet's face "always beamed with a kindly smile," but to talk to him proved difficult.

In 1882 Geikie succeeded Ramsay as Director-General of the Geological Survey and resigned his Edinburgh professorship. His new duties included supervision of the Scottish and Irish branches, the latter no sinecure, when one member of the staff, still well remembered, was on the warpath. Yet now as ever, time was found for literary work. The text-book was not yet published, and "Geological Sketches at Home and Abroad" was in preparation. At the same time he was prosecuting his studies of British Tertiary volcanic history, the results of which were published by the Royal Society of Edinburgh and were afterwards embodied in "Ancient Volcanoes of Great Britain."

The next few years saw no relaxation in this strenuous life. He was elected foreign secretary of the Royal Society in 1889, but undertook a more onerous task as president of the Geological Society in 1891–92. Presidentship of the British Association followed soon after, and among a shower of press clippings with which the occupant of such a post is bombarded, was one from a phrenological journal to the effect that the "organisation of this gentleman is most favourable for almost any sphere of life." The prophet was on safe ground, for, in addition to the posts already mentioned, Geikie was a member of the Royal Commission on Water Supply and of the Departmental Committee on the Ordnance Survey.

Among much other literary work now in hand was a biography of Sir Andrew Ramsay, the late Director-

General. In lighter vein were the dinners of the Literary Club. At these monthly gatherings Geikie met many distinguished men of letters and retailed the latest good stories from Scotland. The appearance of some of these in *Punch* puzzled him for a time, but he eventually detected the route by which they had travelled. A few years later in "Scottish Reminiscences" he published a selection of (but not all) his experiences of Scottish manners, customs and speech.

A visit was paid to Paris in 1891 to attend the centenary of the Institut de France. The guests were received at an evening function by M. Poincaré, then in his thirty-fifth year. Six years afterwards Geikie received through the French Embassy a beautiful specimen of Sèvres ware, but it was not until some months had elapsed that the unexpected gift was explained. Prof. Fouqué and M. Michel Lévy had moved their Government to accord Geikie the decoration of the Legion of Honour. But the French Ambassador pointed out that the British Government did not approve of the acceptance of foreign decorations by British subjects. The china had therefore been sent as a public mark of esteem, with an expression of keen regret that the British Government should be so exclusive. However, sixteen years later the Cross of the Legion of Honour reached its destination.

The International Geological Congress met every third year before the War, and in 1897 assembled at St. Petersburg. There Geikie was presented with other delegates to the Czar and Czarina and saw a charming phase of Russian home life in the country palace of the Dukes George and Michel of Mecklenburg.

The long period of service upon the Geological Survey was now drawing to a close. In the view of the Treasury, the service itself was of a temporary character and would cease to exist when a geological map of the British Isles on the scale of one inch to the mile had been completed. In such circumstances there had been a tendency to shelve questions relating to promotion, salaries and other matters, about which much dissatisfaction had arisen. This led to a request from the staff for a full inquiry, and eventually to the appointment of a strong committee, on which Government Departments, geological and mining interests were adequately represented. The recommendations made by the Committee were eminently practical and satisfactory. "It was to me," Geikie writes, "a great satisfaction to leave the service with the prospect that these much-needed reforms would be carried out." He retired in 1901 after a service of forty-four years and four months.

Abrupt severance from official duties is apt to leave a man at a loose end, but it was far otherwise with Geikie. Some Survey memoirs were still in hand, and various scientific societies made claims upon his time. Attendance at the first meeting of the International Association of Academies took him to Paris, and at the 450th anniversary of the University of Glasgow he was one of the recipients of the honorary degree of LL.D. In the winter of 1902–3 he attended meetings of the Reale Accademia dei Lincei, of which he was a foreign member, unaware that he was thereby earning a small fee for each attendance. In 1903, at the ninth meeting of the International Geological Congress, in Vienna, he renewed intercourse with his old friend Suess and many others. In this year also he was elected one of the general secretaries of the Royal Society, a post which involves much work in connexion with the numerous activities of the Society. Outside the ordinary routine was the making of arrangements in London for the second meeting of the International Association of Academies. The functions provided for the entertainment of the guests included a garden-party at Windsor Castle, when the members were received by King Edward and Queen Alexandra. The first centenary of the Geological Society was celebrated in 1907. It being felt that the presidential chair should be filled on such an occasion by a geologist of outstanding reputation, Geikie, though he had already been president, was asked to allow himself to be nominated. The celebration led to what was probably as distinguished an assemblage of geologists from all parts of the world as had ever met.

In 1908, on the retirement of Lord Rayleigh, the Council of the Royal Society nominated Geikie as his successor to the presidential chair. The many duties which are attached to the post, both within the Society's rooms and outside, made serious inroads upon his time, but gave him the opportunity of devoting his energies more strenuously than ever to the welfare of the Society. The most outstanding incident during his presidentship was the celebration of the 250th anniversary in 1912. Men distinguished in every branch of science attended from all parts of the world. After a short service in Westminster Abbey, the delegates handed the addresses with which they had been entrusted to the president in the Society's Library. In the evening a banquet was held in the Guildhall, at which the toast of the Royal Society was given by the Prime Minister and responded to by the president. An unpremeditated toast was added to the list during dinner, that of Prince Lichnowsky, the newly appointed German Ambassador. In his reply he said, "Never between England and Germany have there been more intimate and more sincere relations than at present. Both countries are working side by side in the same cause of maintaining European peace." It appears to have been a fact that the preparations for the War, then

being made by the higher powers in Germany, were not known to the German Ambassador. Two notable volumes were prepared at Geikie's instance in readiness for the celebration; one an enlarged edition of the Society's "Record," the other a facsimile reproduction of the Charter Book containing the original signature of Charles II., followed by the signatures of all fellows from the commencement, "a collection of autographs probably without an equal, as representative of the science and culture of Europe during the period which it embraces."

At this time the British Academy came into existence and was soon followed by the Classical Association. As president of the latter Geikie chose for the subject of his address the evidence in Latin literature of an appreciation of Nature by the Romans. The subject proved so fascinating that he pursued it later on both at home and amidst landscapes that must have been familiar to some of the Roman poets. The writing of the book, "The Love of Nature among the Romans," served, so far as anything could, to distract his thoughts from the tragedy of the death of his only son, a young man of brilliant promise.

From 1914 Geikie's time has been spent chiefly at his country home near Haslemere, and though not so active as he once was, there has been little relaxation in his industry. In 1920 he was elected as chairman of the Royal Commission of Inquiry into the University of Dublin. "The Annals of the Royal Society Club" was written during these years of retirement, and now has been followed by the fascinating volume to which this notice relates. It was during this period of quiet retreat, on the last day of 1913, that a special messenger brought the intimation that the King had conferred upon Geikie the Order of Merit. He had already been made K.C.B. in 1907. Space does not admit of the enumeration of the academic honours conferred upon him.

I cannot conclude more fittingly than in the words used by Walter H. Page, at the time American Ambassador. In a letter to Geikie on his birthday, which he had learnt was the same day as that of the President of the United States, he wrote, "You also are entitled to great thanks for being born into a world that you have made wiser and merrier by your presence and labour."

A. STRAHAN.

A Biological Study of Radiation.

Radium, X-rays and the Living Cell: with Physical Introduction. By Hector A. Colwell and Prof. Sidney Russ. Second edition, revised. Pp. xi + 365 + 3 plates. (London: G. Bell and Sons, Ltd., 1924.) 21*s.* net.

THE second edition of this book, which was first published nine years ago, brings the experimental biological study of the effects of radiations up-to-date; it includes a new chapter which summarises the action of rays on living structures, and discusses the theories put forward to explain these actions.

The authors are, rightly, cautious in discussing "Laws." Their subject is a new one, and it is only recently that the nature of X- and gamma rays has been settled and their place in the electromagnetic spectrum charted.

How do X-ray exposures cure tuberculous glands? By killing the tubercle bacilli? In a test-tube, X-rays can kill tubercle bacilli, but it takes a big dose—so big that no human tissues could live through the bombardment. How then does a moderate dose cure the patient? Clearly it is the human body that achieves the cure; the tissues react to the radiation, and kill and rid themselves of the intruding bacilli, weakened by the radiation. Many factors may be at work. The action of the X-rays may be selective, weakening the bacilli but weakening the tissue cells less, or actually stimulating the tissue cells to increased activity.

Clearly there are countless problems for experimental solution. The conclusions so far reached are valuable, but (as the authors point out) they are still very incomplete, inconclusive, and even contradictory.

Of chief interest is the bearing of these researches on the treatment of cancerous growth. Stated briefly the conclusions are: Some growths can be abolished and an apparent cure obtained. Others can be reduced in size, with temporary relief, only to take on new activity which defies control by radiation. Even the "cures" are only too commonly illusory. The disease breaks out again in the same place or elsewhere and becomes disseminated. We seem to be no nearer the "cure" for cancer. But we need not despair, nay, we dare not. Although a cure may never be found, there is great hope of our learning how to prevent cancer. We are now certain that cancer is not a disease which springs upon us mysteriously, and strikes us down "like a bolt from the blue." It is the last phase of a chronic disease that affects our tissues, makes them unsound, and deprives them of their powers of resistance.

Certain races live a natural life in the open air, engaged in active agricultural pursuits, and eating the natural "live" foods of Nature (grains, nuts, milk, eggs, fruits, and uncooked vegetables). These races are immune from the disorders of digestion so rife in civilised lands. They do not suffer from dyspepsia, gastric and duodenal ulcer, gall stones, appendicitis and colitis, and they live to a good age without falling victims to cancer. Contrast their state with that of dwellers in civilised towns. Their life is largely indoors and sedentary, their food and drink almost entirely "dead" food; it is frozen for long periods, or boiled and canned, or impregnated with chemicals, such as

borax, sodium salicylate, and saltpetre. Even the fresh foods that reach the consumer un-killed and undefiled, pass through the kitchen, and are there deprived of their living properties, and worked up into appetising dishes. "Hunger is the best sauce," but the life that is forced upon civilised races deprives them of this relish. To make matters worse, sugar (sweetmeats and chocolates) are eaten in great quantity. The consequence is that the digestive system fails; constipation and intestinal stagnation occur; the overfilled stomach and intestines drop and become kinked; their stagnant contents decompose and poison the system. Not only the stomach and intestines, but also every tissue of the body is poisoned and loses its power of resistance. Sooner or later a stage is reached when some part gives way, when we have another case of gastric ulcer or appendicitis, and the surgeon is called in to remove the part that has "rotted." If the surgeon is an observer, he notices that the rot is general and is not confined to the appendix, gall bladder, or gastric ulcer which he is removing.

A person whose tissues are in this state is certainly on the road to cancer, and little lasting good can come of an attempt to cure him by local radiation. He must "clean himself up"; then Nature will have a chance to aid him in his fight for life. The great good that may come from the experimental researches described in this book is that it may teach us Nature's method of ridding itself of morbid growths. The new edition is of immense interest to all who are engaged in the study of tumour growth.

Our Bookshelf.

A Practical Handbook of British Birds. Edited by H. F. Witherby. 2 vols. Vol. 1. Pp. 532+xvi. Vol. 2. Pp. 960+xii. (London: H. F. and G. Witherby, 1919–1924.) 4*l.* 10*s.* net.

THIS important work, which has been appearing in parts since 1919, is now complete, and the corrections and additions in the last part bring the whole up-to-date. The bound book is available in alternative forms, and of these the thin paper edition makes two volumes of little more than pocket size. It is thus a handbook in a real sense, but at the same time the quality of its contents fully entitles it to a worthy place on the library shelf with larger works of reference.

The object aimed at has been to give in a small space and in systematic form all the most important information about the external characters of British birds, their distribution and migration, their breeding habits, nests and eggs, their song and their food. This has been very successfully achieved by the authors responsible for the various subjects. The numerous illustrations, many of them in colour, are admirable from the point of view of practical utility as aids to identification. There are also useful key tables to the distinguishing characters of the different systematic groups.

The book is, however, more than a carefully compiled and well edited work of reference. It represents, indeed, much original investigation, the results of which are presented for the first time. This refers particularly to the descriptions of plumage, most of them by the editor himself, which constitute the most important part of the work. These descriptions have been based upon new examinations of large series of specimens, including those in the British Museum and in Lord Rothschild's large collection, and they take full account of all differences of sex and age and of all seasonal changes: the different geographical races or sub-species are separately treated. The method is consistently followed in this respect, and in a few cases, from their nature unimportant in British ornithology, a phase is frankly mentioned as "not examined." A great labour has obviously been performed, and as a result we have much valuable information not previously available, and a high trustworthy standard throughout.

The treatment of the other subjects is less detailed but quite adequate for the purpose, the limits observed being those proper to a condensed work of reference. The contributors, other than the editor, are Dr. Ernst Hartert, Miss A. C. Jackson (Mrs. Meinertzhagen), the Rev. F. C. R. Jourdain, Mr. C. Oldham, and Dr. N. F. Ticehurst.

This "Practical Handbook," then, in addition to containing important new contributions to ornithology, seems to us to be the most useful systematic text-book of British birds that can be placed in the hands of the serious student of the subject. It undoubtedly takes its place as a standard work.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland: a Record of the Work done in Science, Literature, and Art during the Session 1922–1923 by numerous Societies and Government Institutions. Compiled from Official Sources. Fortieth Annual Issue. Pp. vii+389. (London: C. Griffin and Co., Ltd., 1923.) 15*s.* net.

WE are glad to be able to extend a welcome once more to this valuable handbook, which has now reached its fortieth anniversary. The publishers are to be congratulated on the courage and persistence with which they have issued year by year a volume so useful to all who would keep in touch with scientific developments and at the same time a book necessarily of limited circulation. The volume is divided into the customary fourteen sections, in each of which related societies are grouped. The classification this implies is a difficult problem, but we have little fault to find with the present arrangement; the Institute of Physics would appear more appropriately in the section given to astronomy, mathematics, and physics than in its present place under "Science Generally." The very full index, however, will generally obviate any difficulty which may arise in this way.

For those who are not familiar with the handbook, it is desirable to say that it gives full particulars of the scientific and learned societies of the British Isles, their officers, addresses, meetings, conditions of membership, publications, and, in many cases, the titles of the papers presented and lectures during the year

1922–23. There are also included accounts from Government institutions, such as the National Physical Laboratory, the Royal Observatory, Greenwich, and so on. In some few entries, telephone numbers and telegraphic addresses are also given; this might usefully be extended to all the societies which are served by telephone. We also think that a complete list of the various Research Associations, together with separate entries in their appropriate sections, would be valuable, while other omissions we have noted are the Institution of Chemical Engineers, the Eugenics Education Society, and the Institution of Welding Engineers.

The information provided by the handbook is furnished by officials of the societies concerned, and we must add our thanks to those of the publishers for making the volume possible. No doubt it is by a slip that the new address of the Institution of Automobile Engineers from August last has not been inserted.

Our criticism must not be taken as disparaging. In no other volume, we believe, is similar information brought together, and our suggestions are made in order that the next issue may give us cause for still more gratitude to the publishers and all concerned in issuing the handbook.

Canned Foods in Relation to Health. (Milroy Lectures, 1923.) By Dr. William G. Savage. (Cambridge Public Health Series.) Pp. vii + 146. (Cambridge: At the University Press, 1923.) 8*s.* 6*d.* net.

THIS book consists of the author's "Milroy Lectures," delivered in 1923, with some amplification. The canning industry is a very important one in the United States and South America, and in the overseas Dominions. Though the industry is small in Great Britain, large quantities of canned foods are imported and consumed here. Thus in 1921 some 22,500 tons of canned meat alone (and much larger quantities of salmon and fruit) were retained in Great Britain.

Apart from the magnitude of the industry, there are special reasons why this class of food-stuffs needs supervision additional to that exercised over food generally. The most important of these is that the use of unsound constituents is less easily detectable than in the case of ordinary foods. Dr. Savage has examined various methods of manufacture, and pays a high tribute to the work done by the National Canners' Association (U.S.A.) in the improvement of the products of its members. But he finds that the control exercised over canned foods at the port of entry leaves much to be desired, and that better and more uniform methods are required for the disposal of the contents of rejected tins. Dr. Savage also urges that the date of preparation, together with a code mark for identification, should be stamped on all tins. The important subject of the causation of disease by canned foods is dealt with at length by Dr. Savage, and he comes to the comforting conclusion that canned foods as a whole are safer than fresh foods.

The book contains a very complete summary of this important subject, and concludes with appendices on the principles involved in the process of canning, and on the laboratory methods for the examination of canned foods, and with a selected bibliography of the subject.

Invertebrate Zoology. By Prof. Harley Jones van Cleave. (McGraw-Hill Agricultural and Biological Publications.) Pp. xvi + 259. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 15*s.* net.

IN this volume the author "has endeavoured to collate materials which will serve as a class-room text and reference work," assuming that the student has already had an introductory course in zoology. The attempt to compress an account of the invertebrates into 240 pages is, in our opinion, scarcely successful, for it has compelled the author to deal so summarily with many of the subjects and of the classes that the accounts are too short and inadequate to be of real value; *e.g.*, endomixis is dealt with in about eight lines, and the student can form little idea of the process from a perusal of this brief statement. It would have been better, we think, to omit reference to a number of the more difficult groups, *e.g.*, Phoronida (the account of which occupies about eight lines), and deal more fully with other groups. Some of the references to protozoa require revision, *e.g.*, that *Piroplasma hominis* is the causal agent of Rocky Mountain fever, and the use of "hæmogregarines" as synonymous with Babesia is incorrect. If a cyst of *E. histolytica* is to be illustrated at all, a figure better than Fig. 24 should have been provided. We can only conclude that in a course in which such a compressed account of invertebrates is used, it is intended that much of the information on any given group will be acquired in the laboratory, the text-book serving as a brief summary for reference.

The Diseases of the Breast. By Willmott H. Evans. Pp. xii + 495 + 102 plates. (London: The University of London Press, Ltd., 1923.) 27*s.* 6*d.* net.

THE subject of diseases of the breast is one which presents many problems to the clinician, the pathologist, and the surgeon. Mr. Willmott Evans endeavours to sum up the present views on the subject, and draws on his own experience to express opinions on controversial points. His book is certainly very complete, covering anatomy, physiology, clinical examination, pathology, and treatment down to the last detail. With regard to the disputed subject of dissemination of carcinoma, Mr. Evans has no hesitation in accepting the theory of permeation described by Sampson Handley, with the reservation that embolism may account for a certain number of metastases. The book is well produced and well illustrated; it forms an excellent addition to the literature on diseases of the breast.

Statique et résistance des matériaux. Par Prof. Paul Montel. Pp. vi + 274. (Paris: Gauthier-Villars et Cie, 1924.) 30 francs.

THIS book is practically a reproduction of the lectures delivered at the École des Beaux Arts by Prof. Montel on statics and the resistance of materials. The range does not differ essentially from that covered by English text-books, but to those who have a penchant for geometric in preference to analytical proofs, the book is to be recommended. Wherever possible geometrical demonstrations are adopted and numerical calculations effected graphically. A number of useful practical examples are to be found at the end of each chapter.

Letters to the Editor.

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

The Anomalous Emission of α-Particles from Polonium.

IN a recent issue of the *Zeitschrift für Physik*, Walther Kutzner has given the results of some careful measurements made with the view of testing the validity of Bateman's probability formula in its application to the emission of α-particles by polonium (*Vide Zeit. f. Phys.*, vol. 21, pp. 281–298, 1924). He arrives at the following conclusions :

(1) The emission of α-particles by polonium does *not always* obey Bateman's probability formula for a process of a purely fortuitous nature.

(2) Systematic deviations have been found to indicate a *subnormal* dispersion, *i.e.* the time intervals in which definite numbers of particles are observed occur more frequently, when the numbers lie near the mean value, than would be expected by the laws of probability. On the other hand, the time intervals corresponding to a large or to a small number of particles occur less frequently than theory predicts. (In other words, the familiar "cocked-hat" probability curve is higher at the crown and lower at the brim than would be expected from the theory.)

(3) It is found that the deviations are more appreciable, the greater the activity per mm.^{2} of the radioactive source.

(4) By allowing the source to decay, an improvement is found in the agreement between theory and experiment.

(5) The cause of this behaviour with polonium is discussed, and it is shown that, although the phenomena of scattering, surface oxidation, and diffusion of the polonium into the activated discs can influence the magnitude of the "subnormal dispersion," they are in themselves insufficient to explain the phenomenon mentioned in (4).

(6) For the explanation of this result it is suggested either that the individual radioactive polonium atoms mutually influence each other, or that the individual α-particles influence other atoms (atomic disruption).

From simple considerations one would not expect that an α-particle could approach the nucleus of a heavy atom sufficiently closely to bring about artificial disintegration, and hence it becomes imperative to examine whether Kutzner's results can be explained in a less drastic manner than that suggested under (6) above. The object of the present note is to show that effects identical with those observed by Kutzner are to be expected on the basis of the phenomenon of aggregate recoil, as usually obtained from sources of α-rays deposited on metallic discs. The importance of this phenomenon in the case of polonium was fully discussed in a paper by the present writer in 1919 (*Mitt. Ra. Inst.* Nr. 118, *Wien. Ber.*, vol. 128, pp. 795–830 ; also NATURE, vol. 102, p. 464, 1919), and has been confirmed by additional unpublished results, of which use will be made in what follows.

Electrolytic polonium does not consist solely of individual atoms on the metal disc, but an appreciable part of the deposit may exist in the form of aggregates of polonium atoms. Such aggregates are also formed in the case of the active deposit obtained by exposing a metal plate in emanation. When an α-particle is emitted in the direction of the plate from such an aggregate, the latter recoils from the plate, and in a vacuum leaves it entirely. Under such conditions one instance was noted in which the apparent decay of polonium was such as would correspond to a half period of 59·6 days, as compared with the true half period of 136·5 days. But even at ordinary pressures the rate of decay sometimes appeared to be so low as 127·1 days, so that even under normal conditions some of the recoiled aggregates may disappear from the plate. The number of aggregates per unit area and their complexity increase with the surface density of the electrolytic deposit, and, particularly under reduced pressures, it is the more complex groups that leave the plate first, in consequence of their containing more polonium atoms. In the course of time it follows that the polonium remaining on the disc is less and less complex, and indeed, after a sufficiently long time, one would expect the polonium remaining to consist almost entirely of individual atoms. As a matter of fact, aggregate recoil phenomena do become less marked with the lapse of time, owing to the degeneration of the aggregates, and many curious effects observed with radioactive deposits admit of simple interpretation on these lines (*e.g.* observations by Ratner, *Phil. Mag.* (6), vol. 36, p. 397, 1918).

Owing to the intense ionisation near the surface of a disc coated with polonium, it is easily seen that the aggregates, after recoil, may readily acquire a charge, and in circumstances negatively charged aggregates may preponderate.

Consideration of the above results supplies us with a ready interpretation of Kutzner's observations, for he used an electric counter of the Geiger type, in which a platinum point is enclosed in an outer metal cylinder or hemisphere, charged to a positive potential of more than 1000 volts, there being a small central opening in the front of the counter, covered with thin aluminium foil, through which the α-particles are admitted. In general, the distance of the radioactive source from the counter diaphragm, with respect to which it was centrally arranged, was from 5 to 7 mm., so that the intervening space would be subject to a strong electric field. From what has been said above, it is clear that many of the recoiled aggregates would be attracted to the aluminium foil closing the counter, so that the counts corresponding to the maximum of the probability curve would lie too high, whereas the limiting ordinates observed would be deficient. This is precisely what Kutzner noted (see (2) above). Moreover, since the formation of aggregates is enhanced for higher surface densities of the radioactive deposit, the deviations will be more marked in such cases (cf. (3) above). On the other hand, by allowing the polonium to decay, a progressive degeneration of the aggregates takes place, and the deposit acts more and more nearly like one composed of individual atoms, so that the agreement between experiment and theory improves steadily (cf. (4) above).

Using preparations of polonium of high surface density, Kutzner found, for a given source, that the deviations from theory were more considerable, the larger the aluminium-covered diaphragm through which the α-particles entered the counter. The number of transferred aggregates that are effective will obviously depend on the size of the diaphragm, being greater for larger diaphragms, so that such a result is to be expected, whereas it would be much smaller, or almost absent, when the same experiments were performed with a preparation of low surface density, and this Kutzner found to be the case.

By performing counts in which the source was first centrally opposite the entrance to the counter, and secondly, laterally displaced through 5 mm. with respect to the axis of the counter, Kutzner detected

a better agreement with theory in the latter case. This he ascribes to an influence of the direction of the α-particle beam within the counter, but it seems more likely that it was due to the fact that, in the second case, a smaller proportion of the transferred aggregates fell on the counter window. In another experiment, Kutzner found that with an unscreened source the deviations from theory were less than when the source was screened by a thin aluminium foil. This result may be, as he suggests, connected with the effects of scattering, but if the experiment were performed in the reverse order, one would expect that the screened source would give better agreement with theory than the unscreened.

Finally, Kutzner finds that counts with a willemite screen always yield results about 5 per cent. less than with an electric counter (*loc. cit.*, also *Zeit. f. Phys.*, vol. 23, p. 126, 1924). In view of the above, it is doubtful whether the whole of this difference is due to the inefficiency of willemite screens as compared with electrical counters, though it is generally recognised that deficient counts result from the scintillation method. It seems very probable that thin sections of willemite, as used by Kutzner, are more efficient than scintillation screens made from powdered willemite or zinc sulphide crystals. Were Bateman's formula to be tested by means of such screens, one would expect better agreement between experiment and theory than Kutzner found by means of the electrical counter, owing to the absence of an impressed electric field in the former case.

The deviations from theory in experiments by Rutherford and Geiger and by Hess and Lawson, to which Kutzner refers in his paper, are less systematic than his own. The former (with polonium) probably admit of the above explanation, whereas the latter were done with γ-rays and only for purposes of orientation.

ROBERT W. LAWSON.

Sheffield.

The Rotatory Dispersion of Tartaric Acid.

LONGCHAMBON (*C.R. Acad. Sc.*, vol. 178, p. 951, 1924) has recently found that the rotatory dispersion along the optic axes of crystalline tartaric acid is approximately the same as that of the lævo-rotatory component which contributes to the anomalous rotatory dispersion shown by solutions of the acid. The rotatory dispersion here referred to is measured by the ratio between the rotations for the blue (436 μμ) and yellow (578 μμ) lines of mercury. For the crystals it is 2·14, while for the lævo-component in solution it is estimated to lie between 2 and 2·22. From previous researches Longchambon had concluded that the rotatory dispersion of a given substance is a property which is conserved when the substance passes from the solid to the liquid state by fusion or solution. Applying now this generalisation to the case of tartaric acid, he states: "Le constituant gauche ne serait donc ni un anhydride ni un éther interne; ce serait l'acide tartrique ordinaire, *tel qu'il se trouve dans le cristal*; je l'appelerai 'acide tartrique α.' J'appelerai le corps droit 'acide tartrique β'; c'est la formation de cet acide β de l'acide α, par dilution ou élévation de température, qui produit les anomalies de dispersion rotatoire."

It seems appropriate now to compare these conclusions with those arrived at from the X-ray examination of the crystal structure of tartaric acid (Proc. Roy. Soc. A, vol. 102, p. 506, 1923). Out of this work it was suggested that the dextro-rotatory property of ordinary tartaric acid is associated with the carbon nucleus of the molecule, an arrangement of four carbon atoms which appears to exist in the crystal as an irregular tetrahedron, while the lævo-rotatory power is associated with the rest of the molecule, manifesting itself principally through a twisted arrangement of the four hydroxyl groups, similar, but longer than and in an opposite sense, to the twisted arrangement of carbon atoms. "There is only one part of the molecule to which we can ascribe any degree of stability, and that is the nucleus of four carbon atoms arranged in an irregular spiral. Such effects as ionisation and hydration would tend to destroy the lævo-rotatory action of the four hydroxyl groups, *and it is probable that it requires the application of the forces which bind the molecules into the crystalline structure to complete the lævo-rotatory system.* Any change, such as fusion, solution, and certain chemical reactions, which leads to departure from the orientations which hold in the crystalline structure will tend to eliminate the hydroxyl spirals" (p. 527).

It thus appears that the work of Longchambon supports the conclusion arrived at from the X-ray analysis, that the lævo-rotatory component in solution is substantially the same system as that which produces the strong lævo-rotation in the crystalline form; that the tendency to crystallise and the act of crystallisation, though not unique as changes involving forces which enhance the lævo-rotatory power, are yet well-marked examples of such changes and lead finally, in the crystalline form, to the perfection and stabilisation of a lævo-rotatory system which completely overpowers the effect of the dextro-rotatory part of the molecule. From such a hypothesis it follows that, even in infinitely dilute solutions, since the molecule can never be stripped bare to the carbon nucleus above, the rotatory dispersion will still be anomalous. That this is experimentally true has been pointed out by Lowry and Austin (*C.R. Acad. Sc.*, vol. 178, p. 1902, 1924) in reply to the note of Longchambon. It also follows that the dispersion in the crystal, though the lævo-rotation overwhelmingly predominates, is probably not truly normal either. It is true that Longchambon says "la dispersion rotatoire est d'allure normale, mais très forte, . . ." but I presume this remark refers only to the region of the spectrum examined.

W. T. ASTBURY.

Davy-Faraday Research Laboratory,
Royal Institution,
Albemarle St., W.1, July 7.

Early Canadian Experiments on the Acoustic Method of Depth Sounding for Navigation Purposes.

REFERRING to the article "The Acoustic Method of Depth Sounding for Navigation Purposes" published in NATURE of March 29, 1924, p. 463, it may be of interest to record some experiments carried out by the writer in 1915 on obtaining depths at sea by the echo method.

Having had much experience in carrying on fog alarm researches at Father Point, Que., for several years from 1913, the writer felt in the early days of the War that this site would be an admirable one for carrying out researches on submarine acoustics, with the view of solving some of the problems relating to the submarine situation in Europe. In addition to the facilities for experimental work, such as isolation, wharfage facilities, calm weather, easy access to a main railway line, etc., an important consideration was the fact that supplies of scientific material from America and co-operation with American men of science could be obtained on Canadian territory before the United States had yet entered the War.

In the early autumn of 1915 a plan and report to this effect was sent to the Minister of Marine and

Fisheries; and, while the question was being considered by the Canadian Government, a start at actual research was made with the co-operation of the Submarine Signal Company of Boston, Mass., U.S.A. It was decided to repeat the experiments of Prof. R. A. Fessenden (Trans. Am. Inst. of Elect. Eng., vol. 33, Oct. 1914, pp. 1569-1581) "On Obtaining the Depth of the Sea by the Echo Method." A Fessenden oscillator with the associated motor generator set was installed on the Canadian hydrographic survey ship *Cartier*, and during the month of October 1915, numerous experiments were tried on "depth sounding" (Fig. 1). A short experience showed that for moderate depths, 30 to 40 fathoms, the same oscillator could not be used for receiving the echo, on account of the persistence of transients in the electromagnetic circuits. A separate hydrophone, shielded from the oscillator signal by being placed on the opposite side of the ship, was therefore employed, and experiments, though for the most part unsuccessful on account of the weak echoes received from a sea bottom of soft ooze and clay, gave indications at favourable localities as to the ultimate possibilities of this method.

At this early date and under war conditions, it was practically impossible to obtain thermionic amplifiers

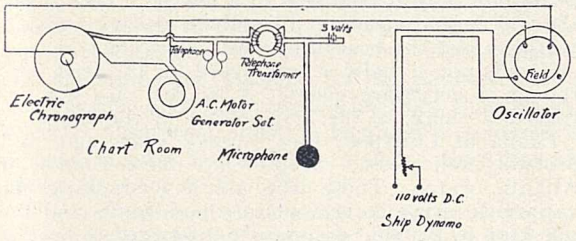

FIG. 1.

by means of which echo signals could be received. Then, too, for the faint echoes involved, the type of hydrophone available was not sufficiently sensitive, while for experimental work the type of oscillator available, weighing 1300 lb., was inconvenient for overboard use, especially with the ship in motion.

In a report submitted to the Electrical and Submarine Committee of the Admiralty Inventions Board, it was finally concluded that special transmitters of less weight, designed for inboard use, would have to be developed in conjunction with a more sensitive type of hydrophone. In order to obviate the use of thermionic amplifiers as much as possible, it was decided to make use of a hydrophone, suitably damped, capable of tuning in to the definite wave-length emitted.

A tuneable diaphragm, forming an essential feature of a hydrophone, was briefly described in the Proc. Roy. Soc., London (99-A, 1912, pp. 163-171). At the request of the Inventions Board the complete mathematical theory of electrically operated sound generator was undertaken, with the view of facilitating design.

It will be readily seen that a diaphragm both for emitting and receiving corresponds to the aerial in radio-telegraphy. In the latter field, the enormous advantage of the aerial tuning condenser for the selection of narrow wave-length bands is the characteristic feature of modern radio transmission and reception, an enormous increase in the range of communication having thus been effected. In just the same way, the writer anticipates a radical improvement in the art of submarine signalling by the introduction of tuneable diaphragms enabling specified wave-lengths to be picked up to the exclusion of others.

During the past few years the writer has been working at improvements in the construction of transmitters and receivers based on the principle of selective tuning, which it is hoped may find a useful field of application in an improved system of depth sounding for navigation purposes.

LOUIS V. KING.

McGill University, June 15.

Study of Explosions.

SIR OLIVER LODGE, in NATURE of July 5, p. 10, suggests that the methods of producing the "Big Bangs," which have previously been used, may not be the most effective for the purpose.

While on service in France with the Artillery, it appeared evident to me that the noises with the greatest "carrying power" were made by the gun discharges, and not by detonations of high explosive shells.

The battery with which I was at the time was a 6-in. howitzer battery, and I noticed that the detonations of our own shells, although visually observed from an O.P. at 2000 or 3000 yards range, were often inaudible; whereas an enemy gun or howitzer at the same order of distance was always distinctly heard.

The noise of the great bombardment near Ypres in 1917, which was clearly heard from the South Downs in England, always seemed to me to be that due to the guns themselves, and quite unlike the characteristic "c-r-r-rumps" of H.E. shell detonations.

It seems possible that the detonation of a high explosive must produce an air wave of a very steep wave front, which may be damped out by the internal friction of the air particles more rapidly than the slower rise and fall of pressure produced by the combustion of the propellent type of explosive.

It is to be hoped that Sir Oliver Lodge's suggestion that in a future trial a charge of gunpowder or cordite should be exploded, in some form of container if necessary, at a considerable height from the ground, will be adopted.

P. J. RYLE.

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Berkshire.

IN view of the recent attempts to utilize surplus munitions of war in the investigation of the propagation of sound in the atmosphere, it may be worth while to direct attention once more to the opportunity that explosions afford for investigating the propagation of seismic waves in the upper layers of the earth's crust. In the Oppau explosion 4000 tons of explosive produced a wave that was recorded by a seismograph at a distance of 365 km. This was a surface explosion. The momenta communicated to the air and the earth by the shock must have been equal, and therefore the amounts of energy that went into the air and the earth must have been in the ratio of the velocities; thus much less than a thousandth of the energy can have gone into the seismic wave. If, however, the explosive is buried deep in the ground, nearly all the energy will go into the earth. Thus a wave of intensity greater than that produced by the Oppau explosion could be produced by firing 4 tons of explosive underground. Further, timing could be made specially easy by having the explosion in wireless communication with the observatories, thus eliminating the uncertainty of the time at the focus.

HAROLD JEFFREYS.

St. John's College, Cambridge.

Different Types of Ions in Hydrogen.

IN a previous letter (NATURE, June 16, 1923, p. 810), and more recently in the Proceedings of the Royal Society (105, p. 116, 1924), I described some experiments on the products of ionisation in hydrogen, nitrogen, and oxygen. It may be recalled that the method depended on the combination of an ordinary ionising potential arrangement with a simple positive ray analysis apparatus.

For hydrogen the principal conclusion drawn was that ionisation at 16·5 volts was not accompanied by dissociation. This conclusion rested on results at very low pressures where no atomic ions were detected below twenty volts and comparatively few even up to the highest voltages used. It was found, however, that at higher pressures the relative intensity of the atomic ions, H^+, became much greater, apparently due to a secondary dissociation of the molecular ions, H_2^+. No appreciable number of triatomic ions, H_3^+, had been observed at low pressures, and no search was made for them in the few experiments made at high pressures.

I have now set up an entirely new apparatus very nearly identical with that used in Cambridge and wish to report further results. The conclusion that the primary product of ionisation in the neighbourhood of 17 volts is H_2^+ has been confirmed. However, as the pressure is increased, it is found that H^+ does not necessarily become dominant. The effect due to H_2^+ becomes smaller and both H^+ and H_3^+ increase in intensity, but their relative size depends on the arrangement of the electrical fields (to be specific, on the strength of the field designated V_2 in previous communications). Thus, by varying conditions of pressure and electric field it is possible to produce almost any desired proportions of the three types of positive hydrogen ion.

The new evidence on a possible critical potential at about 20·8 volts corresponding to ionisation accompanied by dissociation is not conclusive, but makes its reality very doubtful.

The most interesting new result I have to report is, perhaps, the observation of peaks corresponding to apparent values of $m/e = 1/2$ and $1/3$. These are not attributed to anything so unexpected as doubly and trebly charged hydrogen nuclei, but merely to ions which have fallen through the entire electric field as H_2^+ or H_3^+, but which break up in the field-free space between the two slits before passing into the magnetic field. It is nevertheless remarkable that the atomic ions so formed should retain the direction and velocity of the original ions sufficiently to pass on through the magnetic field and produce a "peak." Obviously these results suggest a reinterpretation of the effects in nitrogen and oxygen previously attributed to doubly charged atoms. They also offer interesting possibilities for studying the mechanism of ionisation.

These points and others will be taken up in a full report of the work which I hope to write in a few months.

H. D. SMYTH.
Palmer Physical Laboratory,
Princeton University,
Princeton, New Jersey, June 4.

Transplantation of Heads of Insects.

IT may be of some interest to biologists if I supplement Dr. W. T. Calman's letter under the title of "Chimæras Dire" (NATURE, July 5, p. 11) by a brief record of some experiments of my own. Not having any water-beetles available at the time, I tried to repeat Dr. Finkler's experiments on meal-worms. I cut off the heads of two pairs of specimens, and interchanged those of each pair. In a third case I had a single specimen which had recently moulted, and after removing its head put in its place that of another individual. The heads became attached to the alien bodies. I kept the specimens in Petri jars with a little meal. They made no spontaneous movements, but showed signs of life for a varying number of days, the maximum number being five. The signs of life in question were response to stimulation of the body with a blunt point. The head seemed to be dead long before the body. The only remarkable thing in the result of these experiments was the tenacity of life of the insect body after decapitation, and it may be doubted, especially after the results of Drs. Blunck and Speyer, whether anything more occurred in Dr. Finkler's experiments.

J. T. CUNNINGHAM.
21 Gower Street, W.C.1.

Velella at Port Erin.

WE have just found enormous numbers of the remarkable Siphonophore *Velella spirans* cast up by the tide in a neighbouring bay (Perwick). My daughter and a friend first noticed some specimens floating in a shore pool, and then we found abundance amongst the wet sea-weed at high tide mark, and picked up several hundreds in a few minutes. They were all dead, but many still showed the polypes and tentacles and the beautiful violet coloration.

This is not actually a new record for the Irish Sea, though a very rare event. A similar case was recorded, I think, in the first volume of the L.M.B.C. "Fauna of Liverpool Bay" many years ago, and probably indicates an exceptionally marked inflow of Atlantic water. Those who are now studying the variations in the movements of the currents and the plankton in British Seas may be interested to hear of this unusual occurrence.

W. A. HERDMAN.
Port Erin, July 13.

A Rare British Oligochaet.

IN Mr. Beddard's Monograph of the Oligochæta, p. 216, reference is made to *Rhynchelmis limosella* Hoffm., in these words: "There is every probability that it is a native of this country." I reported the finding of a specimen some years ago at Ringwood, but there was an element of doubt. Now, however, I am in receipt of an excellent specimen sent me by Mr. W. J. Lucas, which puts the matter beyond all question. Mr. Beddard thinks there is a specimen in the Oxford Museum, but I have had no confirmation of this.

HILDERIC FRIEND.
"Cathay," Solihull.

Physical Properties of Clay.

THE late Dr. R. Mullineux Walmsley was interesting himself in my work on the above subject, and for this purpose I lent to him my own special set of my five papers on the subject which were read before the Society of Engineers in the five years 1919–1923 inclusive. Unfortunately, this set has not been found among Dr. Walmsley's papers either at the University of London, the Northampton Polytechnic, or at his private house, and, knowing how careful he was, this points to his having probably lent the papers to somebody in connexion with the matter with which he was dealing. As the sets of these five papers are now so scarce, and especially as the set in question was my own private set, if this letter meet the eye of the person to whom the set was lent, I shall be greatly obliged if he will be so good as to return it to me.

A. S. E. ACKERMANN.
17 Victoria Street, S.W.1.

Colours, Stains, and Dyes.[1]

By Prof. J. F. THORPE, F.R.S.

THE great majority of chemical substances occurring either as natural products or as the outcome of synthetic preparations in the laboratory are colourless. In other words, white light reflected from their surfaces or transmitted through these solutions is unaffected so far as its balanced colours are concerned and emerges unaltered. The absorption of light in these cases is general; that is, it takes place equally throughout the visible range of the spectrum and the object, therefore appears colourless.

On the other hand, there are a number of substances which possess the property of absorbing certain portions of the visible spectrum while reflecting or transmitting the remainder. These substances, therefore, appear to the eye to be coloured in accordance with the portion of the spectrum transmitted or reflected. A red substance is one which absorbs the blue region of the spectrum; a blue substance one which absorbs the red region, and so forth. This is known as selective absorption. Again, there are a number of substances, chiefly members of the carbon family, which have the power of absorbing rays outside the visible region of the spectrum—for example, in the infra-red or the ultra-violet—and these substances, since they possess selective absorption, must be regarded as coloured in a chemical sense, although the "colour" they transmit or absorb is not visible to the eye.

The hydrocarbon benzene is an example of the type of chemically coloured substance, and, as we shall find later, this property possessed by benzene causes it to be the parent substance of those very numerous and industrially important materials—the coal-tar dyes.

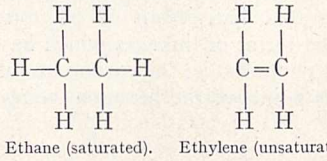
It is not in its lack of power to detect the ultra-violet range alone that the eye fails as an organ of vision, because even in the visible region its power to detect the end colours is seriously restricted. It is most sensitive towards green and red.

The power of a chemical substance to produce selective absorption is without doubt due to its chemical structure; that is to say, white light is "filtered" through the molecular structure of the substance, leaving a "portion" behind in its passage. The colour is therefore dependent on the chemical composition of the particular compound. On the other hand, it is possible to produce visible colour by entirely physical or mechanical means, as, for example, by ruling a number of fine lines on glass, and in these cases colour is independent of chemical structure, being entirely physical in character.

Nature, in producing the variety of coloured substances around us, has adopted both the physical and chemical methods to achieve her ends. The colour of flowers and leaves has been brought about by the use of coloured chemical substances, and these I shall deal with later. But many of the colour effects produced in the wings and feathers of birds and in butterflies are not due to the presence of any coloured substance in them, but to the arrangement of fine filaments or hairs, which serve the purpose of disintegrating white light and reflecting the desired shade of colour. The best test for this kind of colour effect is to examine the coloured object by transmitted light. If no colour is transmitted the reflected colour is probably due to physical causes.

A considerable number of the chemical substances which owe their colour to structure are inorganic in origin, and the colours depend mainly on the presence of some colour-producing metal; for example, chromium, cobalt, copper, and so forth. They are mostly used as pigments for the production of coloured surfaces by painting, or for the production of coloured decorations on china. Of these I do not propose to make any mention, not because they are unimportant as coloured substances, but because they do not trace any relationship to the stains and dyes which belong to organic chemistry, and are bound up with the recurrence of one particular element, namely, carbon.

There are some 300,000 definite compounds of carbon known, and the activities of research chemists add, perhaps, 4000 to these yearly. The majority of these compounds are colourless in the sense that they give only general absorption throughout the visible region of the spectrum. Some are, however, coloured—that is, they give selective absorption within the visible region—and it is evident that in these cases the colour cannot be ascribed to the presence of some particular metal, as with the metallic pigments, but must be due to some special condition of the element carbon. As a matter of fact, it is due to what is known as the "unsaturated state." The greater number of known compounds of carbon are "saturated" in the sense that all affinity which the carbon atom possesses for the atoms of other elements is fully satisfied. This is the case when carbon combines with hydrogen to form methane CH_4, or when it combines with oxygen to form carbon dioxide CO_2. No carbon compound of this type possesses colour, and every "saturated" compound shows general absorption of light. It is possible, however, to cause carbon to combine with carbon by more than one valency, and in such a case a condition of "unsaturation" arises:



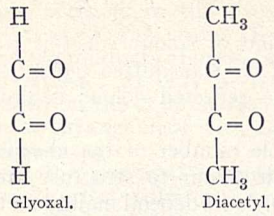
Ethane (saturated). Ethylene (unsaturated).

The affinity of each carbon atom is no longer satisfied by its proper quantity of hydrogen (or oxygen), and since there is naturally always a tendency for the substance to acquire the hydrogen atoms necessary for saturation, the "unsaturated" condition is definitely less stable than the saturated state.

The presence of one unsaturated linkage does not, however, confer colour on an organic compound—at least two being necessary for the purpose. It is also necessary that the two double linkages should be separated by one single linkage. This is known as the conjugated system of double linkages, and its presence in an organic compound apparently confers on it the property of producing selected absorption in the visible

[1] Discourse delivered at the Royal Institution on Friday, April 11.

region of the spectrum. The simplest possible coloured organic substances are therefore glyoxal and diacetyl:

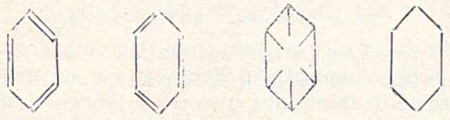


Glyoxal. Diacetyl.

These substances, however, although they are of great interest as showing the origin of colour in organic substances, are relatively unimportant owing to their slight colour and their rarity. It is to the derivatives of the hydrocarbon benzene, upon which is based the chemistry of the coal-tar colour, that special interest attaches.

As already mentioned, benzene shows selective absorption in the ultra-violet region of the spectrum, and is therefore visibly colourless, although, chemically speaking, it possesses marked colour. The great number of the derivatives of benzene are, therefore, visibly colourless, but the chief point which has to be remembered is that, although visibly without colour, these derivatives possess potentially visible colour, and it is always possible to produce visibly coloured substances from them by modifying the molecular conditions which lead to the selective absorption causing visible colour.

The organic chemist's conception of the structure of benzene is still that which was propounded by Kekulé some seventy years ago, and it is fair to say that no theory, either physical or chemical, has been brought forward since then which can be regarded as quite adequate. Kekulé regarded benzene as a substance containing a conjugated system of double linkages, upon which the colour of organic substances depends; but in order to account for the peculiar properties of benzene, its remarkable stability, and the formation of its derivatives, it is necessary to postulate a symmetrical formula which is expressed either by the Armstrong formula or by the simple hexagon—a necessity, which was met by Kekulé by the supposition that there was rapid dynamic interchange between the two unsaturated individuals of his formula. Below are given the forms of linkages which have been given to the benzene molecule, the carbon atoms, assumed to occur at the points of the hexagon, being omitted:

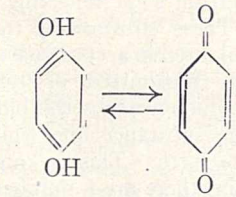


Kekulé (I). Kekulé (II). Armstrong. Conventional form.

This dynamic interchange, leading to symmetry, is expressed both by the Armstrong formula and by the conventional formula, but it is evident that each of them is merely a compromise, and represents an intermediate condition between two rapidly interchanging forms. They do not mean more than this, because any condition which postulates the existence of trivalent carbon has to contend with a number of cases in which the occurrence of this condition leads to instability quite out of keeping with the remarkable stability of benzene and its analogues and derivatives. This is the case with triphenylmethyl and similar compounds.

The dynamic conception of the structure of benzene supplies a reason for the recurrence of the strong ultra-violet absorption which is characteristic of this substance. Moreover, it suggests that if it were possible to modify the conditions leading to this absorption, it might be possible to throw the absorption within the visible range of the spectrum, and thus produce visible colour.

The simplest visibly coloured member of the series is quinone, which is produced easily from hydroquinone by oxidation and is reconverted into hydroquinone on reduction:



Hydroquinone. Quinone.

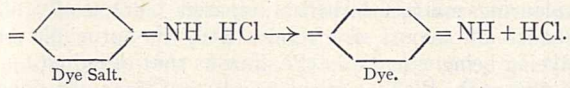
Here, then, at any rate, we have one means by which we can produce visible colour from a benzene derivative. There are certainly other means, but these are not as yet so clearly defined, and there is no question that when H. E. Armstrong propounded his quinone theory of colour he enunciated the fundamental principle on which the chemistry of the coal-tar colours is based. For there can be no doubt that the colours of these compounds are due to the presence in them of a quinone residue, which, acting like the simplest quinone ring shown above, throws the ultra-violet absorption of the visibly colourless benzene derivative into the visible region of the spectrum.

This is easily shown by the conversion of the visibly colourless phenolphthalein into its coloured alkali salt. However, it is a simple matter by altering the groups present to throw the absorption into any portion of the visible spectrum required, and thus to obtain any desired colour. The chemist is able, therefore, while retaining the same skeleton, to produce any colour at will by merely altering the nature of attached groups.

The name coal-tar colour is derived, of course, from the fact that the parent hydrocarbons from which the colours are derived—the benzene hydrocarbons and their analogues—are obtained by the distillation of coal-tar. The first of the series, mauveine, was discovered by the late Sir William Perkin in 1856, in an attempt to prepare the alkaloid quinine synthetically. But Perkin did more than discover a new series of colouring matters. He also introduced a new method of dyeing. Up to that time, dyeing had been a composite process involving the actual formation of the coloured substance on the fibre itself. The two chief processes in use were (*a*) that of vat-dyeing and (*b*) that of mordant dyeing. The first, represented by indigo dyeing, involved the reduction of the coloured substance (indigo) to indigo-white, a material soluble in alkali; the steeping of the fibre in the solution and the reproduction of the insoluble dye by means of the

oxygen of the air. The second required the previous impregnation of the fibre with a metallic hydroxide and the subsequent formation of a coloured lake on the fibre by steeping the prepared material in a dyestuff (alizarine) capable of yielding such a lake.

In each case, therefore, two distinct processes were involved. In the process introduced by Perkin only one operation was necessary. The dye contains, as already mentioned, a quinone or quinonimine residue, which causes the dyestuff in the form of its salt to be soluble in water:



Dye Salt. Dye.

It happens that the coloured base is soluble in the wool fibre, and when the fibre is added to the dye-bath the coloured base is extracted, leaving the mineral acid free in solution. The operation is of the same order as that which determines the extraction by, say, ether of an organic substance soluble in water. The coloured base is not, however, soluble in cotton, and hence this material is not coloured in the dye-bath.

These are known as the basic dyes; and a similar effect is produced by the acid dyes, although, since these are the sodium salts of sulphonic acids, the dye-bath has to be rendered acid previously in order to liberate the free sulphonic acids, which then dissolve in the substance of the wool. Cotton would not, of course, be coloured by this process, although, as it was found that the new basic colours possessed the power of giving an insoluble coloured compound with tannic acid and an antimony salt, it was possible to affix them to the cotton fibre by a two-process method, involving the previous treatment of the material with tannic acid and tartar emetic.

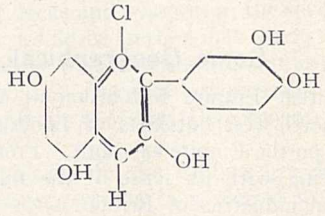
It was not until twenty years later that it was found (Böttinger, 1886) that a certain type of azo-dye derived from benzene possessed the property of being soluble in the cotton fibre, a discovery which led to the preparation of the large number of substantive cotton dyes known at the present day. In this case it is the sodium salt of the sulphonic acid which is extracted. This discovery was entirely accidental, but, as so often happens in organic chemistry, it was found that the property was possessed by a large number of substances of the same type, or having the same skeleton formation, and, since it is possible readily to alter the shade by varying the nature of attached groups, the series contains representatives of all shades of colour.

It must be remembered, however, that there is a marked difference between the two methods of dyeing —one, the older method, in which the dye is formed in the fibre, and the other, the newer method, in which the fibre acts merely as an extractor for the coloured base, acid, or salt. It is evident that, other things being equal, the older processes should give the faster dyeings; that is, the colour would be more firmly fixed in the fibre and less likely to be affected by the various conditions, such as exposure to light, washing, etc., to which a dyed fabric has usually to be subjected. This is, as a matter of fact, the case, and numerous processes have been devised by which the stained fabric (as I prefer to call it) can be rendered more fast by after-treatment; that is to say, by causing another colour to be produced in the fibre from the colouring matter already there. One of the best illustrations of this is the method by which an azo dye can be produced on the fibre from a stained fabric which has been stained by a substance having an NH_2 group:

$$-NH_2 . HCl \rightarrow -N=NCl \rightarrow -N=N . R . OH.$$

There are many other methods, such as after-treatment with metallic salts, or with formaldehyde, which can be employed. Indeed, such processes would be still more necessary were it not for the remarkable tenacity with which the stained fabric, in many cases, retains its stain. The affinity varies in different cases, both as regards the power and speed of absorption, and is probably connected with the size of the molecular (colloidal) aggregates which are present in the dye-solutions. It is not connected with the actual molecular weights.

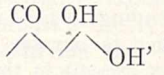
Nevertheless, although there are some stains which possess so marked an affinity for the fibre as to render them comparable with true dyestuffs (those produced on the fibre) in fastness, and some which lend themselves to after-treatment, and fall therefore within the category of true dyestuffs, there are a large number which possess all the inherent disabilities of the class; that is, they are unsaturated organic compounds tending to pass into the saturated (colourless) state under favourable conditions. Such conditions are always present in the oxygen of the air, which in the presence of light constitutes a formidable opponent to all coloured organic compounds. As already mentioned, Nature got over this difficulty in the case of bird's feathers and butterfly's wings and also in the wing cases of coloured beetles by ignoring the organic colour altogether. She utilised them, however, in the case of the flowers, but chose substances highly oxygenated in structure, which would be least likely to be affected by air and light. For example, the colour of the red rose is delphinidine,



and this is also the basis of the colour of the blue cornflower, the only difference being in the character of the group attached to the oxonium oxygen.

However, as the science of organic chemistry advanced, it became possible to contemplate the synthetic preparation of some of the natural colouring matters, of which indigo, alizarine, and logwood were types. These are not natural colouring matters in the sense that they are used by Nature as such, but have been evolved by man for his own purpose by a process of trial and error. They represent the survivors of a vast number of natural substances with which man must have experimented throughout the ages in order to produce colour for his own purposes. Together with certain mordant colours derived from lichens, which are still used for dyeing in certain parts of the country, they constituted the sole means of producing

dyed fabrics at the time when the coal-tar colours were discovered. Their value as dyestuffs was without question, the world's yearly consumption of indigo alone, at that time, representing some 4,000,000*l*.

It must also be remembered that it was not the question alone of the commercial production of the dye in competition with the natural product which was sought, because this must have appeared a totally impracticable problem in those early days. It was rather the search for the reason why alizarine was a mordant dye and why indigo was a vat-dye which was the incentive to research, because when these facts were discovered other substances having similar properties could be prepared. The attack in every case followed the usual lines. In the first instance, the structure of alizarine (the mordant dyestuff of the madder root) was revealed by analysis, when Baeyer found that it gave anthracene on distillation with zinc. Its synthesis from the anthracene of coal-tar followed in the next year, being effected almost simultaneously by Graebe and Liebemann in Germany and by Perkin in England. In this case the preparation was so simple and the raw material so easily obtained that the natural madder industry was rapidly killed. The determination of the formula and synthesis of alizarine showed the particular grouping, namely,  , on which mordant dyeing depended. Hence the preparation of a large number of analogues of varying shades of colour followed.

The determination of the structure of indigo took longer, and occupied Baeyer at Munich some eighteen years. In this case the colour was synthesised and manufactured on a commercial scale three years before its structure was determined, because, as sometimes happens, a reaction, the course of which was then unknown, led to the formation of the dye. Here, again, the determination of structure showed that the property of vat-dyeing depended on the presence of the grouping  , and in consequence, whereas blue indigo was the only known member of its class in 1890, at the present day every shade of colour is represented in this particularly fast series.

Finally, at the beginning of the present century, the accidental discovery of indanthrene by Bohr placed on the market the first member of a series of vat-dyes, which constitutes without question the fastest series of colouring matters hitherto prepared. Practically all shades of colours are represented, the principle of dyeing being essentially the same as that of indigo.

Before the War we relied mainly on Germany for the production of our dyestuffs, and, what was still more serious, we left to them the research work on which the production of new dyestuffs depended. Dyestuff chemistry is merely a branch of organic chemistry, which includes also the preparation of organic chemical substances used in a variety of industries essential in peace and war. The possession of a dyestuff industry implies, therefore, the possession of a band of trained organic chemists and, what is more important, the possession of university and university college laboratories, where organic chemists can be adequately trained in methods of research. As a member of the Dyestuffs Development Committee, it has been my good fortune within the past six months to visit all the dye-producing factories operating in Great Britain, and I have been struck with the very real success which has attended the efforts of the past five years to establish the industry. If we had merely reached the level of excellence attained in Germany before the War, the fact would have been very creditable, but we have done more than this, and in several cases, notably in the production of a new indanthrene green, we have already drawn ahead; a position, it is to be hoped, we shall not again lose.

Some Geographical Aspects of the British Empire Exhibition.

THE British Empire Exhibition at Wembley, in the north-west outskirts of London, strikes at once a note on the Empire as a unit. From the Palace of Engineering, with its sense of the fullness of the metallurgical industries of Britain, across the way to the Palace of Industry, almost crowded out with the multifarious products of Britain's factories, one gathers an impression of diversity as shown by fountain-pens and gramophones in contrast with big guns and giant railway engines, of high quality from the silks and laces to the coach-work on the motor cars, of stability from the various types of safe and strong room to the giant turbines; and, withal, there is a feeling of much energy crowded into a tiny space. Visit may succeed visit to these two great palaces, the main monument to the occupations of Britons at home, and yet their innermost recesses, their by-ways, and their out-of-the-way corners would not all be explored; it would appear that the visitor is left deliberately with few indications of the wealth of British products here housed, for each visit brings to light something previously missed and leaves the thought that there is yet something more to find.

The British Isles are thus presented as a crowded hive of industry, and this impression is intensified when one penetrates below the surface. Mannequin parades, exhibits of machine processes in cotton, paper, and so forth, are co-operative efforts; they are not labelled as the work of one firm or as, necessarily, the product of one district; they are specimens of Britons' work. The student of geography who wishes to emphasise or correct his book-lore is driven to much mental effort to analyse the contents of these great buildings, to sort out the products, say, of the Black Country and to localise the various elements of industrial Britain. Except in a few instances, mainly in the food section, the visitor is not asked to buy, and the exhibit is not primarily designed as an advertisement; in this respect the student would penetrate deeper and more easily into the mysteries of British manufactures at one of the annual trade shows, such as the British Industries Fair or the Motor Show. Of course, customers from overseas can get into touch with manufacturers, but the trading element, the business of selling the goods, is kept in the background; here is primarily an exhibit of what

can be produced by the British Isles as the chief congeries of factories in the Empire.

Over against the impression of works jostling with works to pour out useful commodities for use throughout the Empire lies the first, and the dominant, feeling which is aroused by the pavilions devoted to Australia, Canada, and New Zealand. Each of these suggests life in the open spaces where there is room and to spare for all; a largeness and perspective about the exhibits strikes immediately the right note. In the same spirit the divisions of the country are obscured; it is intentional that the visitor should have to make an effort to discover whether he is examining the products of New South Wales or Victoria, of the Canterbury Plains or Taranaki. Take the simple matter of apples; the housewife at home is concerned with the quality of the fruit, not with the location of the orchards; in each pavilion she may see and buy fine specimens, and she carries away the notion that the greengrocer may supply Canadian, Australian, or New Zealand apples; she may see adjacent pictures of Canadian orchards and only after diligent inquiry learn that one picture shows life in the Annapolis Valley and the other a scene in British Columbia, places 3000 miles apart. Similarly, butter is seen in refrigerating chambers in Canada and New Zealand, sheep are sheared in Australia, timber of all kinds, undressed, dressed, worked into furniture, is shown from all three countries. Canada invites attention to her magnificent water supply with its uses for power installations; Australia indicates by a model farm the irrigation of an arid area.

In these pavilions, as elsewhere, the complete exhibit is a concrete demonstration of the products of each country as a whole, and the best guide to the pavilion is probably a list from a Blue-book of the products of each land; there is little attempt to indicate relative importance; each country says simply, This is what we can do, this is our contribution to the Empire's needs, will the Empire make use of our efforts?

In this regard the main part of each show deals with a few primary products, meat, wool, ores, timber, but a similar note is struck regarding the factory products of the chief towns. Emphasis is not laid upon the work of Toronto in competition with Montreal or of Melbourne rather than Sydney, but upon the one main fact that Canada and Australia can make house furniture, boots and shoes, apparel, and so on, of a quality which exceeds expectation. Canada is not merely a farmer's land, a land of the backwoods and prairie; Australia is more than a home for the squatter or the bushranger. Even the prairies or the Australian back-blocks are no longer the scene of primitive human labour, that of the hands; the prairie quarter section is depicted near a railway with a convenient elevator against which a moving train stops until the grain has poured into the truck; Australian sheep are sheared and Australian cows are milked by machinery.

Leaving the spacious lands the visitor reaches, in turn, India, Burma, and Ceylon, and again receives the right impression of crowds and ceaseless activity, but with this difference, that the activity is concerned, on the whole, with products each of small import. So there comes before him the questions of cotton, tea, and rice. In the Palace of Industry a cinema has told him the story of cotton, and machinery has whirred and clanged as the fabrics were made before his eyes; here are the raw material, the native weaver, and the native product all in readiness for the contrast to be obtained from a subsequent visit to the African pavilions to find experimental cotton growing and other native looms at work.

Here, and more forcibly at Hong-Kong, the spirit of the Eastern bazaar is displayed; here is the peddling of home-made products and the country's curios. Rightly, perhaps, the primitive elements of Indian life are hidden except in relation to the ameliorative work of the missions, India being presented rather from the point of view of the business and needs of the Empire than from that of a true perspective picture of what Indian life is like in all its degrees.

Thus the visitor passes to the smaller sections of the Empire, the best guide, as always, a Blue-book list of products, cocoa, kola, palm oil, rubber, and so on, for the Gold Coast, for example, and in addition, both within and without the pavilions, a skilled attempt to produce the essential atmosphere of the colony with native craftsmen, native scenes, and the products of domestic industries. The tour so far has been a continuous descent in the scale from the English locomotive and the Canadian motor-car to the Indian shawl and the West Coast brass or silver bowl with a hammered pattern, from a Doulton vase to a piece of African pottery. Diamonds, gold, ostrich feathers in South Africa, fish, paper-making, and the Newfoundland dog in Newfoundland, oranges in Palestine, an interesting historical exhibit in Malta, whaling and sealing in the Falklands, copra in Fiji, are but a tithe of the things to see in the remaining pavilions.

Imperial communications are focussed in an interesting model in the Government pavilion, but they are constantly to the fore elsewhere, either in the separate pavilions of the Canadian railways, or as specimens of railway carriages or ship's quarters or as model steamers or models of docks and wharves in the several Imperial units. The would-be settler has every inducement to find out all he wishes to know about any land which attracts him, and Imperial comparisons are possible under the guidance of the Department of Overseas Trade.

Health questions in the Empire are dealt with in the Government pavilion in a section which deserves to become more popular.

In every corner the visitor is carried away to some distant land, from every detail he gathers a suggestion which leads cumulatively to a notion of what each name, Malaya, British Guiana, East Africa, implies, and even a scamper of merely one day's visit through the several pavilions gives reality to these far-off homes of Britons overseas, and the wise visitor probably pauses and looks back over the pavilion itself to grasp the message it conveys; the colour scheme of West Africa, the caribou and bison of Canada, the Maori whare and Samoan hut, the pillars at the entrance with the pagodas of Burma, the Indian pavilion as a whole, all contribute to the general effect, which is intensified by the slow passage over Old London Bridge with the views from either end, the old heart of the Mother City brooding over the wonders brought into being by her sons, the Empire builders.

The Toronto Meeting of the British Association.

LOCAL ARRANGEMENTS.

(From our Toronto Correspondent.)

THE local arrangements for the Toronto meeting of the British Association in August give promise of an interesting time for visitors from the east side of the Atlantic. Committees have been busily engaged with arrangements for local entertainments, sectional excursions, and the main excursion through western Canada to the Pacific coast, which is to take place after the meeting. It is now possible to give a summary of the arrangements which have been made.

The main party of visitors from England is expected to arrive in Quebec on August 2. There they will be formally and appropriately welcomed, and will spend a day at Quebec, leaving late in the evening. They will arrive in Montreal on the following day, and accommodation is being reserved at hotels where visitors will spend a welcome day of rest. On August 4 excursions have been arranged to Macdonald College and to the Port of Montreal. A botanical excursion has also been arranged. While definite plans have not yet been made, it is proposed that the party be divided in Montreal into two approximately equal groups. One of the groups will leave for Ottawa late in the evening of August 4, and will spend the morning of August 5 there, take part in certain official functions and entertainment, and leave for Toronto at midday. The other group will go directly from Montreal to Toronto by night train on the evening of August 4, arriving in Toronto on the Tuesday morning.

For the social side of the meeting in Toronto, several garden parties, receptions, ladies' luncheons, and other entertainments have been arranged. Among these are a recital of Canadian music and the performance of a Canadian play in the theatre of Hart House. An exhibition of Canadian paintings will be on view throughout the meeting at the Toronto Art Gallery, which is five minutes' walk from the University.

On Thursday, August 14, a general excursion has been planned to Niagara Falls. Other excursions to Niagara Falls and its vicinity will be undertaken by sections for their own purposes, and it is suggested that those who wish to go to Niagara primarily to see the Falls should take part in this excursion on August 14 to avoid unnecessarily enlarging the sectional excursions during the meeting.

The following sectional excursions have been planned:

On August 8 the Chemistry Section will visit the industrial plants around Niagara Falls, Welland, and St. Catharines. On this excursion the chemists will spend the night at Niagara Falls.

The Geology Section will make the following excursions:

On the afternoon of August 7, together with a limited number from the Geography Section, they will travel by motor-cars to various points in the vicinity of Toronto where palæozoic rocks may be seen. The party will be under the direction of Prof. Parks, of the University of Toronto, and is limited to fifty. On the afternoon of August 8, under the direction of Prof. Coleman, they will visit various localities in the vicinity of Toronto for the purpose of studying glacial phenomena. This party, which will travel in motor-cars, is limited to seventy-five. On August 9-10 they will visit the Niagara-Grimsby district under the direction of Profs. Coleman and Parks. This excursion is limited to sixty participants. If a sufficient number desire, arrangements will be made for another excursion to the Pre-Cambrian area in eastern Ontario. This excursion would leave Toronto on the evening of August 8, and return on the evening of August 10. It would afford an opportunity for studying the Laurentian and Grenville formations.

In the Zoology Section there will be a motor trip on the afternoon of August 8 to the Forks of the Credit River; on the afternoon of Monday, August 11, a motor-launch trip on Lake Ontario for the purpose of examining the plankton; and on the afternoon of August 12 a motor-car excursion to Schomberg Swamp on the Holland River.

In the Engineering Section on August 9 the engineers will journey by steamers and cars to various engineering works, such as the Welland Canal and the Queenston Power Plant, in the vicinity of Niagara. This excursion will occupy the whole day. On August 11 they will inspect the works of Toronto harbour, making the tour by boat.

The Psychology Section will make a motor excursion to the Ontario Hospital at Whitby on August 9.

The botany excursion will visit High Park, Swansea, and Humber Valley on the afternoon of August 7. And from the evening of August 8 to the evening of August 10 they will camp in the vicinity of Niagara Falls and make various excursions to points of interest to botanists. On the afternoon of August 12, provided with footware suitable for wading, they will visit the Sphagnum Marsh on Holland River, 33 miles north of Toronto, returning to Toronto late in the evening.

The following sectional excursions will take place after the meeting:

A party of geologists, limited to twenty-four, will leave for northern Ontario on the evening of August 14 in a special Pullman car, and will spend the following five days at Temagami, Cobalt, Kirkland Lake, and the Porcupine district. Those geologists who are going on the western excursion will join it on August 19. The northern Ontario excursion will be free of any expense, and members taking part in this and the succeeding botanical excursion will be guests of the Provincial Government of Ontario until they join the western excursion.

A party of botanists, limited to twenty-five, will also leave on the evening of August 14 for Temagami, and will proceed to the summer station at Bear Island. This excursion, which will entail no expense to the participants, will join the western excursion at Temagami early on Monday morning.

Members of the Agricultural Section will visit fruit farms in the Niagara district on August 15. They will also visit certain stock farms and the Ontario Agricultural College at Guelph. They will spend the night of August 15 at Guelph and return to Toronto in the afternoon or evening of August 16, in time to join the western excursion.

The Western Excursion.—This excursion, as has already been announced, will journey from Toronto to

Vancouver and return. Two trains, half an hour apart, will leave Toronto on the evening of August 17. The trains will proceed westward by the Canadian National and Temiskaming and Northern Ontario Railways, and return by the main line of the Canadian Pacific Railway in time for those sailing from Montreal or Quebec to catch their steamers on September 4. An opportunity will be afforded to visit mines and concentrators at Cobalt, and the mines and mills at Kirkland Lake and Timmins. A day will be spent at Winnipeg, a half day at Saskatoon. At Saskatoon a meeting of the Chemistry Section will be held at the University of Saskatchewan, and a new chemical laboratory will be formally opened. Another day will be spent in Edmonton, where Sections C and K will hold short meetings at the University of Alberta. A short visit will be made to Jasper Park.

Arrived at Vancouver, members desiring to do so may visit Victoria by steamer. In Vancouver and its vicinity visits will be paid to great saw-mills, salmon canneries, and copper mines, and short technical sessions will be held at the University of British Columbia.

A train will leave Vancouver on August 26 and 27 respectively. The first train will make stops of suitable lengths at Glacier, Lake Louise, and Banff, and the second at Lake Louise and Banff. From Banff eastward the trains will travel half an hour apart, and stops will be made at Calgary, at Fort William, and at Port Arthur, where the grain elevators will be visited. The trains will also stop at Sudbury, where the mines and smelters of the famous Sudbury nickel region will be the last important feature to be studied.

As has been already announced, the expense for this excursion, including sleeping accommodation, will be 100 dollars return. Meals will be provided on dining-cars. The local committee is endeavouring to get especially low rates for meals, but it is unfortunately not yet possible to announce what these rates will be.

Appropriate guides with detailed itineraries have been prepared for the western and other excursions, and will be issued at the reception room during the meeting. It is unfortunate that the demand for space on the western excursion has been so great that it will be necessary to limit the number of those participating, who will be chosen from the list of applicants during the meeting. Needless to say, preference will be given to overseas visitors.

Obituary.

SIR SYDNEY RUSSELL-WELLS.

BY the death of Sir Sydney Russell-Wells, which happened with tragic suddenness on Monday, July 14, the cause of education, and especially of university education in London, has suffered a heavy loss. With no outstanding scientific achievements to his name, no published work that could be called noteworthy, the founder of no scientific school of thought, he nevertheless succeeded by dint of courage and perseverance in winning a place of honour as a friend of educational development and as a university administrator.

A Londoner by birth, Sir Sydney Russell-Wells received a sound training in science at the old Royal College of Science and University College, proceeding afterwards to St George's Hospital Medical School, where he had a distinguished career culminating in the passing of the London M.D. in 1895. He held the appointment of Senior Physician at the Seamen's Hospital, Greenwich, and of Physician at the National Heart Hospital. In more recent years, while retaining all his interest in general medicine, he tended towards specialisation in diseases of the heart, and won a reputation as a sound and trustworthy diagnostician.

But it was in the University of London that Sir Sydney Russell-Wells's main interest lay, in the University in which he had graduated in science and in medicine, and which at the time of his death he represented in Parliament and on the General Medical Council. Into the controversies of the University he threw himself in his earlier days with keen interest, with knowledge, and, it must be added, with zest. When, however, an opportunity presented itself of rendering service of a positive, constructive kind, he was not slow to avail himself of it. To him more than to any one is due the existence of the School of Commerce in the University, and to him the recognition, tardy but generous, on the part of the City of London of the fact that there was a great University in London. When in 1920 he was elected Vice-Chancellor of the University, he set himself deliberately to the task of impressing the University upon London, and there is no doubt as to his success. His methods were perhaps open to criticism at times, especially among some of the older members of the University, but no one doubted his zeal and energy, his passionate faith in the future of the University, and his jealousy for its rights and prerogatives.

Sir Sydney Russell-Wells's tenure of the office of Vice-Chancellor lasted nearly three years, and the occupancy of the post undoubtedly broadened his experience and enlarged his outlook. He had been a doughty exponent of the claims of the external student, and while he held consistently to the view that the University merely as an examining body was an agency for good, closer acquaintance with its teaching work, which during his Vice-Chancellorship had enormously expanded, filled him with enthusiasm, and he never ceased to play the part of reconciler between opposing schools of thought. He was also largely responsible for the difficult and intricate negotiations which led to the acceptance of the Bloomsbury site for the University. Much of his work was accomplished under great difficulties, for although he was a skilful and well-informed conversationalist and most persuasive talker, he had no gifts of oratory, and his health, never strong, was taxed severely by the strain he put upon himself. But he kept grimly on, knowing, as he must have known, that he would have to pay the price. He died at his work, and his devotion to it and to his University will be long remembered by his friends and his colleagues.

AT the moment of going to press, we learn with much regret of the death in London on Monday night, July 21, of Sir William A. Herdman, emeritus professor of natural history in the University of Liverpool and president in 1920 of the British Association.

Current Topics and Events.

A SOCIETY for Cultural Relations between the peoples of the British Commonwealth and the Union of Socialist Soviet Republics has been founded recently in London. The objects of the Society are: (1) To collect and diffuse information in both countries on developments in science, education, philosophy, art, literature, and social and economic life; (2) To organise lectures and an interchange of lecturers, conferences, exhibitions, etc., and to arrange for the publication and translation of papers and books; (3) To provide opportunities for social intercourse; (4) To take any action deemed desirable to forward the intellectual and technical progress of both peoples. Russia has unfortunately been cut off from all other civilised countries for about ten years, owing to the War and the revolution which followed it. Only in this year has it been possible to break down some of the wall separating Russia from other peoples. Through the crevices Europe begins to see that, in spite of the most difficult conditions prevailing in science and art, the great spirit of Russia is still alive and even active. Hunger, shortage of necessary technical materials, apparatus and books, the necessity of working in rooms and laboratories where the temperature in winter was near freezing-point, prosecution by the Government—all this has not killed the spirit of Russia. The attempts of the Government to proletarise science and art have not been very successful for a simple reason, namely, there is only one truth, the same for proletarians and bourgeois, the desire for which is that peculiar feature which distinguishes a man from an animal. For Russians the breaking down of the wall surrounding their country has become much more important than for countries which are outside this wall: the development of western science, art, literature, philosophy, and social life, which is free and not "controlled" by Government and has proceeded under normal conditions of life, has resulted in remarkable progress. There is no need to point out how vital the knowledge of this progress is to Russia. From this point of view, it is necessary only to wish all success to this new society, provided it does not become an official organisation, but remains free from any official control and concerns itself only with the promotion of friendly relations between the intellectual representatives of both countries.

BY the retirement, after fifty years of service, of Dr. H. J. H. Fenton, who went to Cambridge in 1874 as an undergraduate of Christ's College, the University has lost a well-known personality and the Chemical Department a distinguished man of science. Dr. Fenton has taken part in the development of chemistry in the University from its infancy, since he became junior demonstrator, under Prof. Liveing, some years before the new laboratories, the nucleus of the existing buildings, were completed and occupied in 1888. In 1886 Fenton published an investigation on the hydration of ammonium carbamate to ammonium carbonate in aqueous solution, in the course of which he employed a novel method of analysis depending upon the fact that sodium hypochlorite sets free only the ammonia nitrogen, whilst sodium hypobromite liberates the amide nitrogen as well. In 1894 he began a fruitful series of researches on the oxidation of hydroxy-acids by hydrogen peroxide in the presence of traces of ferrous iron as catalyst. At an early stage of this work he prepared from tartaric acid the interesting compound dihydroxymaleic acid, and by heating it with pyridine obtained the simplest sugar, glycollic aldehyde. In 1899 Fenton and Miss Gostling discovered the chloro- and bromo-methyl furfuraldehydes, which they obtained by treating ketohexoses or cellulose with the corresponding halogen hydrides. Apart from their intrinsic interest, these compounds formed the basis of new colour tests for certain classes of compounds; *e.g.* by treating bromomethylfurfuraldehyde with malonic ester in the presence of alcoholic potash a fluorescent material was produced, which Fenton showed could be employed to distinguish hexoses from pentoses. Another interesting substance, termed by Fenton methylfuril, gave colour-reactions with primary amines and carbamides. Readers of Fenton's "Outlines of Chemistry" and of his more elementary "Physical Chemistry for Schools" will obtain some idea of the scope of the material which formed the basis of his lectures, but only those who followed the lectures were aware of the masterly treatment of the subject. His "Notes on Qualitative Analysis" constitute the *vade mecum* for thousands of students of that particular branch of practical chemistry.

AN exhibition is now being held in the Assyrian Basement of the British Museum of some of the objects found by the Joint Expedition of the Museum and the University Museum of Philadelphia to Mesopotamia during 1923–24. The principal objects now shown were found around the Temple platform at Tell el-Obeid about five miles from Ur. Of these, the most important, from the historical point of view, is the marble foundation tablet bearing the hitherto unknown name of King A-an-ni-pad-da of the First Dynasty of Ur, which dates back to before 3000 B.C. The exhibit includes a pictorial representation by Mr. C. L. Woolley of the walls and entrance of the temple as they stood originally. This enables visitors to appreciate the significance of the remarkable collections of models of animals and the friezes in bas-relief which adorned the walls with representations of animals and scenes of agricultural life. A wonderful copper statue of a bull some 2 ft. 4 in. high and 2 ft. 8 in. long is undoubtedly the oldest hollow statue now known to exist. It reveals a remarkably high technique for so early a date. It was made by carving the body and limbs in wood separately, and fastening them together with copper wire. Thin copper sheets were then hammered over the whole. The exhibition includes several examples of the use of different coloured *tesseræ* inlaid in bitumen for decorative purposes. The collection will be on view for about two months before it is apportioned to the British Museum, Philadelphia and Baghdad.

THE Natural History Branch of the British Museum, which started its series of picture post-cards not long ago, has gone ahead with them rapidly. Some beautiful examples in colour have been produced by Messrs. Stone, Waterlow and Sons, and W. F. Sedgwick. Of these, 70 cards illustrate insects, 10 birds, 5 reptiles, and 15 plants; and 20 cards represent 122 eggs of British birds. The monochrome series comprises 20 views of the building, 90 mammals, 35 birds, 40 insects, 25 plants, 60 fossils, 15 meteorites, 15 reptiles, 10 corals and sponges, and 10 rare and curious natural history books. Among recent additions, those in colour of British flowering plants promise to be as useful as they are attractive; each shows a plant or spray in flower, a single flower, fruit, and sections; they are made from drawings, but the name of the artist is not given. There are three sets of very life-like reptiles and batrachians, presumably from exhibited specimens. Miss Alice B. Woodward, who worked under the guidance of the late C. W. Andrews, has contributed six characteristic reconstructions of extinct mammals, mainly Proboscidea. New ground is broken by a set illustrating the life history of the common eel, based on the memoir and photographs by Dr. Johs. Schmidt. The educational value of all these cards is considerable, and teaching establishments not already acquainted with them should write to the Director for the latest list.

THE statement of activities of the National Research Council of the United States for the year ending June 30, 1923, is now issued as Circular 49 of the Council. It appears that the Council now derives the whole of its finances from other than Government sources, and is in consequence entirely controlled by its own chosen officers. Its budget for the year was half a million dollars, and in addition it is spending one and a third million dollars on the new building at Washington to accommodate the Academy and the Council, described in NATURE of July 22, 1922, p. 120, and June 28, 1924, p. 940. It maintains about 100 post-doctorate research fellowships in physics, chemistry, biology and medicine from funds derived from the Rockefeller Foundation. Under its sponsorship a considerable number of special organisations carry on research on physical, engineering, chemical, geological, biological, anthropological, psychological and medical questions, such as the structure of the atom, research chemicals, petroleum, sex problems, immigration, food and nutrition. There can be no doubt as to the determination of the people of the United States to make their country a great centre for research, nor as to the energy with which they are carrying out their intention.

IN his presidential address to the Society of Chemical Industry, delivered on July 9 in Liverpool, Dr. E. F. Armstrong referred to the success of the chemical exhibits at the British Empire Exhibition, of the chemical literature which has been issued in connexion therewith, and of the Bureau of Chemical Abstracts, which has been formed to prevent overlapping in the abstracts that are issued by the Chemical Society and the Society of Chemical Industry. On the other hand, he deplored recent signs of increasing competition between the various chemical societies, and the inaction of the Federal Council for Pure and Applied Chemistry in regard to the further consolidation of chemical interests and the establishment of a central Chemistry House. The greater part of the address consisted of a dissertation on the fats, written in collaboration with Mr. John Allan, which gives an excellent survey of existing knowledge and problems in this important field, and would be still more valuable if it had been published with full references to the original literature.

A MARKED degree of success appears to have attended the tests of wireless reception and transmission to and from a moving train carried out by the Radio Society of Great Britain on July 4. An experimental apparatus both for sending and receiving was installed on the express train leaving King's Cross at 7·38 P.M. for Newcastle, and signals transmitted from the train were received at distances of more than 200 miles. Observers in London could hear the signals distinctly while the train was approaching Newcastle (268 miles from King's Cross), and reception was reported from localities so far distant from the line as Shrewsbury and Glasgow. In spite of the deafening noise of the train, and other difficulties, the receiving apparatus worked satisfactorily, and those on the train were in touch with the transmitting station of the Society at Shepherd's Bush, London, while the train was passing through Darlington at 65 miles per hour. An experimental station at Bedford was kept in touch with for more than 150 miles. The complete analysis of the results is not yet available, but enough has been done to show that wireless communication with moving trains is a practical proposition.

THE Southend-on-Sea Public Museum (Prittlewell Priory) has just been enriched by the gift by Major Weber of the Hoy collection of birds (1797–1839). With one or two exceptions the Hoy collection is complete and consists of more than 260 cases. Most of the birds were taken in Essex, Suffolk, and Norfolk, and the collection contains many rare and valuable specimens. Among these are the first recorded British specimen of the pectoral sandpiper, bustards, ospreys, and eagles. The Southend Museum contains also the Christopher Parsons collection of birds (1807–1882) from south-east Essex, and since the Museum was opened in 1922 many rare bird visitors to the county have been secured by purchase, these including the first specimen of the yellowshank recorded in the eastern counties and the third in Britain; the smew; blue-headed wagtail; and numerous other birds. Major Weber's gift, added to the existing collection, makes the ornithological department of the Museum noteworthy among collections of local birds in Great Britain.

IN the seventh Trueman Wood Lecture delivered before the Royal Society of Arts on May 21 and just published in the Society's Journal, Sir William Pope spoke on "The Outlook in Chemistry," and gave a lucid exposition of recent progress in the field of atomic structure, valency, and crystal structure.

He referred particularly to the necessity of altering the methods of teaching chemistry which seems to result from this recent work. It was suggested that a preliminary account of the manner in which all the specialised parts of chemistry fit into the general scheme of the electronic structure of matter and energy should be given. The suggestion was also made that progress in chemical discovery would be more rapid if organised research on specific problems were undertaken rather than individual work.

A FEW days ago the British Cast Iron Research Association formally took possession of its own Laboratories, in Guildford Street, Birmingham, which have been equipped for the conduct of chemical analyses and general metallurgical and heat treatment work. The capacity of the Association to deal with its work will thus be greatly increased, but it is not intended to abandon the policy of having investigations conducted in university laboratories and in the works of members. It is anticipated that the Association, which commenced a new financial year on July 1, will incur an expenditure during the year of between 6000*l.* and 7000*l.* The research programme includes investigations on erosion- and corrosion-resisting and other special cast irons; moulding sands; graphitisation; cupola practice; standardisation of test bars, materials and methods; facing sands and blackings, and cast iron to resist abrasive wear, and jointly with the British Motor and Allied Manufacturers' Research Association, automobile cylinders and pistons.

REFERENCE has already been made (May 24, p. 756) to the valuable "Handbook to the Exhibition of Pure Science" prepared by a committee of the Royal Society in connexion with the exhibits arranged by it in the Government Pavilion at Wembley. The Handbook contains, in addition to descriptions of the exhibits, a most instructive series of twenty-two articles by leading authorities upon current scientific work and problems, and every student of science should possess a copy of it. We are glad to know that arrangements have been made for its sale outside the Exhibition through Messrs. A. and F. Denny, Ltd., 163A Strand, London, W.C.2, who can supply the Handbook direct or through booksellers. The price is 1*s.*, or post free 1*s.* 3*d.*; and as the book contains 228 pages it is remarkably cheap, as well as superior to many volumes published at a much higher price, whether intended for the general public interested in science or for students in school or college.

THE annual field day at the National Fruit and Cider Institute of the University of Bristol, Long Ashton, was held on Tuesday, July 15, and was attended by a representative gathering of agriculturists and horticulturists from all parts of the West of England and even farther afield. Among those present were Lord Bledisloe, chairman of the Governing Body of the Station, and Mr. W. G. Lobjoit, Controller of Horticulture, representing the Ministry of Agriculture and Fisheries. The visitors were first given the opportunity of sampling the ciders produced during the last two seasons in the course of the Station's experimental work on cider-making. These were exhibited in the new wing recently added to the cider house. The variation in the quality of ciders due to seasonal influences was markedly illustrated by comparing ciders made in 1922 and 1923 from some of the more famous vintage varieties of apples, such as Kingston Black, Cap of Liberty, and Foxwhelp, the advantage being definitely in favour of the 1922 vintage. Among other interesting features illustrated by the ciders were the effects of storage of the fruit under various conditions prior to cidermaking, the results of natural fermentation of the juice as compared with fermentation of pasteurised juice by specially selected yeasts, and the different degrees of control of fermentation obtainable by methods of racking and filtration. After sampling the ciders the visitors were conducted through the fruit plantations to inspect the various features of the experiments at present in progress. The attention of the parties was directed by guides to the numerous field investigations in progress on many subjects of importance to the fruit-growing industry.

MR. R. M. STEWART, assistant director of the Dominion Observatory at Ottawa, has been appointed director of the Observatory in succession to Dr. O. Klotz, who died in December last.

WE learn that the Radio Society of Great Britain is in touch with the Postmaster-General regarding the restrictions as regards transmissions to the dominions and foreign countries recently introduced into the experimental transmitting licences now being issued. It is hoped that an official announcement may be made at an early date.

AT the annual general meeting of the Faraday Society held on July 7, Prof. F. G. Donnan was elected to succeed Sir Robert Robertson as president. The annual report records considerable activity during the past year, the result of which is reflected in the accounts, which show a deficit of 109*l.* 11*s.* 5*d.* on the year's work. Eleven meetings were held during the year, and of these four were general discussions, which have become so striking a feature of the work of the Society. The subjects of these were: (i.) "Alloys Resistant to Corrosion." (ii.) "The Physical Chemistry of the Photographic Process." (iii.) "The Electronic Theory of Valency." (iv.) "Electrode Reactions and Equilibria." The widespread appreciation in which the publications of the Society are held is indicated in the fact that the sales of Transactions and reprints amounted to nearly 900*l.*, a figure in excess of the amount received for subscriptions. It is surprising to note that the membership of this very active Society is only 432, and that consequently an appeal for a larger membership is made in the annual report. Particulars relating to the Society may be obtained from the secretary and editor, Mr. F. S. Spiers, 90 Great Russell Street, London, W.C.1.

IN commenting upon an article in NATURE of July 12 on "Artificial Daylight," a correspondent suggests that

the apparent indifference to daylight lamps is due to their excessively high prices. Our contributor, Dr. Martin, remarks that he has no knowledge of the actual cost of production, but he agrees that the average price appears to be high. Doubtless, however, an increased demand would cheapen production and result in lowered prices. The question is one with the general question of efficient lighting. To take an actual example, there are many days during the winter in which the grading and examination of such things as seeds, tea, tobacco, etc., is very difficult, if not impossible. There is no doubt that time and money are lost in this way for want of an efficient illuminant. The actual cost of a good daylight lamp would be negligible in comparison with the saving effected; that is, if the user trusted his lamp and the customer had been educated to the point of trusting it also.

THE following are among the pensions granted during the year ended March 31, 1924, and payable under the provisions of section 9 (1) of the Civil List Act, 1910: Mrs. C. A. F. Rhys Davids, in recognition of her contributions and those of her husband, the late Prof. Rhys Davids, to the advancement of Pali and Buddhist knowledge, 100*l.*; Mrs. Blanche Hartog, in recognition of the contributions of her husband, the late Prof. Marcus Hartog, to the study of natural history, 50*l.*; Dr. Alice Lee, in recognition of her services to the cause of scientific research, 70*l.*; The Misses Ethel Marian and Katherine Elizabeth Rivers, jointly and to the survivor, in recognition of the services rendered by their brother, the late Dr. W. H. R. Rivers, to the cause of anthropology, physiology, and psychology, 100*l.*; Mrs. M. F. Robertson, in recognition of the services rendered by her husband, the late Dr. W. F. Robertson, to science and medicine, 100*l.*

MR. F. EDWARDS, 83 High Street, Marylebone, has just issued Catalogue No. 460 (British Empire Series, No. 3), containing the titles of upwards of 1100 works relating to India, Burma, Ceylon, Afghanistan, Beluchistan, Malaya, and Borneo. Many of the books listed formerly belonged to the late Dr. W. Crooke, a regular contributor to NATURE.

WE have received Bulletin 212 of the Department of the Interior, Washington, entitled "Analytical Methods for Certain Metals, including Cerium, Thorium, Molybdenum, Tungsten, Radium, Uranium, Vanadium, Titanium, and Zirconium," by R. B. Moore, S. C. Lind, J. W. Marden, J. P. Bonardi, C. W. Davis, and J. E. Conley. The pamphlet is of great value and should be found useful by analysts. Many modern products (*e.g.* special steels) contain these so-called "rare" elements, and rapid and accurate methods for their estimation are required.

Our Astronomical Column.

LARGE FIREBALL.—On July 7, a few minutes after midnight, a splendid meteor was observed at various places. It appeared, however, at a time when few observers were about, and hence we are not likely to receive many accounts of it. The object gave a very vivid illumination for a few seconds and moved very slowly from a radiant very probably in Scorpio. The descriptions already to hand are not, however, sufficiently definite to allow safe deductions to be made from them. From near Dunstable, the flight of the fireball was recorded as from κ Draconis to a little below α Aurigæ. From near Ludgate Hill, London, the meteor appeared as a large ball of fire leaving a trail of white sparks. The nucleus was yellow in the central part and brilliant orange in the outer portion. Observations of the position of the flight and its duration would be valuable. Large meteors have often been directed from Scorpio in the three months May, June, and July, the radiant point being a few degrees N.E. of the bright red star Antares.

AUGUST PERSEIDS.—This annual display of meteors has already given clear evidence of its activity. Mr. Denning, writing from Bristol, states that he observed an early Perseid this year on June 27, when the radiant was in about $356° + 39°$. From this point in Andromeda, the shower will move to E.N.E. through the northern region of Perseus and on between the constellations of Auriga and Camelopardalus. This stream of meteors has the longest duration of any known shower and the propriety of terming it "the Perseids" is perhaps questionable seeing that the meteors, during a portion of the shower's activity, diverge from Andromeda and other constellations.

Of late years this shower has formed some attractively abundant displays and notably so in 1921 and 1923. In the former year there was a decided maximum, the horary number reaching 250 for one observer on Aug. 12 A.M. Coulvier-Gravièr, a great French observer of meteors in the first half of the last century, thought that, after a maximum which he observed in 1848, the strength of the display declined so rapidly that it would be extinct by the year 1860. His conclusions were, however, far from being realised, and the shower continues to be visible every year with apparently the same richness as it exhibited in former times.

THE CANADIAN ECLIPSE EXPEDITION TO WALLAL 1922.—C. A. Chant and R. K. Young have just published the details of their investigation of the gravitational bending of starlight made at Wallal (Publications of Dominion Astrophys. Observ., vol. ii. No. 15).

An equatorial was taken, the general design of which is stated to resemble that of the 100-inch at Mt. Wilson. The total weight was about a ton. A guiding telescope of $4\frac{1}{2}$-inch aperture was attached to the camera, β Virginis being used for guiding. Two plates were taken for the Einstein investigation, each with 45 seconds exposure; 20 stars are shown, the magnitudes of which range from 4·3 to 9·5, but the two faintest were not used.

Full details are given of the measurement and reduction. The adopted mean shift at the sun's limb is 1·75″, exactly agreeing with Einstein's value. The separate values for measures in the x and y coordinates are 1·32″, 1·96″.

The results are insufficient to *prove* that the individual shifts follow Einstein's law (shift varies inversely as distance from sun's centre): but they group themselves fairly satisfactorily on either side of the theoretical curve.

The three separate investigations made during this eclipse all give mean results very close to Einstein's value.

Research Items.

ZENITH OF PRIMITIVE BABYLONIAN ASTRONOMY.—Prof. Reginald A. Fessenden, of Chestnut Hill, Mass., whose proposals for an archæological expedition to the Caucasus have received support from archæologists and ethnologists in the United States, including Prof. Clay of Yale, and Dr. A. Hrdlička, writes to ask whether any information is available in regard to a primitive Babylonian zenith fixed at Mt. Bakhar, near Baku. Prof. Fessenden is of the opinion that the zenith of primitive Babylonian astronomy, which goes back to a time when the Accadai (Agadi) had not yet descended from their mountain fastnesses, was fixed in the Caucasus. This area he maintains was the meeting-point of the original Babylonian and Egyptian civilisations. In support of this view he argues that the Book of the Dead was originally written in what Dr. Clay has called "Amuraic"—the early Semitic language—and that when it was translated into Egyptian, place-names were transformed and personal names mistranslated. When corrected in the light of a knowledge of the original tongue, these names reveal that the hidden land of Amen was the Caucasus Isthmus, for the road to which the Book of the Dead gave precise directions. The Egyptians and Colchians would thus be the same race, and the Isthmus the old home-land of the former. At the same time, many of the place-names in the neighbourhood of Mt. Bakhar, which antedate the Russian regime, are Babylonian, *e.g.* Schemacha, Marazi, Agadi-Kend, etc. It is therefore desirable to fix the zenith with some accuracy to determine which sites may be investigated by a preliminary expedition with most profit.

THE BLOW-GUN IN ASSAM.—In view of the frequent identity of culture between the Naga tribes and those of Indonesia, it has seemed rather surprising that while the blow-gun occurs among the latter, it should not have been found in Assam. Its occurrence is now recorded for the first time by Mr. J. H. Hutton in *Man* for July. It is found—as a toy rather than as a weapon—among the Thado Kukis, its principal use being to shoot rats. The darts are not poisoned. A similar toy is used in the Philippines; but the Karens of Burma, who appear to be related to the Nagas, employ the genuine blow-gun. The Thado type does not appear to be a degeneration, but is more probably the original form which in this area never developed. It consists of a single internode of simple bamboo, the maximum length being about two feet. It has an effective range of about twenty feet only, though a mere carry of seventy feet can be attained. Several patterns of dart are in use. In one of these, cotton is employed for the plug, although, it is interesting to note, this material does not occur in the area of distribution in Asia of the genuine weapon.

DIENTAMŒBA FRAGILIS IN A CHILD.—W. H. Taliaferro and E. R. Becker record (*Amer. Journ. Hygiene*, vol. iv., pp. 71-74, 1924) the case of a three-year-old girl, who was born in Baltimore and had never left the state of Maryland, infected with several intestinal protozoa, namely, *Dientamœba fragilis*, *Iodamœba williamsi*, *Endamœba coli*, *Trichomonas hominis* and *Giardia lamblia*. The child had never suffered from any intestinal disorder. Prolonged search failed to reveal any encysted stage of *D. fragilis*. The authors tabulate the 33 previously recorded infections with this species, the distribution of which indicates that, in common with other intestinal amœbæ of man, it is indigenous to the temperate zones as well as to the tropics.

DOUBLE EGGS.—Prof. T. H. Morgan contributes (*Scient. Monthly*, April 1924) a useful account of double eggs—twice as large as those normal for the species—which are supposed to arise from the union of two eggs. They develop into embryos twice as big as normal ones. The occurrence of these giant eggs has led to the attempt to unite two eggs by artificial means and to experiments on the fusion of blastulæ or parts of embryos. Prof. Morgan remarks that the results obtained from the study of fused eggs or embryos have not solved any of the larger problems of development, but have broadened our ideas concerning some of the possibilities of regulation between two systems each alone adjusted to produce only a single individual. He describes the recorded cases of the development of giant eggs of sea-urchins and the opportunity these have afforded for estimating the relative importance of chromatin and protoplasm in the development of hybrid larvæ. These giant eggs, the mode of origin of which is unknown, have a single nucleus with twice the normal number of chromosomes, and when fertilised develop at the normal rate. Large blastulæ and plutei are formed which have the normal number of cells, but the cells are twice the normal size. The normal egg of Sphærechinus contains, according to Baltzer, 20 chromosomes and after fertilisation 40; the fertilised giant egg contains, according to de Haan, 60-63 chromosomes, 40 of which probably come from the egg (diploid) and 20 from the sperm. An account is given of the hybrid plutei produced by fertilising giant eggs of Sphærechinus by sperm of Strongylocentrotus, and the stronger resemblance to the maternal plutei is probably due to the greater influence of the larger number of maternal chromosomes. Double-sized eggs of Ascaris and giant embryos of Lineus and of Triton arising from the fusion of two eggs are described and discussed, and reference is made to the origin of embryos which are not giants, but nevertheless apparently owe their origin to the fusion of two eggs (*e.g.* in a strain of Abraxas).

ICEBERGS IN NORTH ATLANTIC.—A descriptive account of the dangers of ice to vessels traversing the ocean between Europe and America, and the effective means taken to avert the danger, is given by Prof. R. de C. Ward, of Harvard University, in the *Monthly Weather Review* for February. A cruise, lasting fifteen days, was made on the U.S. Coast-guard cutter *Modoc*, on ice patrol duty, and the author being a meteorologist of great experience his communication is greatly enhanced. A memorial service was held at the spot where the *Titanic* sank, after collision with an iceberg in 1912, when 1500 lives were lost. The danger zone is now patrolled day and night during the ice season, the position of menacing bergs is given by radio to all passing ships, and no serious collision with ice has occurred since the patrol was inaugurated, a month after the catastrophe to the *Titanic*. Every vessel passing through the ice region, longitude 43° to 55° W., is expected to send by radio to the patrol vessel information as to any ice sighted. The U.S. Government manages the service, other nations assuming a share of the expense. Most of the bergs come from the fringe of glaciers bordering the west coast of Greenland, east of Baffin Bay, others come from the east coast of Greenland, and some start in Smith Sound. Charts are given showing the general drift of icebergs, and the drift track of an iceberg in the season of 1921 is shown, being traced from April 11 until May 12. Hunting icebergs is the business of the ice patrol, and the commanders of the vessels

employed are highly experienced. Photographs are given of several bergs. Testimony is borne to the splendid work done by officers and men, year after year, amid the dangers of ice, fog, and storm.

THE FATIGUE OF METALS.—Profs. H. F. Moore and T. M. Jasper have just published the third portion of their extensive research into the fatigue of metals as Bulletin No. 142 of the Engineering Experiment Station of the University of Illinois. On re-testing wrought specimens of iron and steel which have been subjected to many millions of stress alternations without failure, it is found that their endurance has been increased, the strengthening effect being greatest in those steels which are most hardened by cold-working. The static strength is also increased. Alternating stress above the endurance limit, on the other hand, weakens the metal, although the bad effect may be partly removed by polishing. Reversed axial stresses give an endurance limit which is only about 64 per cent. of that found by alternating bending tests, but this difference has not always been found by other investigators, and may perhaps be due to the form of test-piece employed. The authors consider that their test-piece represents the conditions likely to occur in the actual running of machines, and therefore recommend the adoption of the lower figure for reversed axial stresses. This recommendation may lead to controversy. Steels give inferior tests across the direction of rolling, as would be expected, and it is interesting to note that the cross tests are more improved by heat treatment than the longitudinal tests. It is doubtful whether soft non-ferrous metals and alloys have an endurance limit, and in order to determine this point it will be necessary to continue the tests for hundreds of millions of cycles. The authors take the view that fatigue failures do not take place by slip, but by the tearing apart of minute portions of crystals and spreading of the fissures so formed.

FIBROUS STRUCTURE IN METALLIC ELECTROLYTIC DEPOSITS.—Messrs. R. Glocke and E. Kaupp have recently carried out an X-ray examination of electrolytically deposited metals, which they describe in the *Zeitschrift für Physik* for May. They find it advantageous to use homogeneous radiations of medium wave length, the best results being produced by using an anticathode made of a metal closely following silver in the periodic system, the natural radiation of which excites the silver radiation of the photographic granules. An alloy of antimony and nickel (63 : 33), which melts at 1158°, a temperature nearly twice as high as the melting-point of pure antimony, was experimented with, and appears to be suitable; but the actual measurements were made with a silver anticathode. X-ray photographs were taken in a number of different directions through the material used, and showed that, in many cases, there was a distinct fibrous arrangement of the crystals. The axis of the elongated crystalline "fibres" is in the [011] direction in the case of copper, in the [111] or [112] direction for iron, [001] for nickel and [112] for chromium. In all cases this axis is identical with the direction of the electrolysing current, or perpendicular to the cathode surface. The crystallographic direction of the axis of the fibres depends on the composition of the solution; and, with some solutions, there is no fibrous structure, but the crystals are small and granular. It appears that the fibre axis is the direction of maximum growth velocity of the particular crystal in the electrolyte concerned. The nature of the cathode influences the structure, which is most perfectly fibrous when the cathode and the deposit are of the same metal.

DRY COOLING OF COKE IN GASWORKS PRACTICE.—Hot coke drawn from gasworks retorts is customarily cooled by contact with a stream or spray of water. At the newly erected Garston works of the Liverpool Gas Company the Sulzer system of dry cooling, now in operation at some continental works, has been tentatively applied to the coke derived from a bed of ten retorts, and the results were described at the annual meeting of the Institution of Gas Engineers. The coke so cooled is superior in appearance, higher in calorific power, and burns more freely in an open fireplace than that produced by wet quenching. The increased cost of dry cooling amounts to about 1*s.* 3½*d.* per ton of coke. Economic considerations indicate that the sale of dry coke is a sound commercial proposition provided the consumer realises the superior value of the dry fuel.

CHEMISTRY OF FATS.—A large part of the presidential address delivered by Dr. E. F. Armstrong to the Society of Chemical Industry on July 9 in Liverpool was a joint communication with Mr. John Allan dealing with our present knowledge of fats. After dealing with the composition and constitution of the natural glycerides, the authors emphasise the need for further research on the separation of certain fats which resemble one another closely in chemical composition, but differ widely in physical properties. They describe fully how the fatty acids are distributed in Nature, and indicate their possible modes of formation. They think that fats may be synthesised in plants and in animals from carbohydrates, of which the unit is one containing 18 carbon atoms in its molecule. Milk fats and certain nut oils may be built up from a simpler carbohydrate, like dextrose, the contained acids being synthesised from one another by repeated aldol condensations; and a third possible mode of synthesis is by resolution of dextrose into a C_3-unit and condensation of such units to form acids containing 12 or 18 carbon atoms.

SYNTHESIS OF METHANE FROM WATER GAS.—From work carried out in the laboratories of the South Metropolitan Gas Company and communicated to the annual meeting of the Institution of Gas Engineers, it appears that the reaction velocity of the synthesis of methane from water gas at 290° C. is increased about seventeenfold by the use of an activated catalyst, namely nickel-thoria, in place of nickel. The technical application of the process requires practically complete removal of sulphur compounds from the water gas employed, as it is found that one part of sulphur per million parts of gas effectively poisons the catalyst. Such removal and the necessary adjustment of the hydrogen to carbon monoxide ratio in the water gas can be effected smoothly and rapidly at temperatures industrially applicable, namely, about 550° C., by the passage of water gas and steam over a catalyst consisting of iron activated by chromium oxide deposited on five times its weight of pumice. Excluding the cost of this hydrogenation process, it is estimated that the net cost of production of a synthetic gas of approximate composition CH_4, 64 per cent.; H_2, 24 per cent.; N_2 12 per cent., and of calorific power 690 B.Th.U. per cubic foot, would be 10·9*d.* per therm. The cost of removing carbon dioxide appears to be the deciding factor as regards the possible establishment of the process on an industrial scale. (Cf. NATURE, June 9, 1923, vol. 111, p. 779.)

The Toronto Meeting of the British Association.

PROVISIONAL PROGRAMMES OF SECTIONS.

PROVISIONAL programmes of the Sections of the British Association for the Toronto meeting on August 6-13 have now been arranged, from which it appears that those who attend the meeting will be very fully occupied. The meeting will be noteworthy for the number of American and Canadian men of science who are presenting papers and taking part in many of the joint discussions.

We are indebted to the Recorders of the Sections for the following brief statements of important features of the work of the various Sections.

SECTION A (MATHEMATICS AND PHYSICS).

The outstanding feature of an extensive programme is the discussion which has been arranged, jointly with Section B, on crystal structure. The presidential address which Sir William Bragg will deliver on "The Analysis of Crystal Structure by X-rays" will form the introduction to this discussion, to which, among others, Prof. W. L. Bragg, Prof. S. Chapman, Dr. Shearer, Prof. Desch, and, possibly, Prof. Siegbahn (of Upsala) will contribute.

The exceptional equipment of the Toronto physical laboratory lends special interest to the paper promised by Prof. McLennan on "Recent Developments in Low Temperature Research," because the liquefaction of helium and the luminescence of solid nitrogen will be demonstrated. The United States, as well as Britain and Canada, will be well represented in the programme; the papers by Drs. Mohler and Foote on "Critical Potentials and their Interpretation," Prof. A. H. Compton on "The Quantum Theory of the Scattering of X-rays," Prof. Duane on "Secondary and Tertiary Radiation," and one by Prof. R. W. Wood may be mentioned.

Among the visitors to Canada, Prof. A. Fowler will read a paper on "The Spectra of Ionised Elements," Mr. R. H. Fowler will deal with "Mechanisms of Excitation, Ionisation, and Dissociation in Statistical Theory," and Prof. C. V. Raman will take a principal part in a discussion of the scattering of light.

There are many meteorological and geophysical papers promised, and the Section will have to subdivide in order to deal with them. Sir Napier Shaw has chosen the subject "If the Earth went Dry," and Mr. F. J. W. Whipple and Mr. L. F. Richardson, who are also going from England, will read papers. Canada itself is providing a number of meteorological papers; Sir Frederic Stupart, the Director of the Canadian Meteorological Office, has given as his subject "The Variableness of Canadian Winters." Astronomy will occupy a whole morning; papers are expected from Prof. Eddington on "Theory of Outflow of Radiation from a Star," Dr. H. H. Plaskett on "The Spectra of Nebulæ," and Dr. Silberstein on "Determination of the Curvature Radius of Space-time."

A special feature is being made of afternoon sectional lectures, of which there will be no less than three, and those of exceptional interest. Sir Ernest Rutherford will lecture on "Atomic Disintegration," Sir Richard Paget on "The Nature of Speech," and Prof. V. Bjerknes (of Bergen) on "The Forces which lift Aeroplanes." The last two will be illustrated by experiments. It is hoped to arrange short sessions of the Section at Saskatoon and Edmonton during the transcontinental excursion following the Toronto meeting. Sir Richard Paget has promised to lecture at both places.

SECTION B (CHEMISTRY).

Chemistry will be represented by a good attendance from Great Britain, and interesting meetings are expected. The president, Sir Robert Robertson, has selected "Chemistry and the State" as the subject of his address, and he will also deliver a lecture on explosives. The Section will join with Section A (Mathematics and Physics) in a discussion on crystal structure, and with Section I (Physiology) in one on vitamins, particulars of which will be found under the programmes of those sections. A morning will be devoted to a discussion on electrochemical industries, with special reference to Canada, Mr. H. Freeman dealing with Canadian hydro-electric development, Mr. D. A. Pritchard with the Canadian Salt Co.'s processes, Mr. R. L. Peek with electrolytic nickel, Mr. F. A. J. Fitzgerald with a radiant resistor furnace, and other contributors being Mr. F. A. Lidbury and Prof. F. G. Donnan.

Section C (Geology) will join in a discussion on liquid and powdered fuels, Dr. G. S. Hume reviewing the liquid fuels of Canada, Prof. G. A. Guess describing the use of powdered fuel in metallurgical plants, and Prof. W. A. Bone that of Canadian lignites. In another session, Prof. Bone will deal with the activation of nitrogen in explosions. An important discussion, in which Section A will join, is that on colloids, which will be opened by Prof. J. W. McBain with a group of papers dealing mainly with soaps, whilst Prof. W. D. Bancroft will speak on the permeability of membranes, Prof. E. F. Burton on the mutual action of electrically charged particles in solution, Prof. W. Lash Miller on the distribution of colloidal gold between two liquid phases, Prof. F. B. Kenrick on colloids in distilled water, and Prof. H. S. Taylor on adsorption from silver salt solutions by silver iodide. Visits to electrochemical works are being arranged.

SECTION C (GEOLOGY).

Ontario, one of the most important mineral-producing areas in the world, must of necessity be intensely interested in geological problems, and no gathering of men of science there could possibly avoid devoting considerable attention to that branch of science. While general topics are of interest in any or all circumstances, the industrial applications of geological knowledge are of paramount importance here. In addition, it is not without advantage that the problems confronting geologists and mining men in Canada are largely connected with the most ancient rocks of which we have any knowledge. Consequently the programme of Section C has been designed to stimulate, so far as possible, interest in both pure and applied geological science. The president, Prof. W. W. Watts, has selected as the subject of his address "Geology in the Service of Man," while subsequent speakers will emphasise particular aspects of applied geology as evidenced in Canada, and more especially in Northern Ontario. Inextricably bound up with the practical side of geology in Canada are the various problems connected with Pre-Cambrian rocks (indeed the word Pre-Cambrian is almost a household word in Ontario), and a whole session will be devoted to consideration of problems associated with these rocks in many parts of the world.

Appealing more strongly perhaps to another group of the public will be the joint discussion with the geographical section on changes of sea-level in relation to glaciation, coast-lines, etc., while a third on liquid and powdered fuels has been arranged as a joint discussion with Section B (Chemistry). This latter has had to be fixed to run concurrently with another meeting as the time available will not suffice for all the activities of the Section.

While such questions of general interest will occupy a considerable part of the sessions, the results of recent research work on more special subjects will be expounded by many authors. Mineralogy, petrology, palæontology, and stratigraphical geology will all be represented, so that every branch of geological interest will have its exponents.

As is usual in the case of Section C, excursions to places of interest round Toronto will form an important part of the programme. Three such excursions have already been settled, one being a week-end trip to the Niagara and Grimsby districts. Others will probably be fixed during the meeting, and members are advised to consult the notice boards outside the sectional rooms from time to time. On the western trip following the meeting, opportunities will be given for geologists to examine selected areas *en route*, but such areas must of necessity be determined by factors not entirely geological.

SECTION E (GEOGRAPHY).

The address by the sectional president, Prof. J. W. Gregory, will deal with "Inter-Racial Problems and White Colonisation in the Tropics." Another paper on allied problems will be on "Immigration from a Biological Point of View" by Dr. H. H. Laughlin. Many of the papers will treat of various aspects of Canadian geography, including Dr. Bell Dawson on "Tides and Currents in Canadian Waters," and Mr. E. M. Dennis, Mr. W. H. Boyd, Mr. N. Ogilvie, and Mr. W. H. Herbert on different branches of the work of the topographical survey of Canada. Dr. R. M. Anderson will speak on the status and prospects of the larger mammals of Canada.

Papers dealing with cartography and allied problems will be given by Mr. I. Bartholomew on modern developments in the construction of maps and Mr. J. B. Reynolds on the work of the Permanent Committee on Place-Names. Important papers in physical geography include "Wind, Wave, and Swell in the North Atlantic" by Dr. Vaughan Cornish, "Classification of Oceanic Islands" by Prof. W. M. Davis, and "The Glacial Anticyclone" by Prof. W. H. Hobbs. Prof. P. M. Roxby will lecture on the distribution of population in China, and Mr. Cuthbert Christy on Cape to Cairo progress.

Papers in human geography also include one on some aspects of urban growth by Mr. H. L. Seymour, and another on the influence of geographic conditions on the ancient Mediterranean religions by Miss E. C. Semple. Miss M. I. Newbigin's paper on the training of the geographer should direct attention to the notable lack of such facilities in Canada.

SECTION F (ECONOMIC SCIENCE AND STATISTICS).

The programme for the Economics Section at the Toronto meeting covers a wide and important field. Sir William Ashley's presidential address is "A Retrospect of Free Trade Doctrine." Business forecasting will be discussed by Prof. W. N. Persons, Mr. R. H. Coates, Prof. Mitchell, and Prof. H. W. Mackintosh.

The problem of population is to be dealt with in four papers from different points of view; Sir William Beveridge dealing with the fall of human fertility among the European races, and some of its reactions, Mr. Udny Yule with the population problem from the point of view of the Pearl and Reed law of growth, Prof. MacIver with civilisation and population, and Prof. Field with eugenic worth and economic value. Prof. J. E. Boyle is contributing a paper on the marketing of grain, and a film is to be shown illustrating the marketing of wheat. A discussion is to be held jointly with the Agriculture Section on diminishing returns in agriculture, and papers are to be read by Prof. C. R. Fay and Sir John Russell. Prof. A. L. Bowley will read a paper on the economic outlook in Great Britain, and the problem of unemployment prevention and insurance is to be discussed in papers by Prof. J. R. Commons and Mr. Bryce M. Stewart.

The meetings of the section will, therefore, bring together many of the leading economists of Great Britain, Canada, and the United States.

SECTION G (ENGINEERING).

The programme of the Section opens with Prof. G. W. O. Howe's presidential address entitled "One Hundred Years of Electrical Engineering." The remaining papers to be presented fall practically into two big groups: Canadian engineering problems and the strength of materials.

The first group is to be opened by Sir Henry Thornton, president of the Canadian National Railways, who will discuss railway transportation in Canada. This will be followed by a paper from Lieut.-Col. H. S. Lamb on engineering problems and traffic on the Great Lakes. Mr. J. B. Challies, director of the Water-Power and Reclamation Service, is to deal with the water-power resources of Canada. Water-power development commenced in 1895, and its possibilities may be envisaged from the fact that during the past ten years, while the population has increased 22 per cent., the water-power in use has increased nearly 100 per cent., and its use in industry 245 per cent. The total water-power of the Dominion is estimated at 18,000,000 horse-power, of which nearly 3,250,000 horse-power has been developed and 750,000 is under construction. The story will be taken up by Mr. F. A. Gaby, chief engineer of the Ontario Hydro-Electric, who will deal with the Hydro-Electric Power Commission of Ontario, and by Mr. R. S. Lea, who will discuss the possibilities of power development of the St. Lawrence River. A visit to the Niagara Fall Power Houses will be an appropriate conclusion to this part of the Section's work.

The second part of the programme will be opened by Prof. E. G. Coker with Mr. A. L. Kimball, of the General Electrical Company, Schenectady, who will describe American experiments on the optical determination of stress. Profs. H. F. Moore and T. M. Jasper, of Illinois University, will discuss the evidence for the existence of an endurance limit in metals, Prof. F. C. Lea, the effect of high temperature on the range of repetition stress for steels, and there are several other papers on related topics. The whole subject may be expected to be dealt with in two reports to be presented to the Section, one by Prof. C. F. Jenkin, on the work of the Fatigue Panel of the Aeronautical Research Committee, and another on the work of the Complex Stress Committee.

Other subjects to be dealt with by the Section include questions of public health (Mr. F. A. Dallyn), bio-aeration in sewage disposal (Mr. J. D. Watson), cobalt magnetic steels (Mr. E. A. Watson), and the future of power from fuel (Mr. E. K. Scott).

SECTION H (ANTHROPOLOGY).

Communications by anthropologists from Canada and the United States provide the greater part of the programme of the Section. Dr. F. C. Shrubsall's presidential address is entitled "Health and Physique through the Centuries." Other British contributions will include papers by Dr. A. C. Haddon on "A Suggested Arrangement of the Races of Man"; Dr. T. Ashby on "Recent Archæological Discoveries in Italy"; Mr. H. Balfour on "The Welfare of Primitive

Peoples," and also on "The Art of Stencilling in the Fiji Islands"; Mr. L. H. Dudley Buxton on "Skulls from the Valley of Mexico," and on "Physical Observations on Navajo Children." Prof. H. J. Rose's paper, "The Bride of Hades," will deal with virgin sacrifice as a fertility rite in early Greece and Rome.

Of communications by Canadian anthropologists, a number will deal with work which has been done under the Anthropological Department of the Geological Survey. Mr. Jenness deals with "The Ancient Education of a Carrier Indian"; Mr. T. F. McIlwraith with "The Potlach in Bella Coola," the result of a personal and, possibly, a unique experience; Miss E. G. Spier will analyse the "Ceremony of the First Salmon," and Mr. G. E. Rhoades will discuss "Composition in the Art of the North-west Coast Indians." From the United States Dr. A. Hrdlička will discuss the antiquity of man in America in the light of recent discoveries, with special reference to the skeletal remains recently found at Los Angeles. Mr. B. Oetteking also will give an account of the Santa Barbara skeletal remains; and Mr. Harlan I. Smith will describe "Trephined Aboriginal Skulls from Columbia and Washington." Dr. C. Wissler will deal with "The Segregation of Racial Characters in a Population," and Dr. Laughlin, of the Statistical Bureau, New York, will give an account of some racial characters emerging from the data obtained from immigrants. A joint discussion with Section J (Psychology) on "Racial Mental Differences" will be opened by Prof. W. McDougall.

SECTION I (PHYSIOLOGY).

The provisional programme arranged for the Section is the largest there has been for many years. It contains more than forty communications, covering a very wide range of subjects in physiology, biochemistry, and practical applications of these subjects to medicine.

The proceedings of the Section will open with the address of its president, Dr. H. H. Dale, on "Progress and Prospects in Chemotherapy." There are two joint discussions on the programme, one with Section B (Chemistry) and one with Section J (Psychology). The joint discussion with Section J will be on "Physiological and Psychological Factors of Muscular Efficiency in Industry," and will comprise the following papers among others: Prof. C. Lovatt Evans, "The Physiology of Muscular Contraction in Relation to Efficiency and Fatigue"; Prof. E. A. Bott, "Co-ordinate Volitional Action of Antagonistic Muscular Groups"; Prof. E. P. Cathcart, "Energy Exchange in Relation to Muscular Performance in Laboratory Investigations"; Prof. C. S. Myers, "Conceptions of Fatigue," and Prof. F. S. Lee, "Physical and Chemical Tests for Fatigue."

The joint discussion with the Chemistry Section will be entitled "Vitamins, and the Relation of Light to their Action," and the following are included in the papers to be contributed to it: Prof. J. C. Drummond, "Modern Tendencies of Vitamin Research"; Prof. H. C. Sherman, "The Quantitative Distribution and Nutritional Significance of Fat-soluble Vitamin"; Prof. Walter H. Eddy, "The Isolation of a Bios from Autolysed Yeast"; Prof. E. Mellanby (title not given); Prof. W. Lash Miller, "Bios"; and Prof. W. Steenbock, "Radiant Energy as the Anti-rachitic Factor."

Meeting at Toronto, it is appropriate that the Section should hear something of insulin, and Prof. J. J. R. Macleod and Mr. C. H. Best are, among others, dealing with this interesting subject.

Prof. J. C. Drummond is to deliver a popular lecture on "Cod-liver Oil."

There will be a large number of United States visitors at the Physiology Section.

SECTION J (PSYCHOLOGY).

The papers this year are so diverse in character that it is difficult to group them all under a few general headings. The presidential address by Prof. W. McDougall is entitled "Purposive Striving as a Fundamental Category in Psychology."

Three joint discussions have been arranged: (*a*) With Section H (Anthropology), on "Racial Mental Differences." *Speakers*—Prof. W. McDougall, Dr. C. S. Myers, and others. (*b*) With Section I (Physiology), on "Physiological and Psychological Factors of Muscular Efficiency in Industry." *Speakers*—Prof. Lovatt Evans, Prof. E. A. Bott, Prof. E. P. Cathcart, Dr. C. S. Myers, Prof. F. S. Lee. (*c*) With Section L (Education), on "Tests for Scholarships and Promotion." *Speakers*—Principal E. Barker, Prof. C. Burt, Prof. Sandiford, Prof. Whipple, and Prof. Buckingham.

A welcome feature of the programme is the important contributions of American and Canadian psychologists; for example, "The Problem of Personality," by Dr. Morton Prince, and "The Value of Mnemic Psychology for the Interpretation of Dreams and other Phenomena," by Prof. G. S. Brett, the local vice-president of the Section. A new feature is an informal conference of experimentalists on laboratory and applied researches, to be held on Saturday morning, August 9, Dr. C. S. Myers presiding, when several American, Canadian, and British representatives will exchange views.

Individual papers by British psychologists are: "The 'Self' in Cognition—Intuition, Concept, and Sensory Percept," by the Rev. F. Aveling; "Binocular Vision and Correct Ocular Muscle Balance: its Importance in Every-day Life," by Wing-Commander E. C. Clements; (1) "Psychological Theories of Laughter," (2) "Conscious and Unconscious in Psychology," by Dr. J. Drever; "Feeling and Emotion in Daily Life," by Mr. J. C. Flügel; "The Psychology of Déjà Vu," by Dr. J. T. MacCurdy; "Privileges and Limitations of Visual Imagery," by Prof. T. H. Pear; and "Shape-qualities or Relations?" by Prof. C. Spearman.

SECTION K (BOTANY).

The programme of the Section is noteworthy for the time which is to be devoted to discussions, either within the Section itself or in conjunction with other Sections. The proceedings start with a discussion on the ascent of sap and transport of food materials in trees, which will be opened by Prof. H. H. Dixon: other speakers will include Dr. O. F. Curtis, of Cornell University, Dr. D. F. MacDougal, Prof. V. H. Blackman, and Prof. J. H. Priestley. Another sectional discussion is to be on Canadian forest problems: the speakers at this meeting include Mr. D. Roy Cameron and Dr. J. M. Swaine, who will deal with forest protection in Canada from fire and insects respectively; Mr. E. H. Finlayson on Canadian silviculture, Dr. A. W. Borthwick on the cultivation outside Canada of Canadian trees, and Messrs. R. D. Craig and F. Storey on world timber supplies.

Joint discussions have been arranged with the Sections of Agriculture and Zoology respectively. At the former, the subject will be "Forest Problems," and four papers on aspects of forestry in the United States and in Canada will be contributed by Mr. J. W. Toumey, Mr. R. D. Craig, Prof. J. H. Faull, of the University of Toronto, and Mr. E. J. Zavitz. This discussion, by representatives from two of the greatest timber-producing countries of the world, should prove of great interest and importance. The

joint meeting with Section D (Zoology) will be to discuss the subject of "Species and Chromosomes." It will be opened by Prof. R. Ruggles Gates, and other speakers are Dr. H. Harrison, Prof. T. H. Morgan, of Columbia University, Mr. Julian Huxley, Miss K. Blackburn, and Mr. A. D. Peacock.

Prof. V. H. Blackman's presidential address to the Section will be entitled "Physiological Aspects of Parasitism." Of the numerous papers to be presented, it is impossible to mention more than a few. Contributions from the North American continent include papers on the "black dot" disease of potato, by Prof. B. T. Dickson; on the fluorescent pigments of the Cyanophyceæ, by Prof. F. E. Lloyd; on the distribution of potassium in plant tissues, by Miss E. S. Dowding; on the status of the biogenic law, by Prof. E. C. Jeffrey; on the growth of British Columbia trees, by Prof. A. H. Hutchinson; and on the behaviour of chloroplasts and other cell contents at low temperature, by Prof. F. J. Lewis. A number of papers will also be presented by British botanists.

SECTION L (EDUCATIONAL SCIENCE).

The Section is to open its session with a paper on the teaching of history and geography of the British Empire by Prof. G. M. Wrong, of the University of Toronto, followed by a paper on modern tendencies in the teaching of geography, by Mr. Ernest Young. The presentation of the Report of the special committee appointed last year to inquire into the educational training of boys and girls in secondary schools for life overseas will be followed by a discussion on the subject to be opened by Sir John Russell.

On the second day Principal Ernest Barker will deliver his presidential address, the subject being the "Nature and Conditions of Academic Freedom in Universities." Mr. A. E. Heath, of the University of Liverpool, will follow with a paper on "Modern Developments in the Method and Scope of Adult Education." A joint discussion with Section J (Psychology) on the subject of "Tests for Scholarships and Promotions" will occupy the third morning; the chief speakers will be Principal Barker, Prof. Cyril Burt, Prof. G. M. Whipple, Prof. B. R. Buckingham, and Prof. Sandiford. The latter in conjunction with Messrs. Brennan and Holmes will also contribute a paper on "The Use of Partial Coefficients of Correlation in Educational Research."

A discussion on "Modern Developments in Science Teaching" is to be opened by Mr. C. M. Stuart, late headmaster of St. Dunstan's School, Catford. Prof. J. L. Myres will read a paper on the place of classics in a secondary school system, to be followed by Mr. A. H. Hope, headmaster of Roan School, Greenwich, on the present position of classics in French secondary schools. The fourth morning will be devoted specially to subjects of Canadian interests. Sir Robert Falconer, president of the University of Toronto, will read a paper on "The Canadian University"; the Hon. Dr. H. J. Cody on the administration of education in Canada; Prof. G. M. Weir on an educational experiment in rural Saskatchewan; Dr. S. B. Sinclair on the selection of pupils for auxiliary classes; and Major J. B. Cowles on the working of the Adolescent Education Act in Ontario.

SECTION M (AGRICULTURE).

The meetings of Section M will be held under the presidency of Sir John Russell, the director of the Rothamsted Experiment Station, whose address on "Combination in tackling Farmers' Problems" will be given on Monday, August 10.

The proceedings on Thursday, August 7, will be opened by a short address by the Hon. J. S. Martin, Minister of Agriculture for the Province of Ontario. He will be followed by Dr. F. T. Shutt on "The Influence of Cropping on the Nitrogen and Organic Matter Content of Western Prairie Soils." Mr. H. J. Page, the head of the Chemical Department at Rothamsted, will read a paper on "Nitrogen Balance in the Soil"; and he will be followed by Dr. Scott Robertson on "The Fertilising Effect of Rock Phosphate." The next morning will be occupied by a joint discussion with Section D (Zoology) on "The Soil Population." This will be opened by Mr. D. Ward Cutler. In the afternoon, Mr. J. B. Reynolds, the principal of the Guelph Agricultural College, will speak on "Agricultural Colleges in Canada."

On Saturday, August 9, Mr. R. A. Fisher, of Rothamsted, will read a paper on "The Incidence of Rainfall in Relation to the Wheat Crop," and later in the morning Dr. McRostie will speak on "Forage Crops in Canada." The same day, Mr. Engledow will read a paper on "A Spacing Experiment with Wheat," which will terminate the day's proceedings.

On Monday, August 11, Mr. Godden will speak on the work which is being carried out at the Rowett Research Institute on the mineral requirements of farm animals, and Prof. Berry will follow with a paper on "The Chemistry of the Oat Crop." The afternoon will be occupied by a joint meeting with Section K (Botany) on "Forest Problems in Canada," to which Mr. Zavitz and Dr. Faull are contributing.

On Tuesday, August 12, the whole morning will be devoted to a joint meeting with Section F (Economics), the subject for discussion being "Diminishing Returns in Agriculture." This discussion will be opened by Dr. C. R. Fay, and it is hoped that other speakers will include Sir John Russell, Lord Bledisloe, Sir Henry Rew, and Mr. Ashby.

The proceedings of the Section will conclude with a joint meeting on forestry with Section K, in which such subjects as forest protection in Canada, and the cultivation of Canadian trees in other parts of the world, will be brought forward.

After the conclusion of the meeting, several local excursions have been arranged, including a visit to the Agricultural College at Guelph.

Atoms and Ethereal Radiations.[1]

IN his first lecture the speaker, after outlining the steps by which he and his collaborators had succeeded in pushing the region of wave-lengths explored by mechanically ruled gratings down to 136 Ångströms, presented the results which had very recently been obtained by Mr. I. S. Bowen and himself, through the analysis, with the use of high resolution, of the fine structure of these extreme ultra-violet lines.

Photographs were shown in which such a close doublet as the B_{III} line at 677 Ångströms was not only clearly resolved, but had its components so well separated that their distance apart, which amounted to but 0·15 Ångströms, could be measured with certainty to 0·01 Ångströms or better, and in which the seven components of the 834·0 line of oxygen were

[1] Abstract, prepared by the author, of three lectures delivered on June 16, 17, and 18, at University College, London, by Robert A. Millikan, Director of the Norman Bridge Laboratory of Physics of the California Institute, Pasadena, entitled (1) "Filling in the Gap between X-rays and Light"; (2) "Electronic Orbits in Atoms"; (3) "The Penetrating Radiations of the Upper Air."

clearly obtained in orders as high as the seventh. This high resolution has made it possible for Mr. Bowen and the author to prove with certainty that in their "hot-sparks" in high vacua, they have succeeded in stripping all of the valence electrons from the series of atoms, lithium, beryllium, boron, carbon, nitrogen and sodium, magnesium, aluminium, silicon, phosphorus, sulphur, six electrons having been removed from the outer shell in the case of the atom of sulphur.

As an illustration of the way in which this can be proved, as well as of the way in which the recently discovered laws of atomic mechanics can be beautifully verified, the lecturer took the case of the stripped boron atom B_{III}, the spectrum of which had not before been known. Mr. Bowen and he first predicted that if they had B_{III} in their source they should have a line at 2077·4 Ångströms. They arrived at this figure by dividing the corresponding line of lithium ($3d$-$4f$) by nine. They then set their spectrograph for this wave-length and obtained the predicted line—quite a strong one—at the accurately measured wave-length of 2077·79 Ångströms. They next predicted a line ($4f$-$5f$) at 4500 Ångströms, and obtained it at 4499 Ångströms, or within one part in 5000 of the predicted wave-length. They next predicted two doublets ($2p$-$3d$) and ($2p$-$3s$), of the same frequency separation at 677 and 758 Ångströms, and found both of them in the positions predicted and with the same frequency separation precisely as their theory demanded, this separation agreeing, too, as it should, with that of the first line of the principal series of B_{III} ($2p$-$2s$) first accurately measured in this work. Photographs showing all these lines as doublets, with the correct separation, were shown.

The speaker concluded his first lecture with the presentation of the proof, furnished by his slides, that the Moseley law of progression of frequencies with atomic number, discovered through the study of X-ray spectra, holds also in the region of optical wave-lengths, such as he has been studying with the aid of his mechanically ruled gratings. In particular he showed that the L_I levels of sodium, magnesium, and aluminium obtained from his "hot sparks" fall, along with that of neon, very accurately upon a Moseley line; also that the strongest L line of the foregoing elements can be plotted upon the same straight line with the corresponding lines obtained by Siegbahn with the elements down to copper; and that a like type of progression was found in the L spectra of the elements from neon down to lithium.

Thus, though the wave-lengths between the lecturer's lower limit of 136 Ångströms reached by grating spectroscopy, and Siegbahn's upper limit of 18 Ångströms, reached by crystal spectroscopy, had not thus far been directly obtained, yet this small remaining gap has been bridged over by the establishment of a common law, with the aid of which it is now possible to compute with certainty some of the most outstanding characteristics of the radiations which must fall in the as yet unexplored region. To this extent then, the gap between X-rays and light has already been completely bridged.

In his second lecture the speaker presented, in a series of tables, work of Mr. Bowen and himself, as yet unpublished, in which two other X-ray laws, namely, the *regular*, or relativity-doublet law, and the *irregular* doublet law were definitely extended throughout the whole field of optics. This extension has become possible because the foregoing series of stripped atoms gives the first opportunity to compare, *in the field of optics*, a fairly long series of atoms possessing exactly the same electronic structure, but in which the nuclear charge progresses by unitary steps. It is in general such a series of identical electronic structures which is dealt with in comparing X-ray spectra. Hence the possibility of a very precise comparison of atomic behaviour in the optical and the X-ray regions.

The definite extension by Mr. Bowen and the lecturer of the X-ray laws into the field of optics means unquestionably, to take a simple specific case, that in the second quantum state the so-called $2s$ terms in optics correspond exactly to the L_I terms in X-rays, the $2p_2$ terms in optics to the L_{II} terms in X-rays, and the $2p_1$ terms in optics to the L_{III} terms in X-rays. Stated otherwise, if the L_{II} and L_{III} levels in X-rays represent a relativity doublet, as they have hitherto been supposed to do, and correspond therefore to two differently shaped electronic orbits, one a circle $[2_2]$, and one an ellipse $[2_1]$, then p_2 and p_1 in optics also represent a relativity doublet, and correspond to these same two orbits.

While from an experimental point of view this definite unification of optics and X-rays under a common set of laws (Moseley law, relativity-doublet law, irregular doublet law) must be regarded as a distinct step in advance, since it tends toward a simplification, for the purposes of prediction, of the whole subject, it nevertheless introduces a very serious difficulty into the present status of atomic theory. For it appears to force us to choose between two positions, either of which presents apparently insuperable obstacles.

If we retain the physical interpretation of the relativity-doublet formula—a formula which is derived without the introduction of any arbitrary constant whatever from the theory of the change in mass with speed, and has had *quantitative* successes in interpreting the whole fine structure of the lines of atomic hydrogen and ionised helium—we must discard very largely the interpenetrating-orbit ideas with the aid of which Bohr and other workers have recently interpreted so successfully both optical and chemical phenomena. Specifically the difference between the energies of the so-called s and the p terms in optics can no longer be interpreted as due to the difference in the shapes of the $2s$ and the $2p$ orbits, the $2s$ corresponding to an ellipse, and the $2p_2$ and $2p_1$ to two circles. For if the relativity doublet interpretation is applied to the levels $2p_2$ and $2p_1$, one of these levels, namely $2p_2$, must correspond to an ellipse, while the other, $2p_1$, corresponds to a circle. *This requires that* $2s$ *and* $2p_2$ *be orbits of the same shape, namely,* 2_1 *orbits, despite their large difference in energy.*

If, on the other hand, we retain the assignment of azimuthal and inner quantum numbers which has been universally made in recent years in the field of optics, and hence make the $2p_2$ and $2p_1$ levels correspond to two circles which differ slightly in energy because of a difference in orientation (inner quantum numbers), we are forced by the results herewith presented to treat L_{II} and L_{III} in the same way. This requires us to find some other cause than change of mass with speed to account for their observed difference in energy, which is, however, quantitatively accounted for by this so-called relativity-doublet theory.

Before the accumulation of the present data it was not so difficult as it is now to discard the relativity-doublet interpretation, but in this data the relativity-doublet formula has had new successes, for it fits satisfactorily with the behaviour of a whole group of atoms which pass over in successive stages toward the structure of atomic hydrogen and ionised helium. Thus there now seems to be no place to stop in discarding the relativity-doublet explanation short of abandoning *in toto* the idea of change of mass with speed in electronic orbits, and assuming that it was mere chance which caused this conception to lead to a formula which has had amazing successes, not

only in predicting exactly the fine structure of the hydrogen and helium lines, but also in explaining very beautifully the complexities of the Stark effect in these gases.

Such an assumption of accidental agreement where the relations are so beautifully quantitative and so numerous as they are here is one which the theoretical physicist will be very loath to make. The lecturer felt that further experimental data must be accumulated before a choice could with certainty be made between his alternatives. The present experimental situation, so far as the work of Mr. Bowen and himself are concerned, will be presented fully in forthcoming articles in the *Physical Review*.

In his lecture on the "Penetrating Radiation of the Upper Air," the results of the experiments made by Mr. Bowen and the lecturer at Kelly Field, Texas, were described. They sent up sounding balloons carrying recording electroscopes, thermometers, and barometers to a height nearly twice as great (about 16 km.) as that reached in preceding studies of the penetrating radiation. The total weight of the whole apparatus sent up, exclusive of the balloons, was but 180 grams. The electroscope chamber consisted of an hermetically sealed, steel-walled vessel of about 200 cc. capacity, containing air at varying pressures ranging from 1 up to 11 atmospheres. Four such instruments had been sent up and three recovered, two of which had reached altitudes between 15 and 16 km., and both agreed in giving the integrated ionisation not more than 25 per cent. of that obtained by extrapolation from Kolhörster's curves or computed from his 1914 absorption coefficient $\mu/D = 5{\cdot}77 \times 10^{-3}$ cm.^{2}/gm. These results showed quite definitely that no external source of radiation having the postulated characteristics existed. At the same time, they showed that the balloons in their ascent passed through regions in which the penetrating radiation was greater than its value at the earth's surface, since the integrated leak could not otherwise be greater than its value at the surface.

Dr. Russel Otis, of the California Institute at Pasadena, then checked these results by observations made in a number of aeroplane flights up to altitudes of 17,000 ft. In these flights he calibrated his electroscope at each particular level, thus rendering his results quite independent of any possible effects of temperature and pressure. He found, in agreement with Kolhörster, Hess, and others, that the penetrating radiation decreases slightly up to altitudes of six or eight thousand feet and then begins to increase. The actual values at 17,000 ft. (5·18 km.) were, however, but half those reported by Kolhörster at this altitude. Observations which Dr. Otis then made on Mt. Whitney at altitudes up to 13,000 ft. checked quite well with those made in aeroplanes, thus indicating that the phenomenon is one due to altitude rather than to locality.

The most conclusive evidence as to the source of the radiation has come from a continuous series of night and day observations, inside and outside 5 cm. thick lead screens, which the lecturer and Dr. Otis carried out last September on the top of Pikes Peak (14,100 ft.) in Colorado. During these observations, as a result of a snowstorm, the ionisation inside the closed observing chamber dropped suddenly about 10 per cent., but when the test was made inside the chamber *when it was completely shielded by its 5 cm. of lead*, the percentage fall in the ionisation was about the same as in the unshielded chamber, thus indicating that *local causes* modified the ionisation which got through 5 cm. of lead as much as they modified that which did not have to go through such a screen. If a very penetrating radiation of cosmical origin existed, this should have been completely unmodified by local changes, so that the percentage change inside the shielded vessel should have been very much less than that observed when the shields were removed. This observation was, then, an indication that the whole of the radiation measured in the closed vessel was of local origin.

This indication was confirmed as follows: assuming, following Kolhörster's 1923 conclusions, a penetrating radiation of cosmic origin which produces 2 ions/cc./sec. at sea-level, and has an absorption coefficient per cm. in water of $\alpha = 2{\cdot}5 \times 10^{-3}$, we find that this radiation would produce 6 ions/cc./sec. on top of Pikes Peak and 5·2 inside our lead shield. We found that the ionisation in our chamber contributed by the walls and the lead shields was at least 7 ions, so that if there were no local radiation at all on Pikes Peak capable of getting through our screens, a condition contrary to fact, the lowest obtainable value of the ionisation inside our vessel should have been $7 + 5{\cdot}2 = 12{\cdot}2$ ions. *We observed directly 11 ions.* We conclude, therefore, that there can exist no such penetrating radiation as we have assumed.

Our observations, therefore, seem to us to show that the whole of the penetrating radiation on top of Pikes Peak is of local origin. We have computed its absorption coefficient and find it but a little harder than that of the ordinary radioactive materials. How such quantities of radioactive material get into the upper atmosphere is as yet unknown.

University and Educational Intelligence.

BELFAST.—At the meeting of Senate of the Queen's University held on July 16, a letter was read from the trustees of the late J. C. White intimating that they intended to hand over to the University a sum of 60,000*l.* Of this amount (1) a sum of 45,000*l.* is to be used in founding a professorship of biochemistry with a salary of 800*l.* per annum and equipping the department. (2) The remaining 15,000*l.* is to be used in founding a lectureship in bacteriology with a salary of 450*l.* and equipping the department. The title of the professorship is to be the "J. C. White Professorship of Bio-chemistry," and the title of the lectureship the "J. C. White Lectureship in Bacteriology."

On July 17 the cheque for 60,000*l.* was handed to the honorary treasurer of the University.

CAMBRIDGE.—The Local Lectures summer meeting will be held on August 1-21, and an attractive programme has been issued. The chief subject of study will be Egypt, its ancient, medieval, and modern aspects, and among the lecturers who have been secured are Sir Flinders Petrie, Prof. A. S. Hunt, Dr. A. H. Gardiner, Dr. A. M. Blackman, Dr. W. F. Hume, and Sir William Willcocks. The group of lecturers on science include many of the leading scientific workers in the University, with the addition of Dr. Leonard Hill, director of the Department of Applied Physiology, Medical Research Committee, Prof. H. H. Turner of Oxford, and Dr. A. E. H. Tutton. The inaugural address to the meeting will be delivered by Viscount Haldane. Further information can be obtained by application to Dr. Cranage, Syndicate Buildings, Cambridge; letters should be endorsed "Summer Meeting."

EDINBURGH.—The following doctorates were conferred at the Graduation Ceremony on July 17, the subject of the thesis in each case following the name:—*D.Sc.*: Mr. T. M. Finlay, "The Old Red Sandstone of Shetland"; Dr. R. K. S. Lim, "Gastric

Secretion"; Mr. G. P. Douglas, "The Effect of High Tip Speeds on the Performance of Aeroplane Propellers"; D. Penman, (*a*) "Investigations relating to Temperature Conditions in Indian Mines and to the Explosibility of Indian Coal Dusts"; (*b*) Development of a Simplified View of Mine Ventilating Resistances, with Supplementary Papers." *Ph.D.*: Mr. R. T. Dunbar, "Experiments on the Absorption of X-radiation of Short Wave-length, and on the Associated Scattered and Corpuscular Radiation"; Mr. D. A. W. Fairweather, "The Electrolysis of Salts of Alkyloxyacids"; Honor Bridget Fell, "Histological Studies on the Gonads of the Fowl"; Mr. R. E. Gibson, "The Electrolysis of a Mixture of the Potassium Salts of Acetic and Trichloracetic Acids and on the Nature of Kolbe's Electrosynthesis and Allied Reactions"; Mr. J. Haldane, "The Action of Diphenylformamidine on the Phenols"; Mr. J. H. Kenneth, "An Experimental Study of Effects and Associations due to Certain Odours"; Satis Ranjan Khastgir, "The Scattering of X-Rays and the J-Absorption Phenomenon"; Christina Cruickshank Miller, "Diffusion in Solution"; Mr. T. R. Paterson, "The Influence of Substitution on the Velocity of Reaction between Benzoic Anhydride and an Aliphatic Alcohol"; Mr. W. Robson, (*a*) "The Metabolism of Tryptophane—the Synthesis of Bz-3-Methyltryptophane; (*b*) "The Influence of Insulin on Acidosis and Lipæmia in Diabetes"; Mr. R. H. Slater, "The Influence of the Nature and Position of Atoms in Organic Compounds on the Reactivity of other Atoms in the Molecule. Polarity Effects in Aromatic Halogen Compounds"; Mr. C. M. Yonge, "The Mechanism of Feeding, Digestion, and Assimilation in *Nephrops norvegicus*."

A Diploma in Technical Chemistry is now granted by the University to graduates of British or other approved universities who have taken a degree in science with honours in chemistry. The course of study for the Diploma extends over one academic year, and comprises instruction not only in technical chemistry but also in the elements of engineering practice, and in factory organisation and factory accounting.

Dr. D. Murray Lyon has been appointed Christison professor of therapeutics, in succession to Prof. J. C. Meakins.

Lieut.-Col. E. D. W. Greig has been appointed lecturer in tropical diseases. Lieut.-Col. Greig was formerly Director of Medical Research in India.

Among the recipients of the honorary degree of Doctor of Laws on July 17 were the following: Mrs. Sidney Webb; Mr. F. R. Jamieson, Senior Inspector of Schools; Sir David O. Masson, professor of chemistry at Melbourne; Prof. C. J. Martin, Director of the Lister Institute of Preventive Medicine; Prof. S. J. Hickson, of Manchester; Mr. G. G. Chisholm, formerly reader in geography at the University.

Dr. D. P. D. Wilkie, lecturer in clinical surgery, has been appointed to the chair of surgery for a period of ten years.

GLASGOW.—Mr. Hector J. W. Hetherington, principal of the University College of the South-West of England, Exeter, has been appointed to the chair of moral philosophy, in succession to Prof. Lindsay, now the Master of Balliol.

LEEDS.—Prof. J. B. Baillie, professor of moral philosophy in the University of Aberdeen, has been appointed Vice-Chancellor of the University, in succession to Sir Michael Sadler. Prof. Baillie was educated at Edinburgh, Trinity College, Cambridge, Halle, Strasbourg, and Paris.

MANCHESTER.—Mr. E. A. Milne, assistant director of the Solar Physics Observatory at Cambridge, has been appointed to the Beyer chair of applied mathematics.

ST. ANDREWS.—A letter was read from Prof. A. E. Taylor resigning the chair of moral philosophy in the University on his appointment to the chair of moral philosophy in the University of Edinburgh. The Court resolved to tender their congratulations to Prof. Taylor on his appointment, and to express their appreciation of the good fortune which has enabled this University to enjoy the benefits of his scholarship and share in his reputation for a fruitful period of sixteen years.

It was unanimously agreed to invite Mr. David Morrison, lecturer in logic in the United College, St. Andrews, and in University College, Dundee, to accept the vacant professorship as from October 1 next.

The Court resolved to appoint Dr. G. McOwan, assistant to the professor of chemistry, St. Andrews, to be lecturer in organic chemistry in the United College in succession to Dr. A. K. Macbeth, resigned. It was intimated that Mr. J. Stirling had resigned the post of assistant to the lecturer in botany in the United College, St. Andrews, on his appointment to a junior lectureship in the University of Liverpool. The Court approved the appointment of Mr. J. Duke Stewart as a tutor in anæsthetics in the University.

THE vacant principalship of the Northampton Polytechnic Institute, Clerkenwell, caused by the tragic death of Dr. R. Mullineux Walmsley in June, has been filled by the appointment of Mr. S. C. Laws, principal of the Wigan Mining and Technical College for the past nine years. The appointment is subject to the approval of the London County Council. Mr. Laws was educated at University College, Nottingham, and St. John's College, Cambridge, where he attended as an 1851 Exhibition research scholar and was admitted as an advanced student. He worked at Cambridge at the Cavendish Laboratory under Sir J. J. Thomson and received the special distinction of an extension of his scholarship for a third year, the University of Cambridge awarding him the certificate for distinguished research.

THE Universities' Library for Central Europe, established four years ago under the presidency of the late Viscount Bryce to meet the book-famine in the universities of central European countries, is appealing for funds to enable it to continue its work for at least another twelve months, after which it is anticipated that the economic conditions of those countries will have improved so as to render such external help less needful. The report of the executive committee for the two years 1922–24 shows that during that time 14,000 volumes and 25,000 periodicals were received by gift, and more than 1500 volumes by purchase. The presentations included several sets of NATURE and other journals. The number of consignments despatched were: To Austria 22, Czecho-Slovakia 37, Danzig 4, Finland 10, Germany 64, Hungary 10, Poland 19, Roumania 3, Russia 34. Among the subsidiary activities of the organisation may be mentioned: co-operation with the Vienna International Summer School and with the British Committee for aiding men of letters and science in Russia, and despatching French books to Paris for villages in the devastated areas. The honorary secretary is Mr. B. M. Headicar, of the London School of Economics. Contributions, which may be earmarked for any particular country or university, should be sent to Sir George S. Gibb, London School of Economics, Houghton Street, London, W.C.2.

Early Science at the Royal Society.

July 27, 1664. Ordered, That at the first opportunity Mr. Hooke be put to the scrutiny for the place of curator: That he forthwith provide himself of a lodging in or near Gresham College: And that these orders and votes be kept secret, till Sir John Cutler shall have established Mr. Hooke as professor of the histories of trades.

1681. The President [Wren], Mr. Henshaw, Mr. Colwall, Dr. Gale, Dr. Croune, Dr. King and Mr. Hooke were appointed a committee to go to Chelsea, and to meet at the Swan-tavern there at nine in the morning to speak with the Lord Cheney about inclosing the ground of Chelsea-college next the meadows.

July 28, 1670. The society thinking proper to discontinue their public weekly meetings, there was recommended to Mr. Hooke during this recess the care of these three things: 1. To continue to observe, whether there be a parallax in the earth's orb. 2. To observe the present variation of the needle. 3. To measure the quantity of a degree upon the earth.

1686. There happened much discourse about the way of preserving ships from the worms; and it was remarked, that sheathing with lead was the best expedient, and found to be so by the experience of Sir Anthony Deane; but that the carpenters opposed it as against their profit, affirming that the iron of the rudders so sheathed was more apt to be corroded.

July 30, 1663. Christopher Wren to the president [Viscount Brouncker]—"The act and noise of Oxford being over, I retired to myself as speedily as I could, to obey your lordship, and contribute something to the collection of experiments designed by the society for his majesty's reception. The solemnity of the occasion, and my solicitude for the honour of the society, make me think nothing proper, nothing remarkable enough. It is not every year will produce such a master experiment as the Torricellian, and so fruitful as that is, of new experiments; and therefore the society hath deservedly spent much time upon that and its offspring. To produce knacks only, and things to raise wonder, such as Kircher, Schottus, and even jugglers abound with, scarce become the gravity of the occasion. It must therefore be something between both, luciferous in philosophy, and yet whose use and advantage is obvious without a lecture. . . . It is upon billiards and tennis-balls, upon the purling of sticks and tops, upon a vial of water, or a wedge of glass, that the great Des Cartes hath built the most refined accurate theories that human wit ever reached to. For myself, I must profess freely I have not anything by me suitable to the idea I have of what ought to be performed upon this occasion. . . .

1668. The experiment of shutting up two finches in two glasses of different capacity was tried. The vessels were closed with very good cement, the one containing about four and a half times the liquor of the other. The birds were both put in at the time of fifty-five minutes past four. That in the smaller glass appearing ready to die, after nineteen minutes, was taken out, but found dead. The other was kept in about an hour and twenty-eight minutes, and appearing to be sick, though not so very much so, was taken out, it being time for the society to rise; whereby it seemed, that the times and the quantities of the air necessary for respiration in these birds were almost in reciprocal proportion to one another.

August 1, 1678. Some mention was made of cures done by the natural heat of living bodies outwardly applied. Sir Christopher Wren observed, that the raising of a blister would cure the stinging of wasps. . . .

Societies and Academies.

LONDON.

Geological Society, June 25.—Dr. J. W. Evans, president, in the chair.—Miss M. E. **Tomlinson**: The river-deposits of the lower valley of the Warwickshire Avon; with an appendix by A. S. **Kennard** and B. B. **Woodward.** Fluviatile sands and gravels occur as river-terraces between Stratford and Tewkesbury. The surfaces of these terraces lie on curves parallel to the present thalweg of the Avon. Five such terraces have been identified. No. 5 Terrace, the highest above river-level, has yielded no contemporaneous fossils. No. 4 and No. 3 both contain a warm fauna, with Hippopotamus and *Belgrandia marginata* occurring solely at No. 3 level, and *Corbicula fluminalis* at No. 4 level. No. 2 contains a cold fauna, with numerous remains of mammoth and *Rhinoceros tichorhinus*. No. 1 probably underlies the alluvium, and may be connected with the infilling of the buried channel which has been identified at Fladbury and Tewkesbury. The sole evidence of human industry found is a fresh flint of Mousterian type from No. 2 Terrace.—F. **Raw**: The development of *Leptoplastus salteri* Callaway, and of other trilobites (Olenidæ, Ptychoparidæ, Conocoryphidæ, Paradoxidæ, Phacopidæ, and Mesonacidæ). *Leptoplastus salteri* occurs in the Upper Tremadoc horizon of Shineton Brook (Salop). All stages of development are noted, except the protaspis. The development is divided into successive stages. The earliest stage has a long, simply segmented glabella; long pleural spines occur throughout the body, including three pairs on the head and four on the pygidium; while axial spines occur from the occipital segment throughout. In the last stage the glabella is short, conical, and smooth; of pleural spines, only the genal remain on the head, those in the thorax are reduced, and none remain on the pygidium, where axial spines are also wanting. With certain reservations, these four stages are also claimed to represent successive stages in the phylogeny. This ontogeny sheds much light on that of other trilobites. In the ontogenies of several families, it is the primitively posterior head-spines that at first are dominant—to be superseded later by the middle pair. In Mesonacidæ these again are succeeded by the anterior pair, which, in their lateral revolution, carried before them the anterior branches of the facial sutures, so that these cut the posterior border; they also stretched out the antero-marginal suture to the genal angle. These changes led to the supersession of the dorsal facial suture by the marginal suture, with consequent ankylosis along the former. The family is hereby claimed to have a head-structure not hitherto recognised. It illustrates a general principle—that those only of the cephalic sutures are retained as were necessary for ecdysis. The combined study of trilobite ontogeny and morphology strongly suggests, as Beecher claimed, that here the ontogeny extensively recapitulates the phylogeny; and therefore best indicates relationships. This indicates an early divergence in glabella-form, antedating divergences in cephalic spines and sutures. Members of a "natural" order may, therefore, be expected to agree much more in glabella-form than in the cephalic suture, which has latterly been made the basis of classification.

Physical Society, June 27.—Mr. F. E. Smith in the chair.—O. W. **Richardson**: Thermionic emission from systems with multiple thresholds. The question of the connexion between thermionic emission and the internal electron levels of the emitting substance must be faced. The theoretical problem is attacked from

three different points of view, namely, (*a*) classical statistical mechanics, (*b*) chemical dynamics, and (*c*) the laws of photo-electric action. As a result it seems possible to exclude certain alternatives which might otherwise have appeared not improbable and to formulate a set of rules governing the fundamental phenomena which are not in conflict either with the known facts or with any well-recognised relevant principle.—F. C. **Toy**: A selenium photometer. The instrument was designed for use by photographic manufacturers in measuring the density of a negative after test exposures which vary from strip to strip of the negative. By means of a selenium cell, the intensities of two beams of light are compared, one of which passes through the part of the negative to be tested while the other passes through a compensating wedge which has to be adjusted until its effect on the second beam is equal to that of the negative on the first beam. As one beam is progressively obscured by one shutter, the other is progressively opened, the total illumination of the selenium cell remaining constant provided that the two beams on reaching it are of equal intensity. The method is extremely accurate.—L. **Hartshorn**: A method of measuring very small capacities. A bridge arrangement is described suitable for the measurement of very small capacities (of the order of 1 micro-microfarad and less) at telephonic frequencies. Means of securing (1) great sensitivity, (2) fineness of adjustment, and (3) elimination of capacities to earth and capacities due to the presence of connecting leads, are indicated, so that it is possible to measure the true inter-capacity between any two conductors, *e.g.* the electrodes of a thermionic valve. As a test of the method, it is used to measure the capacity between two steel balls of 1 cm. radius and at distances apart of 2·25 to 8 cm.—E. **Wilson**: A new form of string galvanometer. The magnets consist of two rings of cobalt chrome steel of 25 cm. diameter, the cross-section of the bar being 5 cm. × 1 cm. Each ring has an air gap of 0·1 cm., and the poles have a bevel of 45°, terminating in opposing faces of 0·4 cm. wide. The magnets are mounted one above the other, with their gaps in line, and a separation between the rings of 1 cm. The strings, two in number, are of platinum wire 0·002 cm. diameter, and are supported symmetrically in the gap by a brass former, the effective length of each string being 10 cm. —W. E. **Curtis**: The phosphorescence of fused transparent silica. A mercury lamp and a hydrogen tube, both of transparent silica, were used. Heat increases the intensity of the phosphorescence and decreases its duration. With helium containing a trace of hydrogen, it was found that whereas a condensed (oscillatory) discharge gave the Balmer lines faintly and feeble phosphorescence, an uncondensed (unidirectional) discharge developed neither Balmer lines nor phosphorescence. There was also a correspondence between the localisation of the Balmer lines and that of the phosphorescence. On admitting hydrogen to the helium tube by making it red hot, the phosphorescence was obtained strongly. The effect may be due to radiation of wave-lengths occurring in the hydrogen spectrum, but absent from the helium spectrum; the Lyman series of hydrogen, which lies between λλ 1,215-912 A, is probably the effective radiation.

Aristotelian Society, July 7.—Prof. T. P. Nunn, president, in the chair.—H. Wildon **Carr**: The scientific approach to philosophy. There are two problems of philosophy which are fundamental in their relation to present scientific research. The first concerns the biological sciences. It is the problem of the nature and genesis of the human intellect, whether it is essentially a cognitive faculty of receiving a revelation of reality by simple contemplation and natural reasoning, or whether it is a mode of cognitive activity produced in the evolution of life for a vital purpose, that is, to serve a special form of living activity. The second problem concerns the subject-matter of mathematics and physics. It is the problem of the subjective conditions of sense experience imposed on the observer of Nature, how far they must be held to qualify the objectivity of the results of observation and in what way they can be allowed for or abstracted from. Neither of these problems can be ignored by the scientific researcher, and both carry science beyond the realms of physics and biology into metaphysics and philosophy. The first is the leading motive in the philosophy of Bergson. The second is being forced on the attention of philosophers by the new principle of relativity of Einstein.

DUBLIN.

Royal Irish Academy, June 23.—Prof. Sydney Young, president, in the chair.—K. C. **Bailey** and Mrs. D. F. H. **Bailey**: The colorimetric estimation of thiocyanates and cyanates. The tests proposed by Spacu and by E. A. Werner for the detection of thiocyanates and cyanates respectively by the formation of coloured compounds with copper and pyridine are adapted to the colorimetric estimation of these substances. The estimation can be successfully performed in the presence of most common acids, bases and salts. Cyanates can be estimated thus in the presence of urea, but thiourea interferes with the estimation of thiocyanates.—J. J. **Dowling** and J. A. C. **Teegan**: Optical interference experiments with multiple sources. By the use of a train of two or more biprisms, multiple images of an illuminated slit are obtained. The resultant interference pattern has been observed corresponding to light sources arranged in any symmetrical formation. The fact that these sources do not lie in one plane introduces difficulties.

Royal Dublin Society, June 24.—Prof. J. A. Scott in the chair.—H. H. **Dixon**: Variations in the permeability of leaf-cells. With suitable arrangements, large changes in the electrical resistance of leaf-tissues may be shown to be associated with changes of temperature. Thus it may be inferred that the permeability of the component cells is doubled for a temperature rise of 10° to 30° C. Observations with specially constructed thermocouples show that leaves exposed to sunshine are often many degrees warmer than adjacent shaded leaves, and air-currents often lead to fluctuations of several degrees within a minute. Such temperature differences must give rise to alterations in the permeability of the cells. These permeability variations coupled with tensile stresses in the sap will lead to the transport of materials from the more permeable cells.

EDINBURGH.

Royal Society, July 7.—J. H. Ashworth, vice-president, in the chair.—D. H. **Scott**: Fossil plants of the Calamopitys type, from the Carboniferous rocks of Scotland. The stems of four plants are discussed. They are referred, provisionally, to the family Calamopiteæ, a group, placed among the Pteridosperms or "Seed-ferns" on the ground of anatomical characters. *Calamopitys radiata*, from the Cementstone group of Dumbartonshire, has pith that contains elements resembling tracheids, and may therefore have been a "mixed pith." The strands of primary wood surrounding the pith are large. The secondary wood is remarkable for the enormous width of many of the medullary rays, so that the woody zone consists largely of cellular tissue. This feature distinguishes the plant from all the other known species of the

group. *Endoxylon zonatum* was found in the Carboniferous Limestone series, Dalry, Ayrshire, by the late Dr. John Young of Glasgow. The large pith consists wholly of cellular tissue, surrounded by a number of scattered strands of primary wood. The secondary wood has very narrow, and usually low medullary rays, and is notable for showing well-marked annual rings, characterised by the narrow-celled zones of "autumn-wood." The bark is preserved in this specimen, an unusual feature. The other specimens illustrate two species of the genus, Bilignea, a genus founded by Dr. Kidston, and characterised by the fact that the pith is wholly replaced by a massive central column of short tracheids, presumably for the storage of water. This genus may be described as Eristophyton with the pith replaced by a column of water-storing tracheids. Whether this peculiar structure was derived from a primitively solid wood or from a pre-existing pith cannot yet be decided.—E. L. **Ince**: On a class of partial differential equations. Equations of which $\frac{\partial^2 z}{\partial x^2}+\frac{\partial^2 z}{\partial y^2}+(n+1-x^2-y^2)z=0$ is typical are considered; a set of particular solutions and a solution of a general character are obtained.—Sir Thomas **Muir**: The theory of circulants from 1900 to 1920.

PARIS.

Academy of Sciences, June 23.—M. Guillaume Bigourdan in the chair.—G. **Bigourdan**: The determination of time, and the modified use of the method of corresponding heights. A review of the six methods that have been used, with discussion of the relative advantages and disadvantages of each. The method of corresponding heights of known stars has for a long time been considered the most exact: a modification leading to increased precision is proposed.—F. **Widal**, P. **Abrami**, A. **Weill**, and **Laudat**: Hydremia in the course of diabetes under insulin treatment. Variations in the refractive index of the serum. Insulin profoundly affects water metabolism, causing blood dilution, and these changes can be conveniently followed by the refractometer.—Pierre **Weiss** and Mlle. Paule **Collet**: Paramagnetism independent of the temperature.—V. **Grignard** and R. **Stratford**: The catalytic decomposition of hexahydroaromatic and saturated fatty hydrocarbons. Contribution to the study of the cracking of petrol. The decomposition of pure individual hydrocarbons has been studied; anhydrous aluminium chloride was used as catalyst and the temperatures were generally between 120° and 150° C. The gaseous and liquid products of the reaction were identified. The substituted cyclohexanes undergo a double transformation, a cracking increasing with the length of the side chain, and isomerisation leading to polymethyl cyclohexanes. Both fatty hydrocarbons and substituted cyclohexanes give normal butane under the action of aluminium chloride.—Jean **Effront**: The toxicity of copper salts.—M. Giovanni Battista De Tori was elected correspondant for the section of botany in succession to the late M. Warming.—Marcel **Légaut**: The systems of points in a plane.—G. **Maneff**: Gravitation and the principle of action and reaction.—M. de **Fleury**: Concerning the use of light or extra-light alloys for the pistons of internal combustion engines.—P. **Dumanois**: Concerning aviation motors with very high compression. Some consequences resulting from the use of an antiknocking compound, such as lead tetra-ethyl, in petrol used for aviation motors.—V. **Michkovitch** and E. **Mallein**: A prism astrolable with an impersonal micrometer.—Alfred **Lartigue**: The application to thermodynamics of the representation of Fresnel.—P. **Lejay**: The use of lamps with several electrodes in electrometry.—Georges **Chaudron** and Hubert **Forestier**: Study of the decomposition of ferrous oxide. Anomalies of expansion corresponding with its instability. It has been shown in an earlier communication that ferrous oxide is unstable below 570° C. and that it decomposes according to the reaction $4FeO \rightleftharpoons Fe_3O_4 + Fe$. The present paper gives the result of a study of the velocities of these two inverse reactions.—P. **Laffitte**: The spectroscopy of explosions. With a gaseous explosive the spectrum of the explosive wave, and that of the period of combustion, is a continuous spectrum, the only lines observed being those of elements in the walls of the containing tube. For a solid explosive, the spectrum is continuous without lines.—A. **Damiens**: The absorption of carbon monoxide by cuprous sulphate in the presence of sulphuric acid. Application to the production of hydrogen from water gas. With cuprous oxide dissolved in strong sulphuric acid, the absorption of carbon monoxide is complete up to the limit one molecule of carbon monoxide to one molecule of copper sulphate, and no gas is evolved by this solution in a vacuum. The carbon monoxide is removed by dilution and warming.—Edmond **Bayle** and René **Fabre**: Study of the fluorescence of the alkaloids of the isoquinoline and tetrahydroisoquinoline groups, papaverine, narcotine, hydrastine, and their products of oxidation.—E. **Darmois** and A. **Honnelaitre**: The electrometric study of the acidity of mixtures of malic acid and molybdic acid. The results of the measurements confirm those obtained by the polarimeter: the latter method, however, is much more sensitive.—P. **Lasareff**: A possible cause of the anomaly of gravity at Koursk (Central Russia).—E. **Chaput**: Two types of alluvial sheets: monogenic and polygenic terraces.—Emile **Saillard**: Estimation of raffinose in sugars. Proportion of raffinose in molasses.—R. **Courrier**: New researches on folliculine. Contribution to the study of the passage of hormones through the placenta.—D. **Bach**: Variations of the concentration of hydrogen ions in the course of the assimilation of the ammonium salts of strong acids by *Aspergillus repens*.—A. **Fernbach** and N. **Schiller**: The rôle of the reaction of the medium in elective fermentation.—G. **Petit**: The morphogemy of the kidney of the sirenians.—Ph. **Joyet-Lavergne**: The evolution of the cytoplasmic elements in the cycle of *Aggregata Eberthi*.—A. **Donatien** and F. **Lestoquard**: Pernicious anæmia of the sheep and the goat.—B. **Issatchenko**: Sulphuretted hydrogen fermentation in the Black Sea. The reduction of sulphates to sulphuretted hydrogen in the Black Sea appears to be due to an organism identical with one described by Beijerinck and by van Delden under the name of *Microspira æstuarii*.—MM. **Ménard** and **Foubert**: The technique of the treatment of medico-surgical affections by ultraviolet light.—H. **Penau** and H. **Simonnet**: Experimental pancreatic diabetes and insulin.

COPENHAGEN.

Royal Danish Academy of Sciences, February 1.—N. E. **Nørlund**: On the series of interpolation. A determination of the class of functions which may be represented by the usual expansions of the interpolation theory.

February 15.—J. L. W. V. **Jensen**: Results of some earlier mathematical investigations, hitherto unpublished: (1) Asymptotic determination of the roots of the Q-function of Prym.

March 14.—N. **Bjerrum**: On the dissociation constant of methyl alcohol, worked out together with Miss Unmack and L. Zechmeister. Methyl alcohol dissociates reversibly into ions, and the dissociation

constant is determined at different temperatures and ion-concentrations.

March 28.—Harald **Bohr**: Quasi-periodic functions. General determination of the classes of functions which can be resolved into arbitrarily chosen vibrations (harmonic or otherwise). The inquiry forms a generalisation of the theory of the usual Fourier series. With the help of certain generalisations of the notion of periodicity, it is possible to reach a simple and complete characterisation of the class of functions indicated.

April 11.—P. O. **Pedersen**: On electric sparks. (2) An experimental investigation on time-lag in the electric spark and on spark-formation under various conditions. (3) It is shown that the present theory of the electric spark in some essential points is contradictory to experience and particularly to the experimental results described in (1) and (2). The outline of a new spark theory is sketched.

April 25.—L. Kolderup **Rosenvinge**: The marine Algæ of Denmark, (3): Ceramiales. The Danish species of this order, contributions to their morphology and development, their fructification and occurrence in Danish waters.—Niels **Nielson**: An equation of Lagrange studied by Cayley. The memoir gives a generalisation of the equation studied by Cayley (*Journal de Crelle*, vol. 53). The parameter 4 is replaced by any power of any prime number whatever. The memoir gives the necessary and sufficient conditions for the solution of this generalised equation, also formulæ which allow certain equations corresponding to parameter 4 to be solved at once or proved insoluble.

ROME.

Royal Academy of the Lincei, May 4.—C. **Segre**: Curvilinear elements having tangent and osculatory plane in common.—A. **Angeli**: Analogies in behaviour between certain derivatives of benzene and the corresponding derivatives of the aliphatic series.—G. **Armellini**: Observations on the diameter of the sun made at the Royal Rome Observatory on the Campidoglio. The meridian observations taken at this observatory during the past forty years are used as the basis of calculations of the sun's diameter. The results are independent of any personal factor and are subject only to a very small error due to the inclination to the vertical of the micrometer wires of the transit instrument. The mean value of the radius of the sun at the mean distance, increased by radiation, is found to be $R = 16'1{\cdot}40'' \pm 0{\cdot}02''$, which is almost coincident with that usually accepted, namely, $16'1{\cdot}18''$.—G. **Gherardelli**: Oblique algebraic curves with only autodual branches.—A. **Myller**: Concurrent directions on a surface emerging from the points of a curve.—M. **Picone**: Necessary and sufficient conditions for the existence and calculation of a periodic solution for the most general system of ordinary differential equations.—G. **Charrier**: Oxidation of 2-*N*-phenyl-$\alpha\beta$-naphthatriazole by means of alkaline potassium permanganate solution.—G. R. **Levi** and G. **Natta**: Action of aluminium sulphide on certain organic compounds. At high temperatures, the action of aluminium sulphide on benzene results in the formation of various condensed aromatic hydrocarbons. Under similar conditions, phenols or naphthols are transformed into the corresponding oxides, whereas from alcohols of the aliphatic series, mercaptans may be obtained in good yield and free from organic sulphides.—B. **Oddo** and D. **Curti**: Oximic and iminic compound of the phthalein of phenol.—A. **Desio**: Geological constitution of certain islands in the Ægean Sea.—A. **Clementi**: Osmotic pressure in terrestrial invertebrates. Just as is the case with the vertebrates, so also with the invertebrates, the osmotic pressure of the internal fluids of the organism is less with terrestrial than with marine species, the maximum value in the case of one and the same organism being less in the internal fluids than in the solid tissues.—M. **Sella**: Observations on the development and anatomy of the myotome in the Teleostei.

Official Publications Received.

Bulletin of the American Museum of Natural History. Vol. 50, Art. 1: A Revision of Palæomastodon, dividing it into Two Genera, and with Descriptions of Two New Species. By H. Matsumoto. Pp. 58. (New York City.)

South African Association for the Advancement of Science. Twenty-second Annual Meeting, Cape Town, July 7th to 12th, 1924. Official Programme. Pp. 19. (Cape Town: The University.)

Report of the Department of Industries, Madras, for the Year ended 31st March 1923. Pp. iv+86. (Madras: Government Press.)

Proceedings of the Tenth Indian Science Congress. Pp. xvi+289. (Calcutta: Asiatic Society of Bengal.) 7.8 rupees.

Colony of Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1923. Pp. 9. (Salisbury, South Rhodesia.)

Forestry in the Malay Peninsula: a Statement prepared for the British Empire Forestry Conference, Canada, 1923. By G. E. S. Cubitt. Pp. 24. (Kuala Lumpur: Government Printing Office.)

Ministry of Public Works, Egypt: Physical Department. Some Experiments on the Rating of Current Meters. By P. Phillips. (Physical Department Paper No. 14.) Pp. 17+7 plates+17 graphs. (Cairo: Government Publications Office.) 5 P.T.

Forest Bulletin No. 56: A Report on the Tan Values of Indian Myrobalans and Burma *Terminalias*. By J. A. Pilgrim. Pp. 29. 6 annas. Forest Bulletin No. 57: Tan Investigation of the Burma Hill Pine, *Pinus Khasya*, bark and *Pyinkado*, *Xylia dolabriformis*. By J. A. Pilgrim. Pp. 7. 3 annas. (Delhi: Government Central Press.)

The Indian Forest Records. Vol. 10, Part 9: Tannin Investigation of some Burmese *Dipterocarps*. By J. A. Pilgrim. Pp. iii+23. (Delhi: Government Central Press.) 7 annas.

Union of South Africa. Department of Mines and Industries: Geological Survey. Memoir No. 22: A Subject Index to the Literature on the Geology and Mineral Resources of South Africa. By A. L. Hall. Pp. 384. (Pretoria: Government Printing and Stationery Office.) 10*s*.

University of Colorado Bulletin. Vol. 24, No. 4, General Series No. 205: Catalogue, 1923–1924; with Announcements for 1924–1925. Pp. 390. (Boulder, Colo.)

Bulletin of the American Museum of Natural History. Vol. 50, Art. 2: Third Contribution to the Snake Creek Fauna. By W. D. Matthew. Pp. 59-210. Vol. 50, Art. 3: The Marine Ornithology of the Cape Verde Islands; with a List of all the Birds of the Archipelago. By Robert Cushman Murphy. Pp. 211-278. Vol. 50, Art. 4: The House Wrens of the Genus Troglodytes. By Frank M. Chapman and Ludlow Griscom. Pp. 279-304. (New York City.)

Sudan Government: Scientific Research Committee. Report of the Committee for the Year 1923. Pp. 13. (Khartoum.) 2 piastres.

Calendar of the University of Adelaide for the Year 1924. Pp. 410+108+13. (Adelaide.) 2*s*. 6*d*.

State of Illinois. Department of Registration and Education: Division of the State Natural History Survey. Exchange and Distribution List of available Publications of the Illinois State Natural History Survey and its predecessors the Illinois State Entomologist's Office and the Illinois State Laboratory of Natural History. Pp. 21. (Urbana, Ill.)

Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 74: Radio Instruments and Measurements. Second edition. Pp. 345. (Washington: Government Printing Office.) 60 cents.

State of Illinois. Department of Registration and Education: Division of the State Natural History Survey. Bulletin, Vol. 15, Art. 1: The Apple Flea-weevil, *Orchestes pallicornis* Say (Order Coleoptera; Family Curculionidæ). By W. P. Flint, S. C. Chandler and Pressley A. Glenn. Pp. iii+37. Bulletin, Vol. 15, Art. 2: Notes on a Collection of Erythroneura and Hymetta (Eupterygidæ) chiefly from Illinois; with Descriptions of New Forms. By W. L. McAtee. Pp. ii+39-44. (Urbana, Ill.)

Smithsonian Institution: United States National Museum. Bulletin 128: List of North American Recent Mammals, 1923. By Gerrit S. Miller, Jr. Pp. xvi+673. (Washington: Government Printing Office.) 85 cents.

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 46: A Study of Distinguished High-School Pupils in Iowa. By Prof. Charles Deich and Elmer E. Jones. Pp. iii+58. 10 cents. Bulletin, 1924, No. 1: Educational Directory, 1924. Pp. iii+191. 20 cents. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Bulletin 690-B: Gravel Deposits of the Caddo Gap and De Queen Quadrangles, Arkansas. By Hugh D. Miser and A. H. Purdue. Pp. ii+15-27+3 plates. Bulletin 723: Geology and Ore Deposits of the Manhattan District, Nevada. By Henry G. Ferguson. Pp. ix+163+18 plates. 50 cents. Bulletin 746: Geologic Literature on North America, 1785–1918. By John M. Nickles. Part 1: Bibliography. Pp. ii+1167. 1.25 dollars. Bulletin 752: Coal Resources of the Raton Coal Field, Colfax County, New Mexico. By Willis T. Lee. Pp. vi+254+22 plates. 50 cents. Bulletin 754: The Ruby-Kuskokwim Region, Alaska. By J. B. Mertie, Jr., and G. L. Harrington. Pp. vii+129+9 plates. 50 cents. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Professional Paper 126: Geology of the Coastal Plain of Texas, West of Brazos River. By Alexander Deusser. Pp. xii+139+36 plates. 40 cents. Professional Paper 132-D: The Evolution and Disintegration of Matter. By Frank Wigglesworth Clarke. Pp. ii+51-86. 10 cents. Professional Paper 132-E: An Early Eocene Florule from Central Texas. By Edward Wilber Berry. Pp. ii+87-92. 5 cents. (Washington: Government Printing Office.)

The Institution of Civil Engineers. Engineering Abstracts prepared from the Current Periodical Literature of Engineering and Applied Science, published outside the United Kingdom. Supplement to the Minutes of Proceedings of the Institution. Edited by W. F. Spear. New Series, No. 20, July. Pp. 214. (London: Great George Street, S.W.1.)