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

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" To the solid ground
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SATURDAY, JULY 4, 1925.

CONTENTS.

International Science.

ONE of the most important developments of scientific activity during the latter half of the nineteenth century was the promotion of the exchange of scientific ideas between different countries by means of international associations. Some of these were congresses which met at intervals of three or four years, when scientific communications were read and discussed, and, what was of still greater importance, an opportunity was afforded for those engaged in similar studies to make each other's acquaintance and understand each other's point of view. Some associations were, on the other hand, more especially concerned to secure the co-operation of different nationalities in carrying out observations of particular natural occurrences on a uniform plan, or with standardised instruments, so that the results could be discussed as a whole and no portion of the field of work should be entirely neglected.

The outbreak of War in 1914 caused an abrupt interruption to this friendly intercourse, which had up to that time exercised a very favourable influence in the progress of science. On the occasion of previous hostilities, the conclusion of peace was always followed by a renewal of scientific *camaraderie*, but this did not occur after the last and most disastrous of wars. The policy of the High Military Command of the Central European powers in waging war with a rigour previously unknown in modern times had imported unprecedented bitterness into the struggle; moreover, it must be remembered that, for the first time, scientific men themselves were brought into the conflict instead of continuing quietly to work in their laboratories, and maintaining correspondence with those of other nationalities, as was formerly the case. It is not surprising, therefore, that when the War was over many scientific workers in the allied countries hesitated

to renew the relations that had previously existed, even though it seemed scarcely just to make their former scientific colleagues responsible for the conduct of their countries' military chiefs.

The subject was discussed at an Inter-allied Conference of men of science held in London in October 1918, about a month before the Armistice, and resolutions were passed. The most important, Article I., was in the following terms: "It is desirable that the nations at war with the Central Powers withdraw from the existing conventions relating to International Scientific Associations in accordance with the statutes or regulations of such Conventions respectively as soon as circumstances permit, and that new associations deemed to be useful for the progress of science and its applications be established without delay by the nations at war with the Central Powers, with the eventual co-operation of neutral nations."

A further conference was held at Paris towards the end of November 1918, when details were discussed and an executive committee appointed to prepare a scheme. As a result, an International Research Council was convened at Brussels in July of the succeeding year, and definite statutes of convention were adopted. In these the purposes of the International Research Council are declared to be (*inter alia*): (1) To co-ordinate international efforts in the different branches of science and its applications. (2) To initiate the formation of international Associations or Unions deemed to be useful to the progress of Science *in accordance with Article I. of the resolutions adopted at the Conference of London, October* 1918.

It is the incorporation of Article I. that determines the present character and policy of the International Research Council and the Unions formed under its auspices.

A list is given of the countries "that may participate in the formation of the International Research Council and of any Scientific Union connected with it, or join such Union at a subsequent period." It corresponds to the countries and dominions which were at war with the Central Powers, except that it includes Greece and Poland, and omits Russia and the new Baltic Powers. It then provides that, after a Union or Association is formed, "nations not included in the above list, but *fulfilling the conditions of Article I. of the resolutions adopted at the Conference of London*, and diplomatic Protectorates of the enumerated countries may be admitted either at their own request or on the proposal of one of the countries already belonging to the Union. . . . A favourable majority of not less than three-quarters of the countries already forming part of the Union shall be required for admission. . . . The statutes of the Unions formed by the International Research Council require the approval of this Council." Later, Czechoslovakia and a number of neutral countries, including Denmark, Norway, Holland, Sweden, and Switzerland, were invited to join the International Research Council and the scientific organisations attached to it.

As we have seen, the provision for the admittance of new countries refers only to the Unions, not to the Council itself, but it has in practice been assumed to apply to the Council. In an amendment to the constitution proposed by the Executive Committee this has been explicitly provided.

The meetings of the General Assembly are held, as a rule, once in three years. The last meeting was held in 1922, and the next will be on July 7 in the present year. At the meeting in 1922 it was resolved "that only countries which have adhered to the International Research Council are entitled to be members of the Unions connected with it."

The stringency of the exclusion of the men of science of former enemy countries is consistently maintained in the statutes of the Unions formed under the International Research Council. A rule, which is, it is believed, common to them all, provides that "the President of the Executive Committee [of the Union] may invite to a meeting of the General Assembly [of the Union] scientific men who are not delegates, *provided that they are subjects of one of the adhering countries*." It is at the General Assembly of a Union that scientific questions are considered, but no man of science, however eminent, is allowed to join in the discussion, or even to be present, if he belongs to one of the nations with which the Allies were formerly at war,—and this after seven years of peace.

From the first there were many scientific men among the allied nations who objected to these stringent measures of exclusion, and as time passed their numbers have increased. Geology has not only refused to form a Union under the International Research Council, but, at the Congress in Brussels in 1922, adopted an independent constitution, without any provision for excluding subjects of the Central Powers; and a meeting will be held under it in Madrid in 1926. The International Mathematical Congress that was to have been held in the United States in 1924 was abandoned because in that country "neither scientific co-operation nor financial support were in sight for a congress under the rules of the International Research Council." A meeting was, however, held in Canada, when the American Section of the Union passed a resolution requesting the International Research Council to consider whether the time was not ripe for the removal of the restrictions on membership now imposed by the rules of the Council. The London Mathematical Society has

refrained from attending this meeting, as well as that preceding it at Strasbourg.[1]

In view of the forthcoming meeting of the International Research Council, the Australian National Research Council has asked that this question shall be reconsidered. The Royal Academies of Science of Holland, Denmark, and Sweden, and the Société Helvétique have definitely purposed to amend the statutes by omitting all references to Article I. of the Resolutions of the Conference of October 1918. This change would, it is presumed, permit any nation to be admitted to the International Research Council and the scientific organisation attached to it on a vote of a majority of not less than three-quarters of the countries already included. Switzerland, however, would, by an additional provision, confine the privilege to countries forming part of the League of Nations.

Holland and Denmark wish, on the other hand, to rescind the provisions of the addition to the statutes in 1922, and thus permit a country to be admitted to a Union without previous admission to the Council. The Executive Committee will not support this proposal, but suggests an amendment, providing that a country which has joined the International Research Council has the right to be admitted to the Unions connected with it.

It is to be hoped that the International Research Council will not maintain the present exclusion of subjects of the former enemy powers; for we believe that this position is opposed to the wishes of the vast majority of the scientific men of the allied countries, and, needless to say, to the unanimous convictions of those of neutral lands.

If the Swiss amendments are carried, no distinction will remain between allies, enemies, or neutrals. The only condition of admittance will be membership of the League of Nations and the vote of the Council. This would permit of the admission of Austria at once. Germany would probably be eligible in a few months, but would have to wait for actual admission until the next General Assembly three years hence, unless of course she could be admitted conditionally on her joining the League of Nations. Russia would presumably be excluded, as she is not likely to join the League.

The simplest course would undoubtedly be to leave the question of admission to the uncontrolled discretion of the International Council, retaining, if it is thought desirable, the necessity of a three-quarters majority for a favourable decision. We are hopeful that the General Assembly at Brussels next week will alter a situation which is both unsatisfactory and unreasonable.

[1] Reference may also be made to the letter on this subject by Prof. G. H. Hardy, president of the National Union of Scientific Workers, published in some leading daily newspapers on May 30, 1924.

College Courses and University Examinations.

A BOLD policy has been adopted by the Senate of the University of London with the view of solving one of the oldest and most difficult questions in relation to the organisation of University education in London—the question of establishing a close association between college courses of study and the examinations for university degrees. The college selected for this experiment is the Imperial College at South Kensington, comprising the Royal College of Science, the Royal School of Mines, and the City and Guilds (Engineering) College. Of these Colleges, the Royal College of Science has always adopted a distinctive method of training its students, based on the intensive study of one subject at a time. The impracticability of completely adjusting the degree examinations of the University to this system of training, conjoined with a general desire on the part of the College for freedom in framing curricula, led to a prolonged and somewhat embittered controversy between the College and the University, in the course of which the College authorities adopted the extreme measure of applying for the status of a separate University. This failed, as other attempts of the kind had previously failed; but the fundamental problem remained unsolved.

The history of the controversy as to relating University examinations to college teaching is as old as the University itself. Established by Royal Charter in 1836 for the purpose of examining for academic degrees students of University College, King's College, and other affiliated colleges, the University in course of time adopted an attitude of aloofness to all colleges, though it was no part of the original conception of the University of London, as the Selborne Commission pointed out, that it should be a mere examining body, without any direct connexion with teaching institutions. In those early days great importance was attached to the independence of the examining authority. University College welcomed the Royal Charter for the University, on the ground that the professors of the College would not have to confer degrees on their own students. There were, however, some connected with the College who raised the objection that the examinations would interfere with the independence of College teaching, both by determining the course of study and by affecting the method of instruction; and the College manifesto admitted that "this argument has weight." It is a tribute to the fairness and efficiency of the University examinations that this objection was not pressed for so many years. In 1884 the "Association for Promoting a Teaching University for London" was formed. This was the

first step leading to the reconstitution of the University of London as a teaching University. The Senate and the Convocation—since shorn of some of its privileges—were not unfriendly to the general idea of a teaching University; and the Senate was even prepared to accept college examinations for pass degrees.

It is of interest to note that the College to which the new scheme is to be applied is the College with which Huxley was connected as dean and professor, and that the policy adopted harmonises with his general views. Huxley had a fine conception of the University which London ought to possess. In his evidence given before the Gresham Commission in 1892—a model for soundness of judgment and clearness of expression—he severely condemned the attempt of University College and King's College to "corner" university education in London. As an alternative to the creation of a separate teaching university, he urged that the title and prestige of the University of London should be retained, and the University reorganised in such a manner as to secure uniformity and efficiency in all university work, with freedom and elasticity. "In short, unify without fettering." As to the conduct of university examinations, he urged the Commission to leave the question quite open. Degree-giving was a subsidiary matter, not an end in itself. While Huxley was in favour of trusting a college to organise and test the training of its students, he considered that some outside control was desirable, because every man has a "list," as they say at sea.

The working of this experiment in relating college teaching to university examinations will be watched with interest, and its success may produce important results throughout the Empire in the direction of greater variety and elasticity in all our educational arrangements. Let us hope, too, that it may tend to reduce the fervour of some of the worshippers of the examination-fetish. The internal results should be not less valuable. The Imperial College has not only closed a barren controversy, but also in the process has been selected for a position of special privilege in the University. *Noblesse oblige*. The University, faced with many other difficult problems, is entitled to the full co-operation of all its affiliated colleges. Only last week the partial failure of the Bloomsbury site scheme was announced by the publication of some uninspired correspondence between the Treasury and the Principal Officer of the University. This partial failure is due to the Government's arranging for the transfer of King's College to Bloomsbury without taking the elementary precaution of ascertaining whether this great College wished to move. The problem of providing a home worthy of the University of the metropolis of the Empire still remains. T. LL. H.

Crop-Production in India.

Crop-Production in India: a Critical Survey of its Problems. By A. Howard. Pp. 200. (London: Oxford University Press, 1924.) 10*s*. 6*d*. net.

IN recent years some of the lustre of what Disraeli in a flamboyant phrase described as "the brightest jewel of the British crown" has been dimmed by political happenings. In the less spectacular sphere of economic improvement it might be said that new facets continue to be added to the jewel. The most rabid of Swaraj fanatics must acknowledge that, if British rule has accomplished nothing else, it has, at least, given their country material benefits in fullest measure. Of these no better example can be found than the achievements of the small band of scientific workers who, during the last twenty years, have been applying scientific methods to Indian agriculture.

The most distinguished of these pioneers sets out the amazing story in the volume before us, and it is one calculated to excite the envy of his scientific colleagues all over the world. He presents a record, not only of scientific achievement, but also of an organisation under which the public support of science is not limited to the grudging provision of doles in aid of scientific research; for in India we see in operation a system of government under which the supreme power, when satisfied that scientific work has been successful, straightway by administrative and legislative measures sets a seal on that work. One example will suffice. Mr. Howard and his colleagues establish that an improved cotton (that is, a plant yielding a better fibre and more of it) cannot be effectively introduced unless steps are taken to prevent cross-fertilisation with inferior varieties; thereupon an Act is passed by the Legislature sanctioning the prohibition of the sowing (say in a district of 2000 square miles) of any variety of cotton other than that prescribed by expert plant breeders. But it must not be thought that peaceful penetration is not practised also. The poor *rayat* of India (whose life has been aptly described as "a long-drawn question between a crop and a crop") is as fully alive to the value of good seed as his fox-hunting cousin in the shires; witness such figures as these. The area under Pusa 4 and Pusa 12 (two of Mr. Howard's new wheats) in the United Provinces is now 500,000 acres, and in the North-West Frontier Province 200,000 acres. In the Panjab colonies a new wheat known as Panjab 11 now occupies upwards of 750,000 acres. The achievements of the workers on cotton improvement are equally striking. In the Central Provinces the area under a new variety of this crop, introduced by the Agricultural Department, amounts to 700,000 acres, giving an additional profit to the cultivator of 20*s*. per acre.

In the case of rice (which in India occupies upwards of 80 million acres) some of the figures are equally astonishing, and the catalogue might be extended; many of the crops grown for fibre (such as jute) and for oil (such as linseed) have also yielded results to the scientific plant breeder.

The chief aim, however, of Mr. Howard's book is not to record economic results, many of which flowed from the application of scientific method rather than from original research. During the course of the work a number of problems requiring solution have been brought to light, and Mr. Howard has endeavoured to "set out these problems in simple language" with the view of securing the active co-operation of the public. (In other words, the days of paternal government are passing and the burden which is laid upon scientific workers in democratically governed countries is fast descending upon India.) The problems presented do not affect India alone. They affect the whole field of current knowledge regarding the soil and the plant. Workers in the sciences related to agriculture in all countries will find much food for thought in these pages.

The men who—as a result of Lord Curzon's enlightened policy—went out to India in 1904, found that their text-book knowledge was of little help; nor was Voelckers' classic report (*circa* 1890) of much assistance; for at that date the rôle of the leguminous plant in enriching the soil was unknown. Incidentally, it was familiar to the Indian *rayat*. The writer well remembers extracting, about that period, from a brown man in a loin-cloth a list of crops that enriched his soil—a catalogue, it proved, of some ten varieties of leguminous plants, ranging from the shrub-like Cajanus to the weed-like Lathyrus.

Fortunately, this early period almost coincided with the birth of the Cambridge school of genetics, which, under the inspiration of Bateson and his disciples, has done so much to promote the economic welfare of agriculture. No better field than India for the exploitation of such master ideas as those of the "unit character" and "pure line" could have been found, and of these two tools (in contradistinction to what was experienced in more advanced countries) the latter—the pure line conception—has proved the more useful. As Howard, however, so aptly points out, economic plants fall into two very distinct categories from the point of view of the practical outcome of scientific plant breeding. The isolation and economic introduction of pure lines of plants which are normally self-fertilised—such as practically all the cereals—offers no difficulty; the production of a sufficiently diverse F_2 is the only problem. In the case of normally cross-fertilised plants, however, such as cotton (or the Brassicæ), the practical obstacles are serious. As indicated above, this problem has been partly solved in India by drastic legislation of a type to which the free-born Western would probably never submit. If to free cross-fertilisation self-sterility be added (the clover is an example), the problem of seed production, both scientifically and practically, becomes one of extreme difficulty. As our author points out, "the creation of an improved variety of crop, by itself, is of no practical advantage to the country: it possesses only a potential value. The new variety must be welded into the rural economy before a real economic result can be achieved." It is perhaps one of the most striking features of the Indian achievements that the plant breeders there have studied intensively and successfully this problem of adapting their improvements to rural economics.

To return to the agricultural problems which confront the scientific workers in India: of these the most puzzling, perhaps, is provided by rice, an aquatic plant with no obvious access to added nitrogen. The produce of 10 million acres of this crop has been exported from Burma annually for the last twenty years, and yet the soil shows no signs of diminishing fertility. The problematic source of nitrogen may be fixation by the algæ which inhabit the swamps in which rice is grown. Then, as to the source of the oxygen needed by the roots of the plant, we seem to be equally in the dark. Other problems which have arisen may be briefly indicated. The relation between the economic behaviour of crops and their root development is still obscure. Many facts can be instanced to show that a close relation exists between the quality of a crop and the root development of the plant in varying soils; and an equally important connexion appears to exist between root development and susceptibility to disease. The author believes that attacks of disease in economic plants simply indicate faulty cultural methods, a view that seems to find a parallel in some modern ideas as to disease in the human subject. He is identified with extreme views on the importance of soil aeration, but there can be no question that he presents a body of facts which strongly supports his theories on the subject. The whole question of the "gearing" (as he terms it) between the plant and the soil stands in need of thorough investigation in the light of newer knowledge.

The work of Howard, and, may we add, of his equally distinguished wife, may be taken as a model of what is required of research workers in the applied sciences—the practice of pure scientific research coupled with the rare faculty of a steadfast outlook towards the ultimate economic application of the results. These are qualities which should prove of great value in the direction of the all-India cotton research station to which the author has recently been appointed. A. B. B.

The Literature of Chemical Technology.

Synthetic Organic Compounds. By Dr. S. P. Schotz. Pp. 412. (London: Ernest Benn, Ltd., 1925.) 45*s.* net.

SEVERAL books have appeared during the past year or so, both in Great Britain and in the United States, which deal with certain special branches of chemistry from the industrial and manufacturing points of view. Without doubt many of these treatises are excellent and constitute well-written and concise accounts of particular types of manufacture. They may be regarded, therefore, as valuable contributions to technological literature, and are comparable in this respect with similar treatises written by experts in one or other of the many sections of scientific chemistry. In each case the author may be supposed to have, not only a far-reaching knowledge of his subject, but also to possess sufficient wisdom, as distinct from knowledge, to enable him to sift the grain from the chaff in the published literature of the subject with which he deals. Nevertheless, even in a clear-cut comparison such as this, the difficulties met with by the two types of author are very different.

The writer of the scientific treatise finds to hand a vast amount of published detail from which to draw his material. Moreover, he can assume, with a reasonable amount of confidence, that the sources on which he relies constitute accurate and truthful records of the experimental work done and the conclusions reached. The fact that they have been issued under the auspices of one or other of the world's scientific societies gives him the right to assume that they have been published without reserve or ulterior motive.

On the other hand, the writer of the technological book, as soon as he passes away from matters of personal knowledge, finds himself beset by many troubles which will require the greatest powers of discrimination to overcome. For example, he will have to draw largely on the patent literature; and chemical patent literature, especially that of certain foreign countries, is in some instances a compilation of experimental data, and conclusions deduced therefrom, often emanating from the imaginations of those patentees who wish to retain some special field for the exercise of their own activities, or who may wish to mislead their competitors. He will also have to use the chemical technological literature published in one or other of the various journals devoted to this subject, and, here again, he will encounter difficulties. This type of literature is on the increase, and already there are many publications catering for the requirements of the works chemist and chemical engineer. In them the letterpress and the illustrations often serve as convenient vehicles for the advertisements which form the major portions of the periodicals. The illustrations and the advertisements are mostly those of plant, and this is a useful feature for those who wish to keep themselves in touch with the development of engineering chemistry. The letterpress is, however, frequently of the chatty and personal kind, and only a portion of it is devoted to articles and papers on manufacturing processes and reactions. But, in the very nature of things, it is obvious that such contributions can only be written by authors from the outside, because it is unthinkable that any sane manufacturer, or employee of a manufacturer, would be prepared to publish details of plant and processes very rightly regarded as essential to his works practice and prosperity.

Finally, there are the secret matters, researches carried out by the governments of States in the national interest, usually for war purposes both offensive and defensive. It is here that the angels fear to tread and where discrimination will counsel avoidance. The difficulties in these cases embrace both the types mentioned above, since publication implies either that the data is useless or out-of-date, or that the information is supplied with the direct object of creating a false impression and of misleading a possible enemy. It is evident that no State, however altruistic in outward appearance, would allow any matter of real importance in relation to its war activities to be published, and any chemist doing such a thing from sure knowledge would, in Great Britain, soon fall foul of the Official Secrets Act.

It is therefore clear that the way of the author of the technological book is, indeed, hard, even when he confines himself to some particular branch of his subject with which he has special acquaintance. What then is to be said of a book, such as that under review, which purports to cover the wide field of synthetic organic chemistry, a field with which no human being could possibly have intimate personal knowledge even on the scientific side alone?

It is not suggested that the author has not attempted to carry out his Herculean task with courage and ability. The book has entailed the exercise of great industry and skill in its compilation, and it is evident that the author possesses a wide knowledge of the many intricate subjects with which he deals. It is readable, and the printing and paper leave nothing to be desired. It contains a great deal of information which will be useful to the general reader, although some of the statements made may anger the expert. One general criticism that could be raised is that the formulæ are too elaborate and the frequent use of the benzene ring wholly unnecessary. It is, for example, a shocking waste of the excellent paper to print the formulæ of the phenol-formaldehyde resins on pp. 384, 386, and 387. These formulæ are not based on any single shred

of scientific evidence, and are, indeed, in the highest degree unlikely. The illustrations of plant are admirable, and will serve as excellent advertisements for the firms supplying them. Indeed, it is evident that they are intended as such, because the "Bakeliser" (Fig. 109, p. 372) is also reproduced in the advertisement pages at the end of the book, and when this is not the case, the name of the firm supplying the apparatus appears under the illustration. The plants of the various processes described are also reproduced clearly.

The reviewer has, therefore, no quarrel with the author, but, on the contrary, congratulates him on having accomplished a very difficult task with commendable ability. It is rather the object and utility of the book that he calls in question. As a scientific treatise it is of little value, and as a technological handbook it is in many respects misleading. The statements made, for example, in the article on chemical warfare will bring a smile to the lips of those who have inside knowledge of this subject.

With what, then, are we dealing, and to what kind of reader is the book likely to appeal? It is, as already stated, readable, and will doubtless interest a number of people who take their chemistry lightly and superficially; but, if this were intended, it is surely unnecessary to have included the complex descriptions of intricate organic reactions which only the expert can follow. It may be intended to appeal to manufacturers and to chemists engaged in industrial work, and here again material will be found which will be of interest and general utility, although, if the chemist happens to meet a description of any method of which he has special knowledge, he is not likely to place much reliance on the accounts of other processes. In effect, therefore, the book will appeal to a number of various types of people who may wish to acquire a superficial and incomplete knowledge of many of the operations now carried out in modern organic chemical manufacture and are not in a position to be hypercritical of the information they receive. Doubtless there are several of these, since this is only one of the many books of its kind which have been published and, we understand, are about to be published, and it is only reasonable to suppose that their production pays.

Moreover, there can be no question that books of this kind serve a useful purpose in popularising science, and in bringing home to many people the achievements which the modern development of scientific industrial methods have accomplished in supplying them with some of the present-day requirements of life. The only doubt in the present instance is whether the author has supplied sufficient jam to mask his very large pill and to make it palatable to the general reader.

J. F. T.

The Electrical Theory of Matter.

Handbuch der Radiologie. Herausgegeben von Prof. Dr. Erich Marx. Band 6: Die Theorien der Radiologie. Bearbeitet von M. Laue, P. Zeeman, H. A. Lorentz, A. Sommerfeld und G. Wentzel, Georg Joos, E. Riecke, L. Vegard, P. Debye. Pp. xi+806. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1925.) 40 gold marks.

THERE exists scarcely any branch of science which is not indebted to Germany, not only for important original contributions to its progress, but also for the publication of excellent and comprehensive treatises. With the appearance of this sixth volume, another of these so-called handbooks reaches completion. It is now some years since the last of the previous volumes was published, and it is evident, from the remarks made by the general editor, Dr. Marx, that this volume has only reached completion after much delay and the surmounting of many difficulties. That this should be so is scarcely surprising. From the theoretical point of view, modern physics is in a peculiar position. The two rival theories—the older classical theory and the more modern quantum hypothesis—have each met with marked success in interpreting observed results, but we are still very much in the dark as to the real connexion between the two. Where one fails the other as often as not succeeds. We must therefore be prepared, in such a volume as this, to find, not so much a logical development, but rather a series of attempts at correlating observed phenomena in terms of one or other of the two main lines of thought; and this indeed we actually find.

To do justice in small space to a volume of this magnitude, dealing with mathematical theory and coming from the pens of seven separate authors, is clearly impossible. Fortunately, with such names as Lorentz, Laue, Sommerfeld, Debye, and others on the title-page, there is little room for doubt as to the quality of the contents. From such authors we know what to expect, and a closer inspection does not disappoint us. The previous volumes dealt essentially with the more experimental side of modern physics, and it was intended to devote the final volume to a discussion of its purely theoretical aspect. While this plan has been to a large extent adhered to, the reader will find a pleasant variation in the few chapters which deal with experimental results in fields which have not been covered in the previous volumes. Notable in this connexion are the excellent account of the Zeeman effect and Dr. Joos's summary of the results of work on ionisation potentials.

The volume opens with a discussion of the motion of a free electron in various types of electric and magnetic

fields; after a very full treatment of this question, Prof. von Laue proceeds to consider the problems of conduction through gases and the passage of α and β particles through matter. The discussion of the motion of the free electron is naturally followed by an account of the motions of electrons in the atomic field and of the way in which these may be influenced by external forces. A most lucid description of the magnetic separation of spectral lines comes, as is only fitting, from Prof. Zeeman, whose name the phenomenon bears. That the theory of the effect should be contributed by Prof. Lorentz is also most appropriate, since it was he who first put forward a quantitative explanation of the influence of a magnetic field on the spectrum. The abandonment of the original theory based on the classical mechanics in favour of one founded on the quantum hypothesis is an example of what has taken place in many branches of physics. A general account of the origin of optical spectra on the basis of the Bohr atom is developed by Prof. Sommerfeld and Dr. Wentzel. Prof. Sommerfeld's work on this subject is so well known and so widely appreciated that there is no need to dwell on the merits of this section. The summary by Dr. Joos, dealing with ionisation potentials and the conditions for the excitation of spectra, forms a suitable conclusion to the treatment of atomic radiation.

A long and detailed account of the electrical theory of the solid state, dealing notably with such problems as electric and thermal conductivity, was contributed by the late Prof. Riecke. As a considerable period has elapsed since this section was written, it has been copiously annotated by Prof. Laue in order to bring what is a very thorough discussion up-to-date.

One of the most readable sections is that on the aurora by Prof. Vegard. It is a subject that the author has made peculiarly his own, and his description of the observed facts and the theory are full of points of interest. Some of his conclusions have recently been questioned, especially his explanation of the source of the famous green line; but whether or not his theory will require modification, it has already achieved one of the main objects of any theory in suggesting a new field of research in the study of the spectra emitted by matter at extremely low temperatures when bombarded by electrons.

The final chapters, written by Prof. Debye, are devoted to the theory of the electrical and magnetic properties of molecules. The subject is one of great complexity, and it is impossible not to admire the way in which it has been treated. The subject of magnetism has perhaps scarcely kept pace with the progress which has been made of recent years in other branches of physics, but signs are not wanting that the near future will see a rapid development. Prof. Debye's account, written in his extremely lucid style, indicates some of the lines along which we may expect progress.

The editor and his collaborators are to be congratulated on the completion of the "Handbook of Radiology." This final volume will prove invaluable to all students of modern physical theory, inasmuch as it gives full discussions, with extensive references to original papers, of a wide range of subjects, many of which have not so far received adequate treatment in text-book form. The book is full of indications of probable lines of advance, and in this respect will make an appeal not only to the theorist but also to the experimental worker.

Digitalis in Medicine.

The Action and Uses in Medicine of Digitalis and its Allies. By Prof. Arthur R. Cushny. Pp. xi+303. (London: Longmans, Green and Co., 1925.) 18*s*. net.

OUR knowledge of the action of digitalis on the heart was founded by William Withering, of Birmingham, whose classical treatise was published in 1785. Since that time, owing to the multiplicity and scope of the researches of an ever-increasing number of workers, the literature of the subject has reached such proportions that an attempt to collect together and analyse the results achieved appears already overdue. Prof. Cushny has undertaken this arduous task in compiling the monograph under notice, in which the knowledge acquired during thirty years of personal research is embodied in a critical account of the whole subject, from the time when digitalis was first employed in heart disease up to the present day.

The book opens with an account of the various drugs of the digitalis group and their histories. It is not certain when digitalis first came into medical use, but it was known long before Withering's time, and the English term "foxglove" may bear some allusion to Fuchsius of Tübingen, who described it in 1542 as an emmenagogue. Apart from digitalis, many of these drugs were originally employed as arrow poisons, and for the purpose of trial by ordeal, by the natives of Africa and the Malayan Archipelago. A detailed account is given of the action of digitalis on the frog's heart, illustrated by numerous graphic records of the heart movements. The reaction of the mammalian heart to digitalis, as seen in animal experiment, is similarly dealt with. Some conception of the scope of the laboratory investigation is gained when we are told that the effect of digitalis or allied drugs on the heart is known in the cases of the frog, toad, grass snake, green lizard, rat, tortoise, crab, crayfish, lobster, snail, newt, tadpole and embryonic chick, among others.

Pigeons are relatively susceptible to the drug, rats and toads tolerant, while man is more susceptible, weight for weight, than animals.

In Chapter vi. the author discusses at length the action of digitalis on the blood pressure. Blake's discovery in 1839 that a rise in arterial tension was produced in animals by large doses of digitalis gave rise to a controversy over its action in man which has persisted almost up to the present day, although Sahli showed in 1901 that this result did not follow therapeutic doses. Prof. Cushny holds it proved that this rise in blood pressure seen in animals is due mainly to constriction of the vessels, but he emphasises the fact that there is no evidence of a similar effect being brought about in man by medicinal doses of the drug. No doctrine has died harder among medical men than the belief that digitalis is dangerous in cases of high blood pressure, but it is to be hoped that this has now been finally banished from medical teaching.

After a description of the effects of digitalis on organs other than the heart, its absorption, elimination, and cumulative action, seventy pages are devoted to therapeutics. Withering's knowledge of digitalis was the outcome of ten years' clinical observation in his practice, and although his work was followed by such a vast amount of research in animals, no real advance in the clinical use of the drug can be said to have occurred until more than a century later, when Sir James Mackenzie discovered its almost specific action in cases of auricular fibrillation, again as the result of clinical observation. In the case of abnormal heart rhythms the mechanism of the action of digitalis is now well understood, but we are still unable to account for its variable and uncertain effect in cases of normal rhythm. On this obscurity Prof. Cushny is unable to throw any new light, but we gather that he regards the direct action on the heart muscle, increasing the force of the contraction, as a more important factor than the reduction in rate in bringing about the undoubted clinical improvement which sometimes follows digitalis administration in these cases. At present this cannot be accepted as proved, and it is here that future researches may be expected to add to our knowledge. In pneumonia the author believes that digitalis can effect the heart beneficially, but he is unable to arrive at any definite indications for giving the drug, and does not advise its routine use in this disease.

The effect of digitalis on the electro-cardiogram is described, and we are somewhat surprised to find that Prof. Cushny attaches so little significance to the flattening and inversion of the T-wave which is such a constant effect of adequate doses of the drug in practice. The book concludes with a description of the various preparations of digitalis and the methods used in their assay. A bibliography of 559 references to the literature is placed at the end of the book.

A treatise of this nature, covering the ground of both laboratory research and clinical practice, and coming from such an authority as Prof. Cushny, who has himself played no small part in the development of the subject, is an invaluable addition to the literature of digitalis. Moreover, the book affords the reader ample opportunity for studying the relationship of animal experiment to practical medicine. The fact that the reaction of healthy animals to poisonous doses of a drug may differ widely from the effects of medicinal doses on diseased mankind has not always been sufficiently appreciated in the past, mainly perhaps owing to the tendency of the laboratory worker to become too isolated from the clinician. The advantages of close co-operation between laboratory and clinic are nowhere better illustrated than in this admirable account of the work which has transformed digitalis, once an old country remedy for dropsy, into what may be justly described as one of the best-mapped regions of therapeutics.

Our Bookshelf.

Monographs of the Geological Department of the Hunterian Museum, Glasgow University. 1. *The Collection of Fossils and Rocks from Somaliland.* Made by B. K. N. Wyllie and Dr. W. R. Smellie. Pp. vi+180+18 plates. (Glasgow: Jackson, Wylie and Co., 1925.) 42*s*. net.

THIS work deals mainly with the palæontology of the Jurassic, Eocene, and Oligocene deposits of part of the maritime plain of British Somaliland in the neighbourhood of Bulhar and Berbera (Gulf of Aden), and is based on the collections made by Messrs. Wyllie and Smellie when surveying the region on behalf of the Anglo-Persian Oil Company. It is to be hoped that other companies will adopt this policy of allowing matter of geological interest to be published. The collection has been presented to the Glasgow University Museum.

A summary of the geology of the district is given by B. K. N. Wyllie, based on the joint work of himself and Dr. Smellie, but petroleum is not mentioned. The palæontology is the work of R. B. Newton (Foraminifera and Nautilus), J. W. Gregory (Corals), E. D. Currie (Echinoidea), J. Weir (Brachiopoda and Mollusca), and L. F. Spath (Ammonites). A short account of the igneous rocks is given by A. T. Neilson.

The Jurassic deposits consist of (1) a lower series, the Bihin Limestone, 1000 feet thick, of which the age is not precisely determined but appears to range from Bathonian to Oxfordian. The corals and echinoids are unlike those of Cutch but have affinities with European faunas of similar age, from which it is inferred that the Somaliland sea had no direct connexion with that of western India but must have been a gulf from the Mediterranean. (2) The upper series, known as the Meragalleh limestone, 2300 feet in thickness, is shown

by the ammonites to be mainly Kimeridgian but possibly extending into Tithonian and Infravalanginian. The differences between the ammonite faunas of Somaliland and other regions are regarded by Spath as due to differences of age rather than to difference of facies or geographical province.

The beds of Eocene age consist of limestones and sandstones containing corals, echinoids, lamellibranchs, Nautilus, etc. At about the middle some 2000 feet of gypsum and anhydrite occur, indicating that part of the sea became isolated and underwent intense evaporation. The Oligocene limestone is regarded as of Aquitanian age and contains calcareous algæ, forminifera, corals, etc. The corals resemble those of the Tongrian of northern Italy, Austria, and the West Indies. The absence of Miocene and Pliocene deposits suggests that the Gulf of Aden was not covered by sea until the end of Pliocene times, a little earlier than the date of the raised coral reefs.

It is unfortunate that in many cases the figures of the fossils are unsatisfactory. Some of the specimens were evidently unsuitable for illustration by photographic means and their characteristics cannot be made out.

Researches on Fungi. By Dr. A. H. Reginald Buller. Vol. 3: The Production and Liberation of Spores in Hymenomycetes and Uredineæ. Pp. xii+611. (London: Longmans, Green and Co., 1924.) 30*s.* net.

IT is a pleasure to welcome the third volume of Dr. Buller's researches into the production and liberation of spores in the fungi, the second volume of which was noticed in NATURE of October 27, 1923, p. 614. The delicacy of technique, the minuteness and exactness of the observations, and the assiduousness in the elucidation of abstruse details so characteristic of the first two volumes are well maintained in the present work.

In Part I. the author continues his observations on the mechanisms of spore dispersal in the Agaricineæ. He distinguishes two main types of organisation for the production and liberation of spores: (1) Æquihymeniferæ, with thick wedge-shaped gills, not afterwards destroyed by autodigestion, and (2) Inæquihymeniferæ, with thin parallel-sided gills, afterwards autodigested from below upwards. In the first five chapters the fruit mechanisms of sub-types of the first group are described, *e.g.* Lepiota, Bolbitius, Armillaria. Most of the remainder of Part I. deals with sub-types of the second group, as exemplified by species of Coprinus. Some interesting material on the bilumenescence of Panus, and the parasitism of Agarics on Agaric hosts, is also introduced. Part II. of the volume takes up the production and liberation of basidiospores in the Uredineæ. Dr. Buller finds the essentials of spore dispersal similar to those of the Hymenomycetes. In this case, however, the spores are larger and are shot to a greater distance. Some teleological but none the less interesting correlations are given regarding the curvature of the basidium in Uredineæ, and the straight form found in most Hymenomycetes. As in the first two volumes, the book is profusely illustrated with interesting photographs and many of the author's fine drawings. J. E.

Offa's Dyke. By J. H. Hewlett. Pp. 32+8 plates. (London: Simpkin, Marshall and Co., Ltd., n.d.) 3*s.* 6*d.* net.

FOR some time past it has been evident that public interest in archæological discovery has been on the increase, and that this interest has extended to sites of historic and prehistoric importance is to some extent borne out by the protests aroused some two years ago by the threat to interfere with the amenities of Stonehenge. Mr. Hewlett's description of Offa's Dyke is a book which is welcome on this account. The more well-informed the public is about the antiquities of the countryside, the better chance of the avoidance of wanton damage. Mr. Hewlett has divided his account of this interesting defensive work into five sections. In the first, he gives a general description of the dyke; in the second, he traces its course and offers suggestions as to its line where it has now disappeared; in the third, he describes the country through which it passes; in part four he discusses the theories of its purpose; and in the fifth, gives the main facts connected with the life of Ossa. As to its original place of termination in Flintshire, which is still a problem, Mr. Hewlett states the theories which have been put forward, but himself has no solution to offer, although he is of the opinion that it is Wat's Dyke and not Offa's Dyke which ends at Basingwirke, notwithstanding the occurrence along this line of place-names such as Plas Offa, Bryn Offa, and Clawdd Offa (Offa Dyke).

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Abteilung 2, Teil 2: Bryophyten. Band VII/1: Anatomie der Lebermoose. Von Prof. Dr. Th. Herzog. Pp. iv+112. (Berlin: Gebrüder Borntraeger, 1925.) 8·70 gold marks.

DR. TH. HERZOG has produced a monograph of 108 pages with ninety-three text figures upon the anatomy of the liverworts, and in this space it would appear possible to give a very complete report of progress in this very specialised field. There is, however, no mention of mycorhiza, and some important American work is not discussed. The work is divided into three sections. In the first there is a description of the various types of differentiated cell reported in the group, and it is striking how frequently these differentiated elements are to be found in thalloid forms. This section is followed by two further sections, dealing with the anatomy of gametophyte and sporophyte respectively, in which each group of the liverworts is passed in review in turn.

Introduction to Modern Political Theory. By C. E. M. Joad. (The World's Manuals.) Pp. 127. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 2*s.* 6*d.* net.

THIS short manual gives an excellent and clear account of the various socialistic and communistic theories which have recently become important owing to the success of the revolutionary movement in Russia. Mr. Joad takes naturally to this kind of work and is peculiarly well fitted for it. He can write sympathetically without the loss of balance which spoils the work of the propagandist.

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 Taungs Skull.

THE account which Prof. Dart published of the Taungs skull (NATURE, Feb. 7, p. 195) left many of us in doubt as to the true status of the animal of which it had formed part, and we preferred, before coming to a decision, to await an examination of the fossil remains, or failing such an opportunity, to study exact casts of them. For some reason, which has not been made clear, students of fossil man have not been given an opportunity of purchasing these casts; if they wish to study them they must visit Wembley and peer at them in a glass case which has been given a place in the South African pavilion.

The chief point which awaited decision relates to the position which must be assigned in the animal kingdom to this newly discovered form of primate. Prof. Dart, in writing of it, has used the name of anthropoid ape; he has described it as representing "an extinct race of apes intermediate between living anthropoids and man"—which is tantamount to saying that at Taungs there has been discovered the form of being usually spoken of as the "missing link." That this is his real decision is evident from the fact that he speaks of it as "ultrasimian and prehuman" and proposes the creation of a new family for its reception.

An examination of the casts exhibited at Wembley will satisfy zoologists that this claim is preposterous. The skull is that of a young anthropoid ape—one which was in the fourth year of growth—a child—and showing so many points of affinity with the two living African anthropoids—the gorilla and chimpanzee—that there cannot be a moment's hesitation in placing the fossil form in this living group. At the most it represents a genus in the Gorilla-Chimpanzee group. It is true that it shows in the development of its jaws and face a refinement which is not met with in young gorillas and chimpanzees at a corresponding age. In these respects it does show human-like traits. It is true that it is markedly narrow-headed while the other African anthropoids are broad-headed—but we find the same kind of difference in human beings of closely allied races. Prof. Dart claimed that the brain showed certain definite human traits. This depends upon whether or not he had correctly identified the position of a certain fissure of the brain—the parallel fissure. In the show-case at Wembley a drawing is placed side by side with the "brain cast"; but when we examine the brain cast at the site where the fissure is shown on the drawing, we find only a broken surface where identification becomes a matter of guess-work.

In every essential respect the Taungs skull is that of a young anthropoid ape, possessing a brain which, in point of size, is actually smaller than that of a gorilla of a corresponding age. Only in the lesser development of teeth, jaws, and bony structures connected with mastication can it claim a greater degree of humanity than the gorilla. Its first permanent molar teeth which have just cut are only slightly smaller than those of the gorilla, while the preparations which are being made in the face for the upper permanent canines show that these teeth were to be of the large anthropoid kind.

The other point on which we awaited information related to the geological age of the Taungs skull. Fortunately, Dr. Robert Broom (NATURE, April 18, p. 569) has thrown a welcome light on this matter. The skull was blasted out of a cave which had become filled up by sand washed in from the Kalahari. The fossil baboons found in neighbouring caves differ in only minor structural details from baboons still living in South Africa. In Dr. Broom's opinion the Taungs skull is of recent geological date; it is not older than the Pleistocene; he thinks it probable that it may not be older than the fossil human skull found in a limestone cave at Broken Hills, Rhodesia. It is quite possible—nay, even probable—that the Taungs anthropoid and Rhodesian man were contemporaries. Students of man's evolution have sufficient evidence to justify them in supposing that the phylum of man had separated from that of anthropoid apes early in the Miocene period. The Taungs ape is much too late in the scale of time to have any place in man's ancestry.

In a large diagram, placed in the show-case at Wembley, Prof. Dart gives his final conception of the place occupied by the Taungs ape in the scale of man's evolution. He makes it the foundation stone of the human family tree. From the "African Ape Ancestors, typified by the Taungs Infant," Pithecanthropus, Piltdown man, Rhodesian man, and African races radiate off. A genealogist would make an identical mistake were he to claim a modern Sussex peasant as the ancestor of William the Conqueror.

In the show-case at Wembley plastic reconstructions are exhibited in order that visitors may form some conception of what the young Taungs Ape looked like in life. Although the skull is anthropoid it has been marked by a "make-up" into which there have been incorporated many human characters. It is true the ears are those of the chimpanzee, but the forehead is smooth and rounded, the hair of the scalp is sleek and parted; the bushy eyebrows are those of a man at fifty-five or sixty; the neck is fat, thick, and full — extending from chin to occiput. In modelling the nose, gorilla lines have been followed, whereas the nasal part of the skull imitates closely chimpanzee characters. The mouth is wide, with a smile at each corner.

Prof. Dart has made a discovery of great importance, and the last thing I want to do is to detract from it. He has shown that anthropoid apes had extended, during the Pleistocene period, right into South Africa—into a land where anthropoid apes could not gain a livelihood to-day. He has found an extinct relative of the chimpanzee and gorilla but one with more man-like features than are possessed by either of these. His discovery throws light on the history of anthropoid apes but not on that of man. Java-man (Pithecanthropus) still remains the only known link between man and ape, and this extinct type lies on the human side of the gap.

ARTHUR KEITH.

June 22.

Spectroscopic Evidence of *J*-Transformation of X-rays.

IN a recent letter to NATURE (April 25) Messrs. Khastgir and Watson have given some graphical tables where the wave-lengths of the X-ray line *K* are plotted against the atomic number of the elements Nos. 48-60. In these curves there are two discontinuities at *Z* 52 and at *Z* 56, which the authors ascribe to the supposed *J*-transformation of Barkla. The authors state as follows (p. 605): "This seems to be the first spectroscopic evidence of the *J*-transformation."

The curves are said to represent the results of my measurements of the K wave-lengths. Several of the values, however, are *not* those found in my laboratory, but seem to be taken from different, and not very concordant, measurements. For example, the element Cs (55) had never been published in any paper from my laboratory at the time when the letter by Messrs. Khastgir and Watson was written.

The K-series of the elements in question had been measured in my laboratory once by Dr. Malmer in the earliest days of X-ray spectroscopy (1914–15). His measurements give no evidence of such a sudden change in the slope of the curve as shown in the letter of Messrs. Khastgir and Watson. As these values were obtained with a simple, and not very accurate, method, there are accidental errors of the magnitude 0·005 Å.U. In the *Phil. Mag.* for

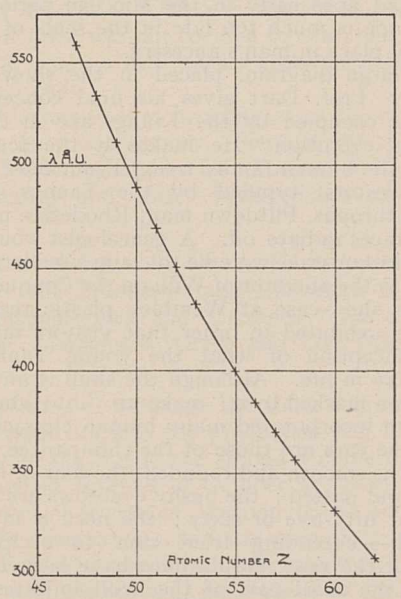

FIG. 1.

November 1919, Dr. Leide and the author described a new method and an instrument by which more accurate measurements could be obtained in this region of wave-lengths. Dr. Leide, who has been working with this apparatus, has just published the results in his dissertation (Lund: Gleerup; and some previous results of his investigation were given in my book, "X-ray Spectroscopy"). His values, which ought to be about 100 times as accurate as those mentioned above, are as follows:

Z.	$K\alpha_1$ λ Å.U.	Z.	$K\alpha_1$ λ Å.U.
47	0·55821	55	0·39959
48	·53386	56	·38445
49	·51103	57	·37004
50	·48948	58	·35647
51	·46931	59	..
52	·45037	60	·33125
53	·43249	61	..
54	..	62	·30833

In the diagram the wave-lengths are plotted against the atomic number Z.

No trace of such discontinuities as described by Messrs. Khastgir and Watson is to be seen.

MANNE SIEGBAHN.
Physical Laboratory, University, Upsala,
May 30.

IN a recent number of NATURE (April 25, pp. 604-605) there is a letter by Khastgir and Watson describing what is apparently spectroscopic evidence of J-transformation of X-rays. It is the purpose of this note to direct attention to data of more recent date which would indicate that these so-called evidences are caused by experimental inaccuracies in determining the wave-lengths of X-ray emission spectra.

It appears from the graph of Khastgir and Watson

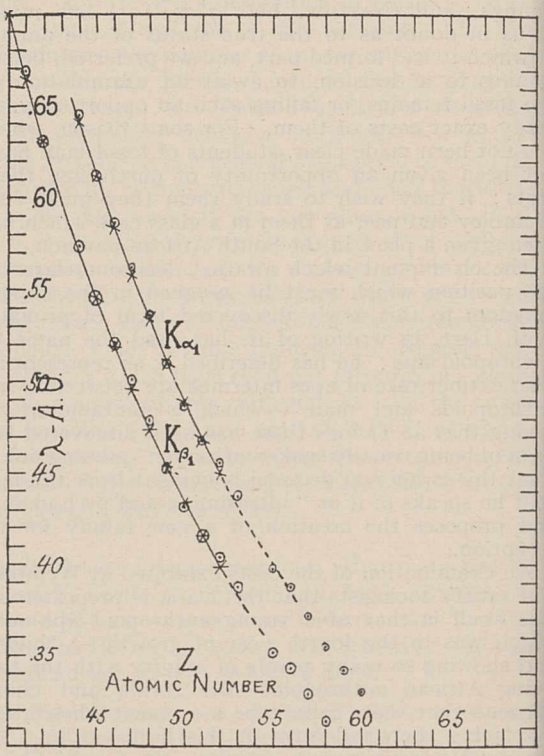

FIG. 1.

that they used values of λ which were determined by Malmer in 1915 (tabulated in "Atomic Structure" by Sommerfeld, p. 153). Siegbahn ("Spektroskopie der Röntgenstrahlen," 1924, pp. 101-102), however, gives values of λ which in some cases are quite different from those of Malmer. I have plotted the values of λ according to Siegbahn's latest work against the atomic number and find that the points fall on a smooth curve, and that there are absolutely no discontinuities. These points are indicated by crosses in the accompanying diagram (Fig. 1). The dots with circles around them indicate the values due to Malmer. Both the $K\alpha$ and $K\beta$ lines are shown in the plot.

It would seem, therefore, that Khastgir and Watson have been led into error by experimental inaccuracies and the peculiar coincidence that the greatest deviation from more recent wave-length determinations occurred at points which correspond with two of the critical absorbabilities for J-transformation. There is, therefore, no spectroscopic evidence of the so-called J-transformation of X-rays.

W. W. NIPPER.
Washington University,
Saint Louis,
Missouri,
May 19.

The Conditions for Calcareous Metabolism in Oysters and other Marine Animals.

THE summer of 1924 was remarkable for an unusually large and heavy growth of the shell of native oysters on most beds in England. In a recent survey of the Fal Estuary oyster beds, full details of which it is hoped will be published later, it was found that a total shoot (*i.e.* maximum increase in height or depth of a shell in a ventral direction) of 30 or more millimetres was quite common. Similar large shoots have been observed in shells from East Coast and other beds in 1924. The fact that the summer of 1924 was not a warm one is a matter of common knowledge and of great interest in connexion with the unusual shell-growth. In warm summers, such as we had in 1921, a big growth of shell is usual, but is then attributed to the generally increased metabolism following upon a high temperature, when biological conditions are otherwise satisfactory; but the rate of shell-growth of the oyster (*i.e.* increase in shell-area, and total increase in shell-weight) under any continuously known conditions is still undetermined. It is, therefore, not possible to state what are the precise conditions which are essential for normal or abnormal shell-growth. These conditions, like those in many other problems relating to the oyster, may not be determined until greater concerted attention can be given to what is admittedly a valuable mollusc. In the meantime it may be worth while to summarise a few observations on the subject.

Most lamellibranchs increase the area of the shell by the repeated addition of small concentric deposits at the edge. The oyster, however, makes a relatively large more or less concentric deposit of thin shell at one operation; this thin deposit, called a shoot, quickly hardens by being thickened.

Good practical oyster-producers say that two of such shoots are frequent in a fair year of growth, and the radius of each such shoot in a 2- to 3-inch oyster may be about 10 mm. This year on the Fal 3 and 4 such shoots, all with practical but not absolute certainty this year's growth, may be found. The variability in the number of shoots laid down from year to year is the main cause of the difficulty or impossibility of estimating the age of young oysters, without very intimate local knowledge of the growth-features. In an average year of growth it would appear that the two usual shoots are laid down in the spring and autumn, that is, on either side of the warm —and also spawning—period. But growth ceases in winter for an undefined period, even on beds such as those off Whitstable (in 1920–21 for example) where abundant food is available. Moreover the present writer has shown that oysters taken from the beds *in winter* and kept under warm conditions, even in practically sterile (Berkefeldt-filtered) water, will grow shell. (See Fish. Invest. 2, VI, 3, pp. 43-44—owing to the demands of economy it was only possible to give the bare observations in that paper.) Further, oysters kept in the laboratory in summer will lay down shell automatically in the practical absence of food (see NATURE, vol. 111, p. 14). These facts point to a controlling factor represented by a minimum temperature, below which shell is not or cannot be laid down, and above which shell-material may be produced automatically.

There is no doubt that lamellibranchs in general at our latitudes resemble the oyster in their physiological reactions with regard to shell-growth, one example of which is shown by the writer for the cockle, in NATURE, vol. 111, p. 147, Fig. 2. If, therefore, calcareous material be only laid down with difficulty at low temperatures, it would be highly instructive to have chemical analyses of those thin-shelled forms which are found in polar and deep-sea waters. Indeed a deposition of calcareous material by living marine organisms, although made so easily in the tropics, appears to be found increasingly difficult as the habitat becomes colder. One is tempted, therefore, to inquire what may be the chemical composition of the vertebræ or any bony parts of polar and deep-sea fishes. There is a fundamental similarity in living animals which warrants such an inquiry.

It may be noted in passing that the secretion of siliceous matter can be effected at very low temperatures by polar and deep-sea organisms, in some of which it is possible that deposition of silica may replace that of calcareous material.

In the good shell-growth of warm and relatively cold wet seasons, in Great Britain the corresponding hydrographical conditions are respectively high estuarine salinities, alkalinities, and temperatures, and low fluctuating salinities with medium temperatures and (probably) alkalinities; in the wetter seasons one would also expect a smaller amount of available food-material. An explanation of growth which meets the facts partially may be given as follows: shell-deposition in a warm summer is rapid, and any arrest of growth which may be due to breeding is masked, while in the wet summer, growth occurs continuously in the medium temperature and low salinity and is only slightly arrested by the generally—but not totally—repressed reproductive phases. Shell-growth may occur in the pre-spawning period of females, *i.e.* in the spring, but requires to be observed more fully in marked individuals in the post-spawning period, in which there is a suspicion of a slowing down of the operation.

The good shell-growth in the summer of 1924 may, therefore, be understood if we assume that repression of the reproductive capacities in the relatively cold summer permitted continuous growth, which was apparently accelerated by the low salinity. The arrest of growth when reproduction is possible in invertebrates is indicated in the diminutive size of the breeding individuals in the summer crops of the sponges, Grantia and Sycon, and the very large size possible in the non-breeding wintering forms of the same genera. There is therefore nothing unreasonable in the explanation of growth so far offered. There is, however, another important type of growth which seems to require a different explanation, namely, that which appears to follow removal of oysters to a fresh habitat. For this type of growth a supposition of a general increase in the well-being of the animal does not seem to be sufficient, nor for the fact that an unusual amount of growth occurred in many stunted forms in the Fal Estuary last summer, except that the low salinities, which can be predicted as a result of the heavy rainfall, would be equivalent to a change of habitat. In this respect it is important to note that in the oyster, and doubtless also in related forms, growth does not necessarily follow a mere accumulation of reserve products, as is shown by the fact that "dumpy" (stunted) oysters, which may constitute 40 or more per cent. of a population, were this year on the Fal mostly very well fished (full of reserve products), while the fast-grown oysters were mostly thin and emaciated as though expended in their efforts in growing. Some biological factor appears to shut down the shell-producing mechanism in certain individuals, while in others automatic response to the environment is clearly very prompt. The problem here denoted once more presents the dual interests of science and economics, the boundaries of which cannot be universally defined.

J. H. ORTON.
Marine Biological Laboratory,
Plymouth, June 5.

The Isotope Effect in the Spectrum of Silicon Nitride.

RESULTS of a quantum theory analysis of the SiN bands and of the vibrational isotope effect in these bands were given in an earlier letter to NATURE (March 22, 1924) and in a paper presented at a meeting of the American Physical Society (cf. *Phys. Rev.* 23, 554, 1924). It is now found that the equations given in the latter for these bands are incorrect. This is due to a wrong assignment of vibrational quantum numbers, corresponding to what may be described as an insidious violation of the combination principle. With the data first used, this violation was not apparent, but new data disclose systematic, although rather small, deviations. A new and, this time, correct assignment of quantum numbers has now been made. The following equation holds for the position of the null-lines of the $Si^{28}N$ bands (n' = vibrational quantum number of the initial, n'' that of the final state of the molecule):

$$\nu = 24234{\cdot}2 + 1016{\cdot}30n' - 17{\cdot}77n'^2 + 0{\cdot}41n'^3 - 0{\cdot}0049n'^4 - 1145{\cdot}00n'' + 6{\cdot}570n''^2.$$

The null-lines, it should be stated, can for many of the bands be measured directly on the plates. At the low temperature of the active nitrogen used in generating the bands, the null-line appears as a conspicuous hole in the band structure, on the low-frequency side of the head.

With the new numbering, the various apparent abnormalities previously noted disappear, and an analogy of the SiN bands to the violet CN bands is brought out. In particular, the isotope effect, previously thought abnormally large for the initial state of the molecule, is now completely normal. Agreement with the theory is exceedingly good if the emitter is assumed to be SiN. No other assumed emitter gives agreement with the experimental data; even for SiO, the agreement is poor. Thus the value of the isotope effect in the identification of the emitters of band spectra, emphasised in a previous letter (April 5, 1924), is again confirmed. As in the case of the BO bands, so in the case of SiN, the testimony of the isotope effect is backed up by the chemical evidence (NATURE, Sept. 6, 1924, and *Phys. Rev.* 25, 259, (1925)).

The agreement of the results with theory is much better if the integral vibrational quantum numbers 0, 1, 2, . . . are assumed than if the half-integral numbers $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, . . . are used. In this respect SiN differs from BO, for which the data indicate (cf. refs. last cited) that half-integral values are needed.

A detailed account of the work on the SiN bands is now being prepared for publication.

ROBERT S. MULLIKEN,
National Research Fellow.
Jefferson Physical Laboratory,
Harvard University,
May 16.

Planetary Densities and Gravitational Pressure.

IN astronomical works the densities of the sun and planets are taken as the ratios of the masses to their apparent volume, the masses being determined by the periods of the bodies which revolve round them.

For the sun itself, and for several of the planets (notably for Jupiter and Saturn), the density so determined is much less than that of the earth, and it seems very improbable that this should really be the case, considering that the materials of which they are composed are the same as those which make up the earth, and that the gravitational pressure to which they are subjected is much greater than that which could be produced by terrestrial gravity.

In the case of the sun, Venus, Jupiter, and Saturn, in which the visible part is vapour or cloud, it seems most likely that there is a dense nucleus in which most of the mass is concentrated, and, assuming for the moment that the whole mass is so concentrated, it is a simple and direct problem to determine the size of the nucleus for any given density.

The depth of the non-solid covering will be the difference between the apparent semidiameter and the radius of the nucleus, and if the latter has the density of the earth, the approximate dimensions in miles are as follows:

	Apparent Semidiameter.	Radius of Nucleus.	Thickness of Envelope.
Sun . . .	432,000	278,000	154,000
Venus . .	3,800	3,600	200
Jupiter . .	45,000	28,900	16,600
Saturn . .	37,500	19,000	18,500

If the density depends on the gravitational pressure, the diameter of the nucleus will be less than the above for the sun, Jupiter, and Saturn, and rather greater for Venus.

There are no experiments on the variation of density of solids under large pressures. If a rod of the mean density of the earth is supposed to reach from the surface to the centre, the pressure on its base is just half that which the same mass would exert at the surface when resting on the same area. Taking the earth's radius as 21 million feet and the earth's density as 5·6, this gives 11,400 tons per square inch as the pressure at the earth's centre.

I have seen no mention of trustworthy experiments at even 100 tons per square inch, and in my own work have never gone beyond 30 tons.

In some trials with precipitated chalk, using pressures of 25 tons to the inch, I have obtained blocks with a density of 1·6 to 1·7—much the same as the density of the upper chalk. In the lower chalk, however, the density sometimes exceeds 2, and it would be interesting to know whether this is the result of gravitational pressure.

A. MALLOCK.

Spiral Springs of Quartz.

I AM greatly interested in the account in NATURE of June 20, p. 943, of the manufacture of spiral springs of fused quartz by Dr. Sliupas, and the comment by Prof. Boys on the achievement.

During the last eighteen months we have been employing similar springs of fused quartz in this laboratory in the measurement of sorption, a preliminary announcement of their use appearing in the Journal of the Am. Chem. Soc. for December of last year (Bakr and McBain, p. 2722), and a full account of the sorption balance is now being communicated.

Our experiences confirm in every way the observations made by Dr. Sliupas in his letter. Several members of the laboratory have prepared these springs of varying dimensions, using the ordinary coal-gas-air blow-flame for forming the coil. (The oxygen-gas flame was, of course, employed for the drawing-out of the fibres from the thick rods of quartz.) The quartz fibre is attached by a smear of sealing-wax to an ordinary arc-lamp carbon of suitable dimensions, which is supported in a well-bored cork, so that it may be rotated about its longitudinal axis. A small weight is suspended from the free end of the fibre, which is then coiled by slowly turning the carbon rod, the fibre being heated by the blow-flame at the point

at which it is being bent. As mentioned in Prof. Boys's note, the close or open coiling of the spring may be effected by slight inclination of the rod to the horizontal, and evenness in the winding is readily secured. When the coil is completed, it is removed from the rod by gentle tapping, and the hooked ends bent into the axis of the coil. We have observed no deterioration of the quartz due to the contact with the hot carbon rod, or to the use of coal-gas.

Spirals of fused quartz fibres of from 0·1 to 0·2 mm. diameter, having from 15 to 30 coils of diameter 0·5 to 1·5 cm., have been prepared in considerable number. Some large springs with coils of 2 cm. diameter were made to order by Messrs. The Silica Syndicate, and these had the same average extension per unit weight suspended from them as the spring of the same dimensions instanced by Dr. Sliupas. Considerably more sensitive springs have been manufactured, but they were too delicate for the purpose for which they were required. There appears to be small limit to the sensitivity that can be obtained, provided that the maximum load required to be carried be small. As an example of a typical spring which we are employing—of the less sensitive kind—we can get a spring that will carry a total load of approximately 0·8 gram, giving an extension of 0·9 cm. per 0·1 gram load; diameter of coils, 1·3 cm.

In the manufacture of long springs we have found it quite easy to join two or more fibres together, using the oxygen flame.

H. GREVILLE SMITH.

The University, Bristol,
June 22.

The Quantum Analysis of New Nitrogen Bands in the Ultra-Violet.

IN a previous letter (NATURE, 114, 642, November 1, 1924), one of the writers predicted a new group of nitrogen bands with an origin at about 65,000ν, having for its initial state the final state of the first positive group, and for its final state the stable condition of the neutral molecule. A group of strong bands in almost precisely the predicted position has now been measured and analysed, but, contrary to expectations, the progressions of this group are not related to those of any other analysed group of nitrogen, or of any other substance.

The new group was obtained with purified nitrogen, at 0·003 mm. pressure, in a long tube, with flowing gas, using ordinary arc discharge. The spectrograms contain the usual nitrogen groups and in addition thirty bands, degraded to the red, extending from λ1354 to λ1854. Seventeen of the thirty have previously been observed by Lyman ("Spectroscopy of the Extreme Ultra-Violet," pp. 82 and 113). The distribution of intensity, except in minor particulars, is similar to that of the second positive group (a typical case), and hence indicates very definitely the correct assignment of vibrational quantum numbers. The resulting equation for the new group is

$$\nu = 68{,}956{\cdot}6 + (1681{\cdot}45n' - 15{\cdot}25n'^2) - (2345{\cdot}16n'' - 14{\cdot}445n''^2),$$

where n'' varies from 0 to 9, and n' from 0 to 3 only, the average (Obs.—Calc.) being 0·1Å.

There are many other bands (or at least hazy lines) between λ950 and λ1350, some of which are quite strong, and also a few rather weak bands between λ1350 and λ2100, but as yet no consistent numerical relations are apparent.

R. T. BIRGE.
J. J. HOPFIELD.

University of California,
May 11.

Sir William Fletcher Barrett, F.R.S.

IN Sir Oliver Lodge's notice in NATURE, June 6, p. 880, of the late Sir William Barrett he says that he (Sir William) "claimed" to have discovered some alloys of iron. Reference to published scientific papers would have shown Sir Oliver that Sir William read a paper in 1899, published in the Transactions of the Royal Dublin Society in January 1900, on the magnetic and electric properties of the alloy now known as stalloy, which is indispensable in the construction of transformers, dynamos, etc. Indeed he was told by an authority that this discovery had saved six million pounds in the construction of the Panama Canal alone. Another alloy, permalloy, is likely to be of even greater use in the future.

That Sir William did not do much more for original research was due to his extreme conscientiousness, in considering that, holding the chair of physics, his first duty was to his pupils, and no private work was ever allowed to interfere with that.

Sir Oliver further says that Sir William had "a stimulating hand in founding the Society for Psychical Research." It was entirely due to Sir William's initiative that the society ever came into being, in order to examine obscure psychical phenomena critically and scientifically. In this work he encountered much ridicule and hostile criticism, but he never suffered this or the undoubted obstacle thus created to his material advancement to hinder him in his arduous and devoted search for truth.

ROSA M. BARRETT.

I WELCOME Miss Barrett's supplementary letter about her brother's work. It is unsafe for a writer of an obituary notice to usurp the functions of a law-court to decide questions of priority or completeness of invention. "Stalloy" was, I believe, a subject of controversy, but those who knew Barrett well may hold that any claim made by him must have been well founded. As to the initiation of the S.P.R., Miss Barrett will find a notice in a forthcoming number of the Proceedings of that Society, wherein full credit is given him, with first-hand knowledge, by Mrs. Henry Sidgwick.

OLIVER LODGE.

A Geological Lecture Illustration.

THE following illustration, which occurred to me while preparing one of a series of talks to schools for the British Broadcasting Company, may be of interest to those who are concerned in teaching elementary geology, though it may not be new.

Almost every one has seen the heaps of sample carpets in large furniture stores. Let the carpets represent the successive strata as laid down in past time. Now suppose that a thick board or wedge be driven underneath the pile of carpets: this will produce a humping up of all the carpets just above the wedge. If we then suppose that the humped-up portion is subjected to continuous wear (denudation) it is quite conceivable that the upper carpets will be worn right through and the lower carpets (older strata) become exposed. The frayed edges of the worn-away carpets become the escarpments of the upper strata, and the analogy may be easily extended by considering carpets of different textures. Other types of deformation may of course be given to the pile, and the geological map subsequent on denudation easily deduced.

G. N. PINGRIFF.

Merchant Taylors' School,
E.C.1.

Problems of the Rhone Delta.

By R. D. OLDHAM, F.R.S.

I.

IT has long been known that the delta of the Rhone has undergone great changes since the close of the period of Roman empire. The changes are attested by historical records, but the evidence is contradictory; in part it seems to indicate a rapid advance of the sea face of the delta during the Middle Ages, yet there are mentions of places and dry land almost up to the present limit, and there is clear proof that places close to the existing coast-line were dry land and inhabited during the Roman period. These contradictions gave rise to a large volume of discussion, at times very controversial, by archæologists, geographers, and geologists during the last century, but the result was inconclusive, for the key to the solution had not been found. Work done since the beginning of the present century has thrown a new light on the problem, and especially a geological study by M. G. Denizot, which was published in 1924 by the Société Géologique de France, has made a re-examination of the question possible, and led to the possibility of drawing an outline of the changes which have taken place since the dawn of our era.

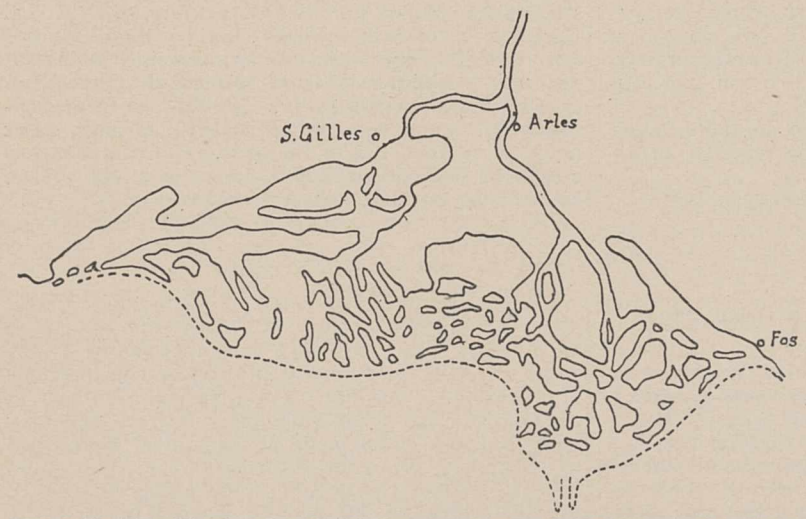

FIG. 1.—The Rhone delta about the end of the tenth century. This sketch does not attempt accuracy of detail; it is purely diagrammatic and intended to represent the general type of topography which resulted from the subsidence in the Dark Ages. The outline of the waterways must have been more intricate than can be restored, or represented, on a small-scale map. The broken line represents, approximately, the outline of the delta in Roman times.

On a map of the region, the river Rhone is seen to divide just above the city of Arles into two branches, of which the western flows past St. Gilles and, curving to the southwards, enters the Mediterranean just west of the village and shrine of Saintes Maries, while the main stream, which carries four-fifths of the water, flows southwards to the sea, keeping near the eastern margin of the delta proper. Between these two streams is a triangular tract of country, known as the Camargue, and in the middle is an expanse of salt water, the étang de Vaccarès, which communicated freely with the sea by an island-studded stretch of water before it was cut off by the formation of an artificial protective embankment. As seen on a map, the appearance is that of a normal alluvial delta, where the two branches of the river are bordered by fully developed alluvial plains, while between them is a tract of marshy or flooded country, not yet fully reclaimed from the sea, and as such it has generally been interpreted; some strips of ground, too high to be part of the alluvial plain, being regarded as relics of old coastal barriers, now separated from the sea by the advance of the delta.

The description of M. Denizot puts the question in a different light, for he describes the country round the étang de Vaccarès, on the north, the east, and west, as rising to heights of two to three metres, with an undulating surface, the result of subaerial denudation, and in the alluvium forming this high land, he found fossil remains of *Cardium edule*, and other living marine molluscs, at heights of more than a metre above sea-level. As cockles cannot live and thrive above high-water mark, it is evident that, since these deposits were formed below sea-level, there must have been an uplift of the land, and the relation of the present surface to the Roman remains, which are found in this region, shows that this uplift, though extremely recent in the geological sense, must have preceded the advent of the Romans, and probably of their predecessors, the Phoceans and Phœnicians.

Though very recent, this uplift is not the most recent change of level which has taken place. In 1903, Mr. R. T. Gunther established for the neighbourhood of Naples a series of regional changes of level, which ended up by leaving the land some twenty feet lower, relative to the sea, than during the Roman period, and, since then, evidence has accumulated of a similar change of level in other parts of the Mediterranean, from Venice to Alexandria and Carthage, nor is it wanting along the coast of Provence. In the very region of the Rhone itself, remains of Roman buildings have been found below sea-level, in the étang de Vaccarès; and in the Gulf of Fos are remains of old buildings, regarded as remains of the port of Fossæ Marianæ, which was an important seaport in the early centuries of our era.

A very vivid description of these is given by M. Toulouzan, who mentions buildings, and long jetties of stone, as visible beneath the sea in calm weather. The archæology of this writer was so brightly tinged with imagination, that the existence of these ruins has been doubted, or denied, but there is independent evidence of the remains existing under the sea in the Golfe de Fos, and the discovery of remains of Roman construction below sea-level has also been recorded in the étang de Vaccarès. Apart from this, M. Denizot, in the paper referred to, gives evidence of subsidence of the land near Fos, though he denies the possibility of its amounting to anything like nine metres. That some

subsidence of the land has taken place is, therefore, established, but the direct evidence on record, if we except the statements of M. Toulouzan, does not give a measure of it. For this we must look to the changes which have taken place in post-Roman times, which not only give indirect corroboration of the subsidence, but enable its amount to be estimated, as certainly not materially greater than five, or less than four, metres, and the date to be fixed as in the period which elapsed between the beginning of the eighth and the close of the tenth centuries.

One result of the recognition of this change of level is that the current conceptions of the delta in Roman times must be revised. The whole region then stood some twelve to fifteen feet higher above sea-level than at present, and, if the land were again to be raised to this level, the whole of the great expanse of water, forming the étang de Vaccarès and extending to the sea, as well as all the salt lakes, which are in more or less direct communication with the sea, or only cut off by alluvial and coastal barriers, would be converted into dry land. The delta, instead of being smaller than at present, might have extended farther out to sea than now; the great spreads of pestiferous salt marshes, which render the country almost uninhabitable, would be largely or entirely drained, and instead of the subsoil being everywhere so charged with salt that a supply of drinking water can only be procured by storing the rainfall, it would probably be obtainable from surface wells. The country, in fact, would be fertile and habitable, justifying the description of the ancient writers, and accounting for the numerous remains of considerable settlements which have been, and are still being, found. Through this region the branches of the Rhone would flow in channels cut out of the up-raised alluvium, with a flood-plain on either side, and the mouths would issue on the sea-face, where the action of the waves, driven directly against the bar by the prevailing storms, would give rise to the same difficulties and dangers of navigation as at present, troubles which Caius Marius solved, in the same way as the French engineers of the last century, by cutting a ship canal from the river to the sea.

With the subsidence in post-Roman times, a change in the conditions took place. In a region where no point rose more than thirty feet above sea-level, the whole of the low lands would be submerged to a greater or less extent; numerous creeks and channels would penetrate the land, converting the gently undulating ground into islands of varying size, separated by channels of varying width and depth; the river, instead of ending on the exposed sea-face of the delta, would debouch into deep and sheltered inlets of the sea; the conditions leading to the formation of a shallow and dangerous bar would be mitigated, and the entry made possible for ships of greater draught and tonnage than before or at present. In the network of channels and expanse of shallow water, resulting from this subsidence, the recovery of land from the sea, by the alluvial deposits of the river, would take place with rapidity, the position of the mouth, and the course of the channel, would be continually changing, until the river once more reached the sea-front of the delta. One region, however, was protected by the accident of configuration of the surface, and while, on either side, the channels were largely filled up by river silt, the great étang de Vaccarès, with the island-studded waters to the south, remained little affected, and have preserved a representation of the conditions which must have been widespread, along the whole of the outer portion of the delta.

Besides the numerous salt lagoons, or étangs, which owe their origin to this subsidence, there are expanses of modern alluvium, which, but for the complete embankment of the river, would still be in process of formation. This modern alluvium, according to M. Denizot, can often be sharply distinguished from the older, prehistoric alluvium, on the undulating, eroded surface of which the Roman settlements were built; in other places the boundary is less easily recognised, but the distinction is none the less complete, and it is largely possible, by an examination of modern maps and a comparison with older ones, to extend his direct observations, and to compile a map which will, at least, give an indication of the general distribution of land and water at the time when the subsidence had ceased, and before sedimentation had been able to make material progress.

Such are the deductions which may be drawn from a purely geological study of the region. It remains to be seen how far they are consistent with, or supported by, historical records.

II.

The western branch of the Rhone, which takes off from the main stream just above Arles, flows past St. Gilles and then bends southwards to enter the sea by the Grau d'Orgon, near Saintes Maries, but the last part of the present channel, from Silvéréal on, dates only from 1552, when the river broke away from its old course. Before that date it had followed another channel, farther west, now known as the *Rhône mort*, past Peccais, to the salt lagoons south-east of Aigues-mortes, and in 1532 was diverted from them by a cut direct to the sea, which became known as the *Rhône vif*, the mouth of this channel becoming the *grau neuf*. Between St. Gilles and Silvéréal the river crosses a great expanse of marsh and swamp, which extends westwards towards the étang de Mauguio, and is separated by a barrier of slightly higher land, an inland delta of the Vistre and Vidourle. M. Denizot refers to this tract, which he recognised as composed of modern, or as we may say, post-Roman alluvium, quite distinct from, and newer than, the older alluvium forming the more elevated undulating surface to the south of it. Even now the greater part of this ground can scarcely be described as dry land; it is mostly swamp and, in all but the most recent maps, considerable tracts are shown as permanently flooded. It bears all the appearance of being a tract which has been reclaimed by river deposits in quite recent times. A relic of this old, and once extensive, sheet of water, which spread over this ground, may be seen in the étang de Scamandre, still about six feet in depth, and evidently bounded by the sloping surface of the alluvial plains of the Rhone on the east and the Vistre on the west.

It is not possible, from the information available of a geological or topographical character, to determine whether this sheet of water formerly extended westwards to the étang de Mauguio; for this we must look

to historical records, and foremost among them may be put the history of St. Gilles. By some writers this place has been identified with the Heraclea, mentioned by Pliny the younger, on the strength of a supposed inscription, which has been wholly discredited by later research. That a Roman town stood where it now stands is certain, but this was not Heraclea, for Pliny mentions that place as one which had become legendary, even in his time, and there is not only no evidence, but a strong presumption, that the St. Gilles of Roman times was not in use as a port. It was otherwise in the eleventh and twelfth centuries, when the Dark Ages were passing away, for at that time St. Gilles was not only a recognised seaport, but also the most important one along this coast. In 1109 Raymond of St. Gilles collected there a fleet of forty ships, to transport an army of four thousand fighting men to the Crusades. Three years later the Knights Hospitaller of St. John founded their first establishment outside the Holy Land at St. Gilles, because it was then the port most used by pilgrims to and from Jerusalem. Mention of the use of St. Gilles is fairly frequent in the records of the twelfth century, and in 1160 the Rabbi Benjamin of Tudela describes it as a flourishing town frequented by visitors from the most distant lands, situated on the banks of the Rhone, and within three miles of the sea. As the sea is now nowhere within five times that distance of St. Gilles, and as there is a continuous strip of what must have been dry land, though possibly penetrated by channels, the sea of the Rabbi could not have been the Mediterranean; it could only have been that expanse of water which has been referred to.

These accounts give no clue as to the direction in which the navigable channel of access lay, but an incident of the wars between the republics of Genoa and Pisa throws light on this subject. Some Pisan galleys, pursued by Genoese, took refuge by ascending the Rhone to St. Gilles; the Genoese, instead of following them, went up the main stream, past Arles and, rounding the point of the Camargue, descended the lesser branch of the river to St. Gilles. The Pisans hearing of their approach fled down stream, as the chronicle reports, by another river and another mouth called the Gradus Capræ, which appears in the French version as Grau de la Chêvre, where the Genoese, in pursuit, captured and burnt some of the galleys and proceeded, searching for more, until they reached the Grau de Montpellier, now called Palavas, where they met a contrary wind and had to return by the river to Arles and so on to Genoa.

This is the last appearance in history of St. Gilles as a port accessible from the sea. In the following century, when Aiguesmortes was founded, in 1240, St. Gilles could no longer have been a seaport; it is certain that there was no direct access to it from the étang de Mauguio, and the Grau de la Chêvre of the thirteenth and fourteenth centuries was the mouth of the old river course, of the *Rhône mort*. This channel, however, seems not to have been navigable, and it is very questionable whether it was meant, in the record of the naval adventure of 1165; if the statement of the Rabbi Benjamin of Tudela can be accepted, the river had not then extended so far, and the narrator, without definitely stating it, implies that the course from the Grau de la Chêvre to Montpellier was in sheltered waters, and not in the open sea. The implication is that the access to St. Gilles was from the westwards, and if so its decline and disappearance, as a port of destination, was due to the closing of this channel on one hand, and the advance of the western and smaller branch of the Rhone on the other.

This conclusion is strongly supported by a study of those remarkable relics of the Middle Ages known as the portolan maps. It is known, from incidental references, that sea-charts of some kind were in use in the twelfth century, but they appear to have been mere sketches, drawn from memory by navigators, of the approaches to individual ports, or of stretches of coast-line; only towards the end of the thirteenth century did the normal portolan appear. This gave a representation of the Mediterranean and Black Seas, and of parts of the Atlantic coasts of Europe and Africa, with a surprising degree of accuracy. The origin and history of these maps have been the subject of much discussion, but it is generally agreed that they were sea-charts made for the use of sailors, that they originated independently of, and were uninfluenced by, any earlier maps, and that, once the type had developed, they went on being reproduced, with merely variations in detail, throughout the succeeding centuries until the seventeenth or even into the eighteenth century.

In the region of the Rhone Delta, the maps all represent a broad inlet of the sea, stretching from Cette to the Rhone, drawn in a conventionalised outline and dotted over to represent shoal water. To this statement an exception must be made of a few of the earliest maps; in the very earliest, the Carte Pisane of the end of the thirteenth century, the representation of the mouth of the Rhone is so purely conventional that no conclusion can be drawn from it; of slightly later date, 1318, are two maps by Petrus Verconte, of very different character and great interest. They represent a great inlet of shallow water, extending from just east of Cette, over the étang de Mauguio to beyond where St. Gilles would be, were it marked on the map; and, more than that, one of these maps also shows a sheet of water, north-eastwards of the termination of this inlet, in the position of the tract of land, between St. Gilles and Beaucaire, which was permanently flooded until it was drained by the digging of the canal from Beaucaire to Aiguesmortes. In neither of these maps does the inlet extend to the Rhone, but stops short, and at the eastern end a river is shown entering it, which must be meant for the western branch of the Rhone.

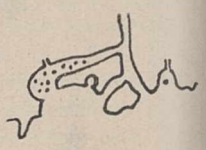

FIG. 2.—Coast-line between Cette and Cap Couronne, from the Catalan Atlas of 1375. This shows the general type of the representation of the Rhone Delta, which runs, with small variations, through the whole series of the portolan maps, with the exception of the early one by Petrus Vesconte, shown in Fig. 3.

It is impossible to examine these maps without being struck with the facts, that they evidently owe nothing to any pre-existing map of which we have any knowledge, and that they are equally evidently an attempt to represent something which really existed. The author of the general map must have had before him a local chart of this region, probably one of those mentioned above, which had been drawn at a time when St. Gilles was still a port; but this was a century before

the map was drawn, and so the omission of the name of St. Gilles can be accounted for. Vesconte knew that there was no longer a port of St. Gilles, if he knew that there ever had been, and, being of no interest to those for whom the map was made, it was omitted, but the topography he took, directly or indirectly, from the older map. If this map is compared with a restoration of the twelfth century topography, as deduced from modern maps of the region, the agreement, as regards the eastern end of the inlet, is so close, that his representation of the western portion, where direct restoration is more uncertain, may be taken as corroboration of the western approach to the port of St. Gilles.

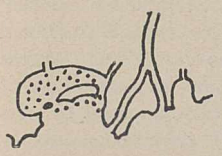

FIG. 3.—Coast between Cette and Cap Couronne, from the map by Petrus Vesconte, dated 1318.

The later history of these maps, so far as it affects this region, may be briefly summed up. The Vesconte map is the last which gives an air of reality to the western channel, and it is probable that in contemporary maps, by other makers, the representation had already assumed the conventional form, seen in the Dulcert map of 1339, and repeated throughout the series of later maps. At the same time, there is a great advance in the representation of the sea-face, which maintained a remarkable correctness until about the middle of the fifteenth century; after that, a change of conditions, by deterioration of the channels of access to Arles and Aiguesmortes, and by the increase in size of the merchant ships, led to this coast being avoided by the mariners who used these charts, and a steady deterioration set in, due to errors introduced by repeated copying, uncontrolled by any check.

From the evidence outlined above we may reconstruct the history of St. Gilles as a seaport. In Roman times it was an inland town, of no great importance, past which one of the branches of the Rhone flowed, as at the present day, but, instead of turning southwards, the river flowed on to the west, in a valley cut out of the upraised alluvium, to where the étang de Mauguio now stands. Then came the subsidence in the Dark Ages, the lower part of this valley became submerged, and an inlet of the sea was formed, with sufficient depth of water to enable ships to reach St. Gilles, which, by 1080, had become so well established that it was selected as the most appropriate landing-place for a princess of Sicily, on her way to the Court of France. The importance and prosperity of the port increased during the succeeding half-century or more, but, once further subsidence of the land had ceased, the alluvial deposits of the river began to advance into the flooded lands until St. Gilles, instead of being a port on an inlet of the sea, became a town on the banks of a small river, and at the same time the rivers Vistre and Vidourle, entering the inlet near its western end, built up a barrier across it. These two causes, combined, made access from the sea to St. Gilles increasingly difficult until, by the end of the twelfth century, its life as a seaport had come to an end. Since then, the remains of this old inlet were gradually filled up by silt deposited from the flood-waters of the rivers, and the process would still be going on, if these rivers had not at last been completely hemmed in by flood-proof embankments.

(*To be continued.*)

The Centenary of the Railway.

By Engr.-Capt. EDGAR C. SMITH, O.B.E., R.N.

THE celebration of the centenary of the opening of the Stockton and Darlington Railway is an occasion of world-wide interest, for from that pioneer line has sprung the vast network of railways which stretches to the uttermost parts of the earth. It was the first of British public steam railways, and just as the Romans were the great builders of roads, so our race became the great builders of railways. Even as British ships navigate every sea, so railways designed by British engineers traverse every continent. The modern textile industry and the steel industry both had their birth in our isles, but it is probable our three greatest contributions to material progress were the steam-engine, the steam-ship, and the locomotive. Watt and Stephenson, like Shakespeare, Newton, and Faraday, have been eulogised beyond measure, but we are perhaps even now too near the revolutions they set in motion to realise their full significance in the history of mankind.

The Stockton and Darlington Railway was opened on September 27, 1825, when George Stephenson drove his famous engine *Locomotion* from Darlington to Stockton with a train of miscellaneous vehicles and trucks filled with goods and passengers. That great experiment must always be associated with the name of Stephenson, who, however, was but the outstanding representative of the pioneers of the steam railway to whom tribute should be paid. Tracks of wood and wheels of iron had been in use for many years. In 1801 William Jessop had built the first authorised public line, the Surrey Railway. It was probably Jessop who gave us our gauge of 4 ft. 8½ in. By 1820 railways were becoming common, and no fewer than twenty were sanctioned in that year alone. These were worked by horses. In the eighteenth century, Cugnot, Murdock, and Trevithick had all built steam-carriages; and in 1804 Trevithick set a locomotive to work on an iron track in Wales. In this engine he used the exhaust steam as a blast. Two or three years later Trevithick had one of his engines running round a track where Euston Square now stands. Blenkinsop's engines with cogged wheels date from 1812, and about the same time Foster and Hackworth assisted Hedley to construct *Puffing Billy* and *Wylam Dilly*, the two oldest locomotives now extant. Stephenson's first Killingworth engine *Blucher* was built in 1814, his second in 1815, and eight years later, with assistance from Pease, Richardson, and Longridge, he opened his engine factory at Newcastle, where *Locomotion* was built.

Originally projected by Edward Pease as a mineral line for bringing coals from near Bishop Auckland to the sea, the plans for the Stockton and Darlington Railway were passed in 1821, and two years later, largely through Stephenson, powers were obtained for

carrying passengers and for using locomotives, the general idea being to use locomotives on the level and stationary winding engines for the inclines. At first *Locomotion* was the only locomotive, but it was soon followed by other engines afterwards named *Hope, Black Diamond, Diligence,* and *Royal George,* for it was found that "an intercourse and trade seemed to grow out of nothing." Stephenson by now was also engineer to the vastly more important railway, the Liverpool and Manchester, and just as he had prevailed upon Edward Pease to use the locomotive for the Durham line, so he converted the proprietors of the Lancashire line to his ideas. When the line was nearing completion a prize of 500*l.* was offered for a locomotive fulfilling certain conditions, and the remarkable success of the *Rocket* at the historic Rainhill trials held in October 1829 sounded the knell of both horse railway and stationary-engine railway. A year later the Liverpool and Manchester Railway was formally opened by a procession of eight locomotives, headed by the *Northumbrian,* driven by Stephenson, and with that event the era of the steam railway set in.

Railway progress since those early days has been due to two great schools of engineers: the mechanical engineers devoted to the design and construction of rolling stock, and the constructional engineers responsible for the track. To the former belong both George and Robert Stephenson, Hackworth, Bury, Crampton, Gooch, Fairlie, Ramsbottom, Baldwin, Webb, Belpaire, Borsig, de Glehn, Mallet, Pitkin, and Vauclain, whose names have been household words. Between the *Rocket,* weighing with her tender 7½ tons, and the giant *Virginia,* built by the American Locomotive Co., weighing 450 tons, lies the work of a great army. With her fire-box surrounded with water spaces, her copper tubes and her direct drive, the *Rocket,* compared with anything which had gone before, was as a racehorse to a dray horse. It was in the *Planet,* however, that the cylinders were placed under the smoke-box with the driving wheels aft as we have them to-day.

In the history of the locomotive it is impossible to say too much for Howe's invention of the link gear, which gave the driver a simple means of reversing, and also of regulating the cut-off in the cylinder. The link gears of Walschaerts, Gooch, Allan, and Joy were all later than Howe's invention, which was made in 1842. Other landmarks in the history of the locomotive are the brilliant invention of the injector by Giffard, the introduction of his ingenious water trough by Ramsbottom, the use of compounding by Mallet and Webb, and the introduction of superheating, notably by Schmidt. But in truth every part of the engine and boiler, tubes, valves, gauges, cylinders, pistons, springs, bearings, axles, and cranks, have been the subjects of close investigation and continual improvement. In the development of rolling stock, special mention should be made of the invention in 1869 of the Westinghouse brake, while we are also indebted to the United States for the Pullman carriage and the Swift refrigerator car. Scientific research has long been the handmaid of locomotive engineers, and it is worth recalling that August Wöhler's epoch-making work on materials began with the study of axles.

Just as Stephenson was the first to build an iron railway bridge, so he was the first to lay a line across a bog and to drive one through a hill. There can be no denying him the title of "the father of the railway." After the Liverpool and Manchester line came the London to Birmingham, then the Grand Junction continuing this line to Liverpool, and the South Western, South Eastern, and Eastern Counties Railways. With these and other railways at home and abroad are associated the names of Robert Stephenson, Locke, Brunel, Berkley, Errington, Vignoles, Bell, Hawkshaw, and Brassey. On some of the lines were works of great magnitude. Of the early bridges the most remarkable was the Britannia Bridge over the Menai Straits. Its originality, its great length, its height, and the audacity and skill displayed in raising the immense spans to the top of the towers created as much interest in the public mind as the building of the *Great Eastern* in the next decade. Robert Stephenson and Fairbairn were the engineers of the bridge, and for Fairbairn, Hodgkinson carried out his important inquiries on the strength of iron structures. The Britannia Bridge was opened in 1850. Five years later a railway bridge was thrown across Niagara by Roebling, and the year 1859 saw the opening of the Victoria Bridge over the St. Lawrence, of Lohse's bridge across the Rhine at Cologne, and of Brunel's bridge over the Tamar. These bridges, of course, were all built of iron, but with the steel age came even more remarkable structures, such as the Forth Bridge, containing sufficient steel to build two battleships, and the Victoria Bridge over the Zambezi River, high enough to overleap St. Paul's.

Less spectacular than bridge-building, but of equal importance in the development of railways, has been the art of tunnelling. The first railway tunnel was that on the Canterbury and Whitstable line. The elder Brunel's Thames tunnel, begun in 1824, was not a railway tunnel, but it led to the invention of the shield, which, improved by Greathead, has been used for all our tube railways. But the romance of tunnelling centres around the Alps. First came the Mont Cenis Tunnel, then the St. Gothard, then the Arlberg, the Simplon, and the Lötschberg. These have a combined length of 46 miles. It was in the Mont Cenis Tunnel, begun in 1857 and finished in 1871, that Graddoni and Sommeiller, through Colladon the physicist, first used compressed air, and it was reading of their work which gave Westinghouse the inspiration for his brake. To the lay mind there is nothing more marvellous than the boring of long tunnels from the opposite sides of a massive mountain range, and making them meet within a few inches. The total discrepancy in the alignment of the Simplon Tunnel, 12 miles long, was only 3½ inches. Tunnelling, like all railway work, may be said in the words of Emerson, to be "girt about with a zodiac of sciences, the contributions of men who have perished to add their point of light to our sky." If men had not followed the motion of the stars, pored over the mystery of light, or studied fossil forms, the Alps would still have remained as great a barrier to the traveller as they were to the armies of Hannibal, and in commemorating the centenary of the railway we do homage alike to those who have enlarged the boundaries of knowledge and to those who have applied that knowledge to useful ends.

Current Topics and Events.

THE Committee which is to be charged with the responsibility of advising the British Government on Empire problems involving scientific investigation is to be called the Committee of Civil Research. A Treasury Minute issued on June 24 stated that it will be a Standing Committee reporting to the Cabinet, analogous in principle to the Committee of Imperial Defence. "The president of the Committee will be the Prime Minister, and the regular chairman, in the absence of the Prime Minister, will be a minister nominated by him for the purpose; the membership of the Committee will, as in the case of the Committee of Imperial Defence, consist of such persons as are summoned by the Prime Minister, or the chairman on his behalf. The Committee will be an advisory body and will have no administrative or executive functions. It will be charged with the duty of giving connected forethought from a central standpoint to the development of economic, scientific, and statistical research in relation to civil policy and administration, and it will define new areas in which inquiry would be valuable." We must confess that this announcement altogether destroys the high hopes raised by the statement made by Lord Balfour in the House of Lords on May 20. It cannot be too strongly urged that the analogy between the Research and Defence Committee has been carried too far. The expert is in the ascendancy at the Admiralty, the War Office, and the Air Ministry. He has considerable weight given to his opinions, and ministers are not infrequently forced to bow to his judgment on matters of defence. But in matters relating to scientific research in connexion with State departments, this is not the case. The permanent administrative officers in charge of departments are those to whom reference is made, and they determine whose and what advice is to be followed. Until more information is forthcoming regarding the new Committee, we hesitate to pass final judgment upon it. For the moment, however, it appears to us that the administrator has triumphed not only at the expense of the scientific worker, but also at that of the Empire as a whole.

IN the course of his reply in the House of Commons on June 29 to a motion of censure on the Government for its handling of the problem of industrial depression and unemployment in Great Britain, the Prime Minister, Mr. Baldwin, made some noteworthy remarks on the relation of scientific research to industry. "No one," he said, "will assert that British industry can be saved by science alone, but . . . until scientific methods and scientific men can take their place in industry, and an equal place with the administrator and the financier, British trade will never be strong enough or resilient enough . . . to meet the sudden and unexpected changes which will always arise in international trade." Mr. Baldwin thinks that "the present situation in industry will cause our people more and more to turn their minds to what scientific research and scientific management can do." Speaking of expenditure on research, he stated that "the electrical industry to-day is spending a quarter of a million a year on research—an impressive figure for this country—but there is one company in the United States of America that is now spending 9,000,000 dollars a year and has 3000 trained workers in its research laboratories, and is going to increase that number to 5000, and there is no doubt that victory in the long run will go to the nation which can harness most efficiently and more securely science to its industry." He also referred to Government expenditure through the Department of Scientific and Industrial Research, and to the twenty-four industrial research associations now in being, in order to "show how I regard it as vitally important to link up science with our industries to-day and to say that the Government will always consider in what way they can best help in the attainment of this great object."

THE problem of low temperature carbonisation of coal received special mention in Mr. Baldwin's speech. The present position, according to Mr. Baldwin, is that "research has been going on at the Government station and by various processes in private hands, several of which have reached remarkable results so far as the laboratory is concerned. The time has not come yet when a commercial process has been successfully devised." He stated that he is convinced that "what has been proved successful in the laboratory will be proved successful commercially. . . . If the results of the new experiments at East Greenwich justify it, the Government will certainly consider the question whether they might not erect a plant upon a commercial scale to help in the development of this scheme."

THE third triennial conference of the International Astronomical Union is to be held at Cambridge during the week July 14–22 under the presidency of Prof. W. W. Campbell, formerly director of the Lick Observatory, and now president of the University of California. The meetings will commence with an inaugural ceremony at the Senate House of the University, when it is hoped that the Earl of Balfour, Chancellor of the University, will welcome the conference. The work of the Union is necessarily largely done at the meetings of its many committees, but the General Assembly will meet on four mornings for general business and for the ratification or modification of the reports of the committees. Among visitors from abroad who are expected to be present at the Conference we may mention Prof. Baillaud, M. le Comte de la Baume Pluvinel, Prof. Bigourdan, and General Ferrié from France; Miss Cannon, Prof. E. W. Brown, Prof. S. A. Mitchell, Capt. Pollock, Dr. St. John, Prof. Schlesinger, Prof. Shapley, and Dr. van Maanen from the United States; Prof. Cerulli and Prof. Abetti from Italy; Prof. W. de Sitter, Prof. Hertzsprung, Prof. Nijland, Prof. van Rhijn, and Prof. Zeeman from Holland; Prof. Chant, Dr. Henroteau, Prof. J. C. McLennan and Dr. J. S.

Plaskett from Canada; with Dr. H. Spencer Jones and Senator A. W. Roberts from South Africa; Dr. Comas Sola and Prof. Herrero from Spain; Prof. Nagaoka from Japan; Prof. Zeipel and Dr. Lundmark from Sweden; Prof. Stroobant from Belgium; Prof. Voûte from Java, and Prof. Wolfer from Switzerland. The tale is far from complete, but it is clear that Prof. Fowler, the secretary of the Union, may look forward confidently to a successful gathering and to much useful work being done.

WE have received from Prof. E. H. L. Schwarz, of Rhodes University College, Grahamstown, a letter claiming the recent age of the Taungs skull, on the ground that the change in geographical conditions at the locality may be of modern date, in accordance with his view that the climate of South Africa has undergone a great desiccation in the course of the past century. He therefore considers that forests suitable for great apes may have survived near Taungs until recently. Prof. Schwarz adds: "The Taungs skull was associated with a large number of brain casts of young baboons. Mr. F. Y. FitzSimons informs me that the cave-dwellers of the Zitzikamma used to eat young baboons; the rock shelters are full of bones, but the skulls are all intact, showing that the men did not fancy eating the brains. It is probable, therefore, that the young Australopithecus, whose remains have been preserved to us, had been caught as prey by a man of the period. What nature of a man was he? When the bone breccia of Broken Hill, Rhodesia, was first discovered, some very distinctive stone implements were found in it; it was only long afterwards that the skull of Rhodesian man was found in the same deposit. The artefacts are made of clear vein quartz, and are of quite a different type from all other South African ones. I had previously obtained them from the Great Brak River, Mossel Bay, while we have almost identical ones in the Albany Museum, from the Bezuidenhouts River, Johannesburg. The Rhodesian race was, therefore, widely distributed throughout South Africa, so the man who snared the young Australopithecus probably belonged to it."

A SCHEME for a very large transmission network for electric power in the eastern part of the United States will probably come into operation in the immediate future. It will link together Washington, Baltimore, Philadelphia, New York and Boston with two of the principal coal-fields in America and with a hydro-electric station obtaining power from the St. Lawrence Rapids. Many small water power plants in the mountains of New York State will also be linked with the network. As the St. Lawrence Rapids are about 300 miles away from the centre of distribution, it is proposed to use the very high pressure of 300,000 volts. As 220,000 volts are already used in California, the American engineers do not anticipate any difficulty. To diminish the inductance of the transmission lines and to prevent brush discharges, several aluminium conductors in parallel will be used instead of one copper conductor. The very large steam plants in New York, Philadelphia, and Boston, all of which obtain their coal by water transport, will supplement the steam power plants in the mine fields and the hydro-electric plants. Luckily abundant feed water is obtainable near the mine fields. The hydro-electric plants will run at full load continuously, the steam plants only being used when the demand exceeds the capacity of all the hydro-electric plants. All manner of labour-saving devices and apparatus for increasing the efficiency can be employed in very large power stations. It is estimated that when this scheme is put into operation, it will save millions of tons of coal per annum, as well as greatly increase the total power available.

ON June 25 the Johnston-Lavis Geophysical Collection, bequeathed to University College, London, under the will of the late Dr. Henry Johnston-Lavis, formerly professor of vulcanology in the University of Naples, was formally thrown open to the public by Sir Henry Miers. The collection contains a complete and unique series of specimens, maps, books, lantern- and microscope-slides illustrative of South American vulcanology since historic times, as well as collections of rocks and minerals from other parts of the world. The collection of Vesuvian minerals, in particular, is probably the finest in the world, and contains most of the species listed by Zambonini in his "Mineralogia Vesuviana." Of particular importance are the large number of specimens of the rare minerals aphthitalite, nocerite, and chlormanganokalite, the latter mineral being discovered by Dr. Johnston-Lavis himself in the eruption of 1906, and afterwards described by him and L. J. Spencer. The crystals of aphthitalite and idocrase described by France are also in the collection. There is, in addition to the Vesuvian and other minerals, a small but very fine collection of ores from the lead-zinc mines of Laurium, Greece, the smithsonites, aragonites, and aurichalcites deserving special mention. There is a large hanging geological map of Vesuvius, prepared by Dr. Johnston-Lavis, showing the distribution of all the lavas since historic times; and a large collection of guasches, coloured prints, engravings, etc., of past eruptions, and a unique library of vulcanological literature dating from 1508. The collection, which is temporarily housed on the two upper floors at 134 Gower Street, is available to the public for purposes of inspection or research on application to the office at University College, Gower Street, London, W.C.1.

THE American Ambassador, Mr. Alanson B. Houghton, unveiled a tablet in the library of the Royal Aeronautical Society on June 29 to the memory of the British and Americans who lost their lives in the wreck of the R. 38 on August 24, 1921. It will be recalled that the airship was built originally for the British Navy, but, on the decision being taken to abandon experimenting with airships, was sold to the United States. It was undertaking a flight carrying a mixed crew of Royal Air Force and United States Navy men together with some of the scientific staff of the National Physical Laboratory, when it broke its back and came down in the Humber.

only four of the crew being saved. Prof. L. Bairstow, in thanking the American Ambassador for performing the unveiling ceremony, stated that the failure of R 38 was a great misfortune to airship development. In his opinion, the airship would bring many achievements, which at present would be regarded as remarkable, within human range; for example, 24 hours from the limits of civilisation to the North Pole or 100 hours from London to India. He also referred to the development of methods of handling airships, and in conclusion stated that, as representing British scientific aeronautics, he hoped that progress would be based on knowledge—that is, research—as part of the tribute which the nations owed to those who had gone before.

SIR GEORGE A. WILLS, Bart., who with his brother the late Mr. H. H. Wills provided means for the erection of the new University buildings recently opened in Bristol by His Majesty the King, has promised a sum of 75,000*l.* for the extension of the Museum and Art Gallery buildings erected in 1904 by his cousin the late Lord Winterstoke. By this gift the exhibition space of the Museum and Art Gallery will be more than doubled, and a much needed opportunity provided of relieving the congestion in all departments which has become very marked during the last few years. The new buildings will be a backward extension of the present Art Gallery and Museum buildings and adjoining the new building of the University, with which they will be in communication. The site area is about 1860 square yards and will allow of the provision of store buildings and staff rooms. It is hoped the work will be completed in two years.

FURTHER details of his Arctic flight are given by Capt. R. Amundsen in his full story published in the *Times* on June 23. The position where he descended in order to take observations, and from which he afterwards returned, is now given as lat. 87° 43′ 2″ N., long. 10° 19′ 5″ W. While searching for a landing-place among the floes, Capt. Amundsen had been a little farther north. The two machines descended at some little distance apart. One was abandoned, the crew falling back with some difficulty on the other aeroplane, which was freed from the grip of the ice after long efforts. The chief difficulty then to be faced was the provision of a level run for starting. The rapid drift and continual screwing of the pack for a time destroyed all attempts. At length a track 1800 feet long and 36 feet wide was completed, and by reducing the load to 4180 lb. the explorers contrived to get a start. Then all went well until in close proximity to Spitsbergen they were forced to make a brief halt on the surface of a rough sea before reaching North Cape safely. Capt. Amundsen's full account of his journey reveals no scientific results of importance, and none was anticipated.

ON Friday, June 26, a meeting was held at Dorchester House, Park Lane, by the kind invitation of Sir George and Lady Holford, when Dr. G. Claridge Druce was presented with a book plate, the gift of 250 friends and members of the Botanical and Exchange Club. The presentation was made by Viscount Grey of Fallodon, who referred in his brief address to Dr. Druce's great botanical knowledge, and dwelt on the kindness which he has shown in putting that knowledge freely at the disposal of others, and his power of inspiring interest while imparting it. Dr. Druce replied, and expressed his thanks for the gift, and his pleasure that it should have been given by Lord Grey, whose love of Nature is so well known. He spoke of the work of the Botanical and Exchange Club, and referred also to the discoveries which have been made by the members in recent years and to the measures which are being taken to prevent the extermination of rare British plants. Dr. Scott then moved a vote of thanks to Sir George and Lady Holford for allowing the meeting to be held in their beautiful house. About eighty of the subscribers were present at the meeting.

IT was interesting to note at the close of the War that the Constantinople Museum, thanks in great measure to its Director, Halil Bey, showed less sign of disintegration than many other departments of public life. Nor was it long before its archæological activities were resumed, and useful work, if not on a very extended scale, was done. The Constantinople correspondent of the *Times* in the issue of June 25 describes excavations now being carried on by the authorities at Kadikeuy—the ancient Chalcedon. The foundations of a building about 90 feet long and built of big blocks, many roughly cut, have been brought to light. A fragment of stone containing a cross and surrounded by moulding suggests that the building probably was Christian, and may have been the famous church of St. Euphemia in which the Great Council was held in the year 451. Other signs of an active interest in archæology among the Turks are to be noted, especially the excavation of tumuli in Angora, the institution of a new branch of the Museum for Assyrian and Hittite monuments, and a new museum for objects of Turkish culture, as well as the projected formation of an ethnographical museum under Halil Bey and Jelal Essad.

SIR RONALD ROSS will open the new building of the British Mosquito Control Institute at Hayling Island, Hants, on Monday, August 31, when a party of members of the Section of Zoology of the British Association, which will then be in session at Southampton, will visit the Institute. The building has been designed to carry on work relating to the study and control of British mosquitoes, which was begun at Hayling Island in 1920 by Mr. J. F. Marshall and a local committee, and has resulted practically in ridding the Island of what was once an intolerable nuisance. The chief offender was found to be the salt-water mosquito *Ochlerotatus detritus*, which breeds in intertidal areas and is common at many seaside watering-places. Before any anti-mosquito measures can be carried out successfully, it is necessary to identify the chief species prevailing in a district, and as the work at Hayling has become known numerous specimens have been sent there for identification and for advice as to the best methods of dealing

with them. It seemed desirable, therefore, to provide a special building to deal with what has grown from a local to a national organisation, and this building, which will contain a demonstration museum, laboratory, drawing-office, photographic room, and other facilities for instruction and research on British mosquitoes and anti-mosquito measures, will shortly be completed. Among the distinguished entomologists and other naturalists who have consented to serve as members of the Council of the Institute are Major E. E. Austen, Dr. Andrew Balfour, Sir James Crichton-Browne, Col. S. P. James, Prof. H. Maxwell-Lefroy, Dr. G. A. K. Marshall, Prof. E. B. Poulton, Sir Arthur Shipley, and Sir William Simpson.

IN pursuance of the policy already announced, by which the functions of scientific research and technical development, which were formerly combined in one directorate, have been divided between two directorates, both under the supervision of the Air Member for Supply and Research, Sir Samuel Hoare, Secretary of State for Air, has appointed Mr. H. E. Wimperis to be Director of Scientific Research, and Mr. D. R. Pye to be Deputy-Director of Scientific Research under the Air Ministry. Mr. Wimperis has been acting provisionally for some time as Director of Scientific Research. He received his engineering training at the Imperial College of Science, London, and at Cambridge. After several years with important engineering organisations he joined the engineering staff of the Crown Agents for the Colonies, and on the outbreak of war began his intimate association with aeronautics, undertaking experimental work both for the Royal Naval Air Service and the Royal Flying Corps, particularly with regard to navigational and armament devices. He became, on its inception in 1915, head of the Royal Naval Air Service, now the Air Ministry, Laboratory at the Imperial College of Science and has held that position continuously since. He is the author of several works dealing with the internal combustion engine and air navigation and of a number of scientific and technical papers. Mr. Pye is a fellow of Trinity College, Cambridge, and is at present lecturer in engineering at the College. He was trained at Cambridge, afterwards becoming chief assistant to Prof. Jenkin, who was in charge of engineering studies at the University of Oxford. During the War he joined the Royal Flying Corps, and was posted for duty as an experimental officer; later he served at the Air Ministry, acting as scientific assistant to Colonel H. T. Tizard, Deputy-Controller of the Technical Department. Since then he has been working at Cambridge, and has carried out research work in relation to aero engines.

A SEVERE earthquake is reported to have occurred on June 27 on the coast of California. Santa Barbara seems to have been most affected, and according to an account by the New York correspondent of the *Times*, the main street has been broken up and many of the buildings of the city destroyed. The High School, the County Hospital and the Arlington Hotel are referred to in particular as badly damaged. A seismic wave is stated to have flooded low-lying land along the coast. Twelve deaths have been reported. Shocks were also felt in Butte, Anaconda, Great Falls and Billings.

IN connexion with the 250th anniversary of the founding of the Royal Observatory, Greenwich, and to meet the delegates to the International Astronomical Union, the Royal Society is holding a conversazione on Thursday, July 23, at 9 o'clock.

PROF. BOHUSLAV BRAUNER, Director of the Chemical Institute of the Charles University of Prague, has been elected an honorary member of the Russian Physico-Chemical Society, Leningrad.

COMMEMORATION DAY at Livingstone College, Leyton, was held on June 10. There was a good gathering of old students and others under the chairmanship of Dr. Andrew Balfour, who delivered an address. Dr. Tom Jays, the Principal, reviewed the work of the College during the past year and appealed for further funds, 800*l.* being needed to close the financial year without deficit.

A PARTY will leave London on July 31 for a holiday, lasting fifteen days, and for field work in geography, geology, botany, and regional survey in the Vale of Chamonix and on the slopes of Mont Blanc. This area is classic ground. The members of the party will go over some of the ground covered by the pioneer workers H. B. de Saussure, Forbes, Tyndall, Vallot, and Ruskin, and attempt to continue their investigations. Particulars of the arrangements may be obtained by sending a stamped, addressed envelope to Mr. Valentine Davis, Cheshire Training College, Crewe.

MR. P. MORLEY HORDER has been appointed architect for the permanent buildings of the London School of Hygiene and Tropical Medicine to be erected on the site adjoining Keppel Street, Gower Street and Malet Street, near the British Museum. It will be remembered that the funds for the erection of the new building are being provided by the Trustees of the Rockefeller Foundation, who offered the British Government the munificent gift of nearly half a million sterling for site, building and equipment.

THE Jerusalem correspondent of the *Times* states in a dispatch which appears in the issue of June 19 that Mr. Turville Petre, in the course of excavations by students of the British School of Archæology, has discovered the front part of a human skull of Neanderthal type in a cave near Tabzha, to the north of Tiberias. It is said to show the marked characteristics of the type in the highly developed supra-orbital ridges, the receding forehead, and the thickness of the bone. The cave in which it was found is below well-defined historical levels and contains, under a layer of fallen roof stones, a six feet couch of soil rich in Mousterian implements.

WRITING from Finsbury Technical College, London, E.C.2, Mr. H. M. Atkinson informs us that while cycling on June 21 from Norwich to Cambridge, he counted more than sixty dead birds on the road, including wrens, starlings, sparrows, finches and

(?) hawk, together with several small rodents. Mr. Atkinson noted that birds rose and flew across the road at his approach but were able easily to avoid the bicycle. Apparently they are not so successful in avoiding motor-cars. Mr. Atkinson suggests that head-lights at night, or the polished, tarred road-surface itself during the day time, may have proved the attraction bringing the animals to the road, where they readily fall victims to fast traffic.

THE course of lectures delivered by Mr. W. A. F. Balfour-Browne to a juvenile audience at the Royal Institution last Christmas is to be published by the Cambridge University Press under the title of "Concerning the Habits of Insects." The same house will also issue Sir J. J. Thomson's Fison Memorial Lecture on "The Structure of Light." It is expected to be ready in July.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in the department of civil engineering, architecture, and building in the Bradford Technical College—The Principal (July 8). An assistant pathologist to the Jessop Hospital for Women and the Children's Hospital, Sheffield, and demonstrator of pathology in Sheffield University—The Registrar of the University (July 11). A senior research assistant at the Building Research Station of the Department of Scientific and Industrial Research—The Secretary, 16 Old Queen Street, S.W.1 (July 20). Two probationer naturalists (one with special qualifications in mathematics and a knowledge of biometry and statistics, and one with natural history qualifications, preferably with subsidiary physiology) under the Fishery Board for Scotland—The Fishery Board for Scotland, Edinburgh (July 31). Temporary assistant chemists in the Government Laboratory—The Government Chemist, Clement's Inn Passage, W.C.2 (July 31). The professorship of anatomy in University College, Dundee—The Secretary and Registrar, University, St. Andrews (August 1). The William Prescott chair of the care of animals—causation and prevention of disease—in the University of Liverpool—The Registrar (September 15). A lecturer on tropical hygiene at the London School of Hygiene and Tropical Medicine—The Secretary, 23 Endsleigh Gardens, N.W.1. Head of the commerce department of the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth. A physical laboratory steward at the Woolwich Polytechnic—The Principal. A woman teacher of physiology at the Chelsea Polytechnic—The Secretary, Chelsea Polytechnic, S.W.3. A technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for work in connexion with photography, with special application to aerial photography—The Superintendent (quoting A. 76). A junior technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for experimental work in aerodynamics—The Superintendent (quoting A. 75). A junior technical assistant at the Royal Aircraft Establishment, South Farnborough, Hants, for general physical work in connexion with instruments—The Superintendent (quoting A. 66).

Our Astronomical Column.

NOVA PICTORIS.—A letter from Mr. H. E. Wood, of Johannesburg, contains the interesting announcement that the Nova has been identified with a star of magnitude 11·0, on the C.P.D. photographic scale, which appears on photographs taken with the Franklin-Adams Star Camera on March 17, 1914, March 18, 1914, February 10, 1921.

Its brightness before the outburst is slightly less than that of Nova Aquilæ 1918, and considerably less than that of T Coronæ.

The position for 1925·0 is R.A. $6^h\ 34^m\ 57^s{\cdot}2$, S. Decl. 62° 34′ 33″; annual precession $+0^s{\cdot}528$, S. 3″·02. Dr. H. Spencer Jones stated at the meeting of the British Astronomical Association on June 24, that the Cape photographs of the spectrum indicated the usual bright bands, but they showed less shift than was the case with most Novæ. The bands were less conspicuous 10 days after discovery, although the magnitude had risen from 2·4 to 2·0.

COMETS.—Several observations of Tempel's comet have been obtained. Its magnitude is about 11; as it approaches both earth and sun during July it will steadily brighten, but this is offset by its southward motion.

The following ephemeris for 0^h is by M. Ebell (B.Z. 24):

	R.A.	S. Decl.	log r.	log Δ.
July 1.	$18^h\ 30^m\ 47^s$	4° 58′	0·140	9·578
9.	18 34 46	8 50	0·133	9·545
17.	18 40 27	13 40	0·127	9·522
25.	18 48 32	19 24	0·122	9·509

The comet is due south about 23^h. It is near 2 Aquilæ on July 9. This comet has the third shortest period of any known comet. Encke and Skjellerup (1922 I) come at the head of the list.

Mr. J. Larink has deduced a new orbit of Schorr's Comet (1918 III).

$T = 1918$ Sept. 28·603 G.M.T.
$\omega = 278°\ 38'\ 47''$
$\Omega = 118\ \ 0\ \ 33$
$i = 5\ \ 35\ \ 2$
$\phi = 28\ \ 5\ \ 1$

Period, 6·7071 years.

Mr. Larink finds 1925 May 27·90 G.M.T. (new) for the recent perihelion and gives the following search ephemeris:

	R.A.	N. Decl.	log r.	log Δ.
July 17.	$5^h\ 12^m\ 48^s$	19° 38′	0·274	0·418
21.	5 22 54	19 51	0·276	0·416
25.	5 33 0	20 1	0·278	0·413
29.	5 42 54	20 9	0·280	0·411

The comet was observed in 1918 more than three months after perihelion, so its detection this year is not hopeless, though the conditions are less favourable. Since it was discovered at Bergedorf, the astronomers of that observatory (to which Mr. Larink belongs) are making special efforts to recover it.

Research Items.

STONEHENGE.—The excavations in progress at Stonehenge have now covered the greater part of the site, only the north-western area awaiting examination. The sixth report on the results, which was presented by Col. Hawley on behalf of Mr. Newall and himself at a recent meeting of the Society of Antiquaries, deals with the south and south-west area. No objects of any importance were turned up; but a number of holes, some shallow, others reaching to a depth of 28 inches and ranging in width from 15 to 23 inches, were found. These pointed to the possible existence of a stockaded passage or long roofed building at this point, and it is conjectured that they were contemporary with the causeway at the main entrance, where similar post holes have been found. Nothing of the Stonehenge period had penetrated to the lower levels. Another causeway with pits in the ditch on each side of it was exposed. Seventy-one holes in all were discovered; but it is impossible to say what their use may have been, though they were too irregularly placed and too widely spaced to have formed a building. Further investigation has shown that the area of foreign stones must have held a much larger number than had hitherto been supposed, and they must have presented the appearance of a low wall. The discovery of a seventeenth-century glass flagon suggested that the removal of these stones had been comparatively recent.

UNITS OF MEASUREMENT IN ANCIENT EGYPT.—In *Ancient Egypt* for June, Sir Flinders Petrie puts forward and discusses a suggestion by Mr. J. Tarrell to account for the fact that the varying thicknesses of the courses of the great Pyramid tend to group around certain heights. The courses a dozen times or more start with a thick course, and dwindle until a thick course occurs again. An enormous number of blocks must have accumulated in the years of preparation. When the masons were ready to build, they shifted the quarrymen to another quarry and started sorting the blocks for each course according to size. This process was repeated from time to time, each thick course representing the beginning of a supply from a fresh source. The variations in thickness suggest the use of the cubit and double cubit, 20·6 and 41·2 inches, as the unit of a great number of the blocks, with a digit measure between, the groups being at 50, 40, 30, 32 (?), 34, 36, and 38 digits. Large exceptions point to local measures which may have survived into later times: 21·3 in. is the medieval Nilometer cubit; 22·2 in. the double foot of Syria found down to Roman times; 23·2 in. the double Roman foot, an ancient measure in Etruria; 26·3 in. the double of the northern foot (the foot of Germany and the basis of measurement in England which survives in the furlong and chain, and is important in France); 28 in. the Turkish *pik*; and 38·1 in. the Persian *arish*.

THE CRYSTALLINE STYLE.—Whereas in lamellibranchs a crystalline style is common, in gastropods it occurs in only a few genera. Mr. N. A. Mackintosh has given (*Quart. Journ. Micr. Science*, March 1925) a careful description of the style of Crepidula—the slipper limpet. The style, which is contained in a sac partially differentiated from the intestine, is a straight transparent rod of gelatinous consistency built up of co-axial layers surrounding a spiral core. It is composed chiefly of globulin and contains an amylolytic enzyme. The style and the style-sac resemble those of lamellibranchs so closely that they must be regarded as homologous in the two groups. A list of about two dozen gastropods is given in which the style is known to occur, and it is suggested that the style has been lost in all but a few gastropods, or that its appearance in this group is to be explained on the principle of orthogenesis.

GELATION AND SOLUTION IN CELLS.—In his report (Year Book No. 23) on the work of the Department of Embryology of the Carnegie Institution of Washington located in Baltimore, Dr. G. L. Streeter refers among other items to the work of Mrs. G. M. Lewis on gelation and solution in cells. When a culture of embryonic tissue is washed with a saline solution to which any of the ordinary acids has been added to give it a P_H of 4·6, the cells undergo coagulation and exhibit appearances which are regarded as characteristic of cell-death. The nucleus becomes granular and acquires a bright thick membrane; in the cytoplasm the granules cease their activity, and pseudopodia are not put out. If now, before the coagulation proceeds further, the acid solution is washed off, the cells recover their normal appearance, and such a culture if returned to the incubator may live as long and remain in as good condition as the controls; in other words the gelation is reversed. Such gelation can be brought about and reversed several times in succession. The cytoplasm can be made more fluid by means of a solution of alkalies with a P_H of 8·6 to 9. The cells, instead of remaining spread out on the cover glass, begin to round off, the mitochondria change from filaments to short rods and all the granules are in dancing movement. By bathing the cultures in normal solution the process can be to some extent reversed, but the cell never spreads out again, and such a culture does not live so long as the controls. One of the most effective acids in bringing about the gelation of living cells was that obtained from sterile dead tissue, and Dr. Streeter remarks that this fact should be of importance in explaining the toxic nature of crushed or burned tissue.

NUTRITION OF MYCORRHIZA PLANTS.—Dr. M. C. Rayner has published the results of further research on the nutrition of *Calluna vulgaris* (*Brit. Journ. Experimental Biol.*, vol. 2, January 1925, pp. 265-292). The most striking of these is the observation of regular and well-marked digestion of the mycelial constituents in the root mycorrhiza. Digestion begins soon after the production of young roots in the spring, is carried out throughout the growing season (during which mycelial activity reaches a maximum), and continues until growth ceases in the autumn. It cannot therefore be regarded as a phenomenon of senescence. The author shows that under certain conditions the roots may be infected by the fungus, but that typical mycorrhiza may not be established. By means of a special technique it is possible to find, in early spring especially, the hyphæ of invading root cells undergoing digestion before branching of the filaments can take place in the cells. This formation of suppressed mycorrhiza is regarded as highly significant, and is held by the author to explain the discordant results of previous workers. Assuming it to be correct "the formation of mycorrhiza is a reciprocal phenomenon involving co-operation on the part of the root cells" and "represents a temporary phase of toleration on the part of the plant cell interposed between one involving immediate destruction of an entering hypha and the wholesale digestion of the mycelium which eventually takes place." It is held, in consequence, that the obligate relation in Calluna is associated with fungal infection and seedling development rather than with the subsequent stage of typical mycorrhiza

formation. The cytology of digestion, the distribution of the mycelium in the shoot, experiments with cuttings, and a general discussion on the nutritive relations in Calluna are other subjects dealt with in the paper.

WATER ABSORPTION BY LEAVES.—J. G. Wood has recently directed attention (*Australian Journal of Experimental Biology and Medical Science*, Vol. 2, pp. 45-56, 1925) to the remarkable capacity for water absorption possessed by the relatively uncutinised leaves of species of Atriplex. These plants, the "salt-bushes" of Australia, are the characteristic plants over vast areas of dry plains, and as their root system is poorly developed, this power of absorbing water by means of the leaf system may be of considerable significance. It appears to be due to a remarkable accumulation of sodium chloride in the leaves of these plants. Even when growing in soil containing relatively small quantities, considerable accumulation of the salt occurs in the plant. As the result of microscopic examination of leaves placed in a solution of silver nitrate and then exposed to light, this accumulation seems to be most pronounced in the veins and in the chlorenchyma surrounding the veins.

RADIUM ORE DEPOSITS IN CENTRAL ASIA.—The presence of certain radioactive uranium minerals in Ferghana, Russian Turkestan, has been known since the beginning of this century. The centre where such deposits have been found is the Tuya-Muyun copper mine, where uranium was discovered long ago. More recently that mine has been studied extensively by several Russian mineralogists, geologists, and chemists, and since 1923 the mine has been regularly exploited. Results of the work of the expeditions recently published by the Russian Academy of Sciences show that the deposits are of great practical value as a source of radium; moreover, a study of geological conditions of the Ferghana province leads to the suggestion that radium deposits are not restricted to that mine only, but are much more widely distributed along the northern slopes of the Alai and Turkestan ranges. Further investigations are being carried on by the recently founded State Radium Institute of the Academy.

THE GEOLOGY OF SOMALILAND.—Mr. R. A. Farquharson's first report on the geology and mineral resources of British Somaliland, 53 pp., 1 map, forms a valuable contribution to the geology of East Africa. The report includes a general summary of the Somaliland sequence, which has recently been described in a monograph published by the Hunterian Museum of the University of Glasgow. To the sequence already known Mr. Farquharson's most important addition is that of a series of ancient unfossiliferous slates with interbedded limestones, for which he makes the interesting suggestion that they are the northern extension of the Karagwe Series of Kenya Colony and Uganda. The local Jurassic rocks he attributes entirely to the Kimmeridgian; but in the absence of any information as to the fossils he collected, it remains uncertain whether this identification is likely to stand, or whether he obtained them only from the upper part of the Jurassic. Mr. Farquharson's conclusions as to the age of some Kainozoic rocks do not agree in some respects with those based on the collections made by Messrs. Wyllie and Smellie, and an account of the author's fossils and his geological map will be awaited with interest. The longer section of the report includes an account of the occurrence of numerous economic minerals, some of which are regarded as promising, though nothing has been so far proved of commercial value under present conditions. In some of the specimens collected by the author, assays at the Imperial Institute record a trace of gold. The report is illustrated by a map in which, unfortunately, the place names are sometimes spelt differently from those in the text. The Las Khorai of the map is apparently Las Gori of the report. It is regrettable that a report issued at the end of April 1925 should be dated as if published in 1924.

THE PETROLOGY OF SAMOA.—Prof. R. A. Daly has written a very valuable account of the geology of Tutuila and the smaller American islands of the Samoan Group for Publication No. 340 of the Carnegie Institution of Washington. The average basalt of Tutuila is almost identical with that of Hawaii and with the average plateau basalt of the world. This close resemblance of the oceanic and continental basalts is strongly suggestive of a nearly uniform substratum below the heterogeneous crust. The alkali-trachytes and other intermediate rocks, occurring in Tutuila mainly as volcanic necks and dykes, are regarded as differentiates of ordinary basalt. The cause of the differentiation is, however, recognised to be still an unsolved problem, though the common eruptive sequence—basalt, trachyte, basalt—found in very many volcanic centres, receives a suggestive explanation. One of the domes of Tutuila is built up in part of quartz-trachyte similar to that of Ascension Island. It is remarkable as one of the rare examples of a lava in the open-Pacific area containing primary quartz, and unique in being farther removed from a visible continental border than any other case yet described. It suggests to Daly that the submerged edge of Australasia may really extend as far to the east as Samoa. The lithification of beach sands is another problem which is fully discussed. The view is adopted that the formation and distribution of the "beach rock," as the firmly cemented sand is termed, are controlled by the action of the more violent storms. These are known to pile up calcareous sands over the normal beaches, and in their new position bacterial decomposition of the organic matter associated with the displaced shelf sands tends to precipitate calcium carbonate sufficiently to fix the grains. Further precipitation from the saturated tropical sea water then completes the process of cementation. Ordinary clean beach sands are not cemented because they are kept in incessant movement by wave-action.

THE RAYLEIGH SEISMIC WAVE.—Part 5 of Vol. 2 of the *Japanese Journal of Astronomy and Geophysics* contains a memoir of 93 pages by Mr. H. Nakano of the Central Meteorological Observatory, Tokyo, on the properties of the wave propagated along the surface of the earth due to some seismic disturbance in the interior. He finds that the wave does not make its appearance at the surface at a point immediately above the focus, but at distances from that point which depend on whether the originating disturbance is of the dilatational or distortional type. Its amplitude when it first appears at the surface is small and it does not attain its full value until the wave has travelled a distance along the surface which is large compared with the depth of the focus. The retardation of phase at each point of the surface is the same as it would be if the disturbance originated at the point on the surface over the source at the instant it actually originated at the source. The author hopes by a study of the laws of propagation in a laminated earth and comparison with observations to arrive at more definite conclusions as to the structure of the interior of the earth.

SURVEYS IN TIBET.—In the annual reports of parties and officers, 1921–22, which is published as a supplementary volume to the general report of the Survey of India for that year, there is a brief record, accompanied by a map, of the late Sir H. H. Hayden's surveys in Tibet in 1922. Sir H. H. Hayden, who was accompanied by an Indian surveyor, travelled through the central and south-eastern parts of the country to report on certain mineral-bearing areas for the Tibetan government. His routes lay between Lhasa and the great lakes of Tangra, Kyaring, Ziling, and Nam. Altogether some 36,000 square miles were mapped on a quarter-inch scale, of which only some 4000 miles had been previously surveyed: the remainder was known only from rough route surveys of the native Indian explorers Kishen Singh and Nain Singh, and the tracks of the few European travellers who had previously succeeded in penetrating this region.

BINARY ALLOYS OF ANTIMONY AND BISMUTH.—The equilibrium diagram of the binary alloys of antimony and bismuth has been already studied by several investigators. The results, however, do not agree well with one another, and a re-determination of the diagram has been carried out by Otani at the Research Institute, Sendai (Report No. 91). He has determined the liquidus and solidus by measurements of electrical resistance. With regard to the former, he measured the difference in potential between two fixed points in the specimen, both in the liquid and solid states. The current passed through the specimen for the measurement of the potential fall was 1·5 amperes, and the electrodes dipped into molten alloys were iron wires about 0·8 mm. thick. The rate of heating and cooling was about 1 degree per minute. The liquidus curve is found to be smooth and convex upwards. In the case of the determination of the solidus, the alloys were tested in the form of rods 5 mm. thick and 9 cm. long. These rods were made by casting the alloys in an iron mould and afterwards annealing them just below their solidus for a sufficiently long period to obtain a homogeneous structure. This was confirmed by microscopical examination. The temperature-resistance curves obtained on heating show that the solidus also is a smooth curve, which is concave upwards. The crystallisation interval in the case of the 50 : 50 alloy is nearly 200° C. This, of course, diminishes on either side. Thus the form of the liquidus and of the solidus in this system belongs to the ordinary type of solid solution where all points of the liquidus lie between those of the pure metals.

THE CURRENTS IN SUPRACONDUCTORS.—Supplement No. 50 of Communications from the Physical Laboratory of the University of Leyden contains a report by Prof. Kamerlingh Onnes of the results of the experiments on the mutual action of the electric currents in two supraconductors in the neighbourhood of each other. In one case the two supraconductors are concentric rings of lead in liquid helium with their axes horizontal and the inner ring supported by a long vertical fibre provided with a torsion head. The currents having been produced in the rings by the diminution of a magnetic field along their axes, the inner ring is rotated about 30° out of the plane of the outer by means of the torsion head. The rotation of the inner ring is observed by means of a mirror attached to it and is found to be invariable to within less than 1 part in 1000 for 6 hours. When the inner ring is replaced by a spherical shell also of lead and the experiment repeated, the torsional couple necessary to rotate the sphere is only one-third that for the ring. The author concludes that the paths of the electrons amongst the molecules of matter are fixed and unaffected by any transverse magnetic field.

DOMESTIC GRATES.—Technological Paper No. 13 of the Fuel Research Board is an account of the investigation of the relation between the design of a domestic grate and the heat radiated by it into the room, carried out by Dr. Margaret Fishenden under the auspices of the Manchester Air Pollution Advisory Board. The measurements show conclusively that diminution of the depth of a grate from front to back increases the heat radiated into the room per pound of coal consumed. Ease of maintenance of the fire limits this diminution in most cases to a minimum of four inches. The bars of the grate should be as slender as possible, and the grate should be visible from as large an area of the floor of the room as possible. Conduction losses through the back of the grate should be minimised by the use of firebrick instead of iron. The throat of the flue should be adjustable in area so as to permit regulation of the flow of air through the room, and an adjustable air inlet beneath the fire should be provided for the regulation of the speed of combustion of the coal.

PRECIPITATION OF RADIUM SULPHATE.—Sulphate ions will precipitate radium in the presence of a large excess of barium even though the solubility product of radium sulphate is not exceeded. H. A. Doerner and W. M. Hoskins have investigated this phenomenon and publish their results in the Journal of the American Chemical Society for March. At equilibrium, the reversible reaction

$$BaSO_4 + RaCl_2 \rightleftharpoons BaCl_2 + RaSO_4,$$

gives a distribution of radium and barium represented by the equation

$$Ra^{\cdot\cdot}(\text{final}) \times Ba^{\cdot\cdot}(\text{initial}) = K \times Ra^{\cdot\cdot}(\text{initial}) \times Ba^{\cdot\cdot}(\text{final})$$

which is mathematically deduced from the principle that the radium-barium ratio of the precipitate (" crystal surface ") is proportional to the radium-barium ratio of the solution. This equation is confirmed experimentally, K, obtained by several methods, being 1·8. The equilibrium is largely influenced by crystal growth. The possible application of the theoretical equations to adsorption, fractional crystallisation, etc., is discussed.

SOLID SOLUTIONS OF WATER AND OXYGEN.—The attention of chemists so far has been centred chiefly on compounds subject to the law of multiple proportions, but, according to N. S. Kurnakov (*Annales de l'Institut d'analyse physico-chimique de l'Académie de Science de Russie*, vol. 2, liv. 2, 1924), we must admit that this type of change is merely a particular case of a more general case—the constant change of the solid phase. Attention is directed chiefly to the ferrous compounds with a variable amount of oxygen and water in such substances as mica, tourmaline, hornblende, and also phosphorus salts. For these substances, the absorption of different amounts of oxygen does not affect the structure of the crystal but creates continuous variations of colour and optical properties. The greyish-black, bluish-green, and blue colour of such substances is remarkable as being doubtlessly connected with the amount of absorbed oxygen. A very characteristic example is the mineral vivianite, which is a hydrated phosphorus oxide of iron, which may also be produced synthetically. In the early stages of their formation the crystals are nearly colourless, but become more blue as oxygen is absorbed, without changing their structure, and remaining quite homogeneous. The amount of water in vivianite crystals is also variable; the latter depends on the formation of solid solutions of water, and is very common among numerous classes of chemical compounds.

The Imperial Entomological Conference.

THE second Imperial Entomological Conference, which was summoned by the Secretary of State for the Colonies at the instance of the Imperial Bureau of Entomology, was held in London on June 9-18, and was attended by twenty-one delegates, representing the governments of most of the British Dominions and Colonies. The delegates were received by Earl Buxton, chairman of the Committee of Management of the Bureau, at Burlington House, where the meetings were held. They were also invited to a reception at the British Museum (Natural History) and to meetings of the Zoological and Linnean Societies, and were given the opportunity of visiting Oxford and Cambridge, and the Rothamsted Experiment Station and the Ministry of Agriculture's Pathological Laboratory at Harpenden.

The public meetings of the Conference occupied four days, one of which was largely devoted to the general aspects of applied entomology. Dr. G. A. K. Marshall, Director of the Bureau, read a paper on "The Aims and Organisation of Economic Entomology." After briefly reviewing the steadily increasing importance of tropical agriculture as a source of the world's food supply and raw materials, he said that the economic effect of insect pests is not fully realised. The suggestion sometimes made that crops that suffer severely from pests in a given country should be abandoned in favour of others is not feasible in the case of essential crops, and as the world's population increases, it will become more and more necessary to protect them from insect pests.

The present organisation of economic entomology is unsatisfactory. Economic entomology should be preventive, but a government entomologist, responsible for a huge area of country, cannot hope to do more than wait to be called in by planters for advice, which only happens when an outbreak of a pest is well under way, and its control has become difficult, if not impossible. What is required is that the planters should themselves employ their own entomologists, who would be continually working on the problems of their special crops, and would take steps to prevent outbreaks of pests from arising. This would effect an enormous saving, and should be regarded as a form of insurance. The Hawaiian Sugar Planters' Association affords an excellent example of how a scheme of this sort should be put into practice. The government entomologists would then be free to undertake research.

Dr. T. W. Munro gave an account of the organisation of forest entomology in England, and in the discussion that followed, the various systems of economic entomology at home and in a number of the Dominions and Colonies were described. A point strongly emphasised here, and also at the other meetings, was the diversity of problems presented, not only by the obvious differences of climate, crops and pests, but also by the great differences in the populations concerned. Thus in Egypt, where agriculture is chiefly in the hands of the illiterate classes, measures against insect pests are not only organised, but also actually carried out, with excellent results, compulsorily by the government, the growers paying the bulk of the cost; whereas, at the other end of the scale, in South Africa all that is necessary is for one of the more progressive men in a district to be shown what to do, the others being only too glad to imitate his work.

In discussing the qualifications of an economic entomologist, Mr. H. H. King pointed out that he must not only have had the necessary scientific training, but must also have personality and a knowledge of men, so as to be able to convince those with whom he has to deal that they would benefit by carrying out the measures he suggested.

Several of the meetings were devoted to pests of particular crops and other aspects of economic entomology in the various colonies, and a great deal of valuable information was interchanged; but they were, of course, of rather specialised interest. Perhaps the most important discussion of the meetings, however, particularly in view of the reports of the East Africa Commission and of the League of Nations Conference on the subject (NATURE, June 27, p. 985), was "Co-ordination of Effort in Tsetse-fly Investigations." The chair at this meeting was taken by Mr. W. Ormsby Gore, Under-Secretary of State for the Colonies. In opening the discussion, Prof. Warrington Yorke said that the problem is not purely entomological, but comprises four factors, namely, the trypanosomes concerned, the population and domestic stock, the transmitting agent or tsetse-fly, and the reservoir of the virus, or big game. An advance can only be made by taking into consideration at the same time and in the same locality all these factors. In short, he advocated centralisation of effort. Much of the scattered work at present being carried out is failing to produce satisfactory results owing to its being misdirected, to lack of continuity and to lack of funds. He thought, however, that the International Commission suggested by the Sleeping Sickness Conference that met in May under the auspices of the League of Nations was premature, and that knowledge is not yet sufficiently advanced for regulations to be formulated governing the international frontiers of tropical Africa. More is to be hoped for from an inter-colonial conference, by means of which the work of entomological, medical and veterinary research could be combined under one central organisation, supported by pooled contributions of all the colonies interested.

Mr. C. F. M. Swynnerton agreed that co-ordination between the different branches of science was very necessary, but considered that a central organisation would meet with almost insuperable difficulties. He pointed out that there are twenty species of tsetse-fly, each having its own requirements in the matter of habitat and possibly fauna, and also occurring in a variety of combinations. There are thus probably fifty different tsetse-problems in different parts of Africa. Each colony should have its own department for the subject; touch should be maintained between the colonies by mutual visits and, if possible, by a travelling director who should go from colony to colony. He described the work in Tanganyika Territory, an account of which has already been given in NATURE of March 7, p. 338, and showed how co-operation has been obtained not only among the various scientific departments, but also with the natives themselves. International and inter-colonial co-operation must be provided for, as the problems are often the same on different sides of political boundaries. He does not consider measures against game justifiable in the present state of knowledge; and even if they proved to be so, they would be very difficult in practice. He gave instances of cases in which they have actually defeated their own object.

Dr. A. Balfour agreed with the need for inter-colonial co-operation, but considered that, as the problems in the east and west of Africa are so different, and intercommunication so difficult, it might be better to have two organisations instead of the single one suggested by Prof. Yorke.

Major E. E. Austen objected to Prof. Yorke's unqualified statement that game is the reservoir of sleeping sickness. He supported the idea of an International Commission, for, in the special problems to be dealt with, political boundaries are often not natural ones. He emphasised the multiplicity of the problems presented by the various species of tsetse-fly and the consequent need for attacking them by every feasible method. Dr. A. G. Bagshawe pointed out that it is only within the last two years that we have been shown by Mr. Swynnerton that valuable land can actually be recovered from the fly. All efforts should be concentrated on making this work a success on a larger scale. Dr. G. A. K. Marshall observed that trypanosomiasis has to be dealt with on two main lines: the attack upon the disease, and the attack on the flies. A single comprehensive investigation in one place may be excellent on the medical side, but on the entomological side there are numerous problems that can only be solved by investigations in many different localities. While on the medical side further extensive research is the primary need, this is not the case on the entomological side, at least in those countries where the advance of the flies constitutes a dangerous menace. Here the primary need is for an immediate direct attack upon the flies by methods similar to those so successfully employed by Mr. Swynnerton, accompanied by appropriate research. One great difficulty in the past has been procuring the necessary funds; and the reclamation of valuable land by a direct attack on the fly is more likely to appeal to the governments and commercial interests concerned than any programme of purely scientific research.

The chairman supported the idea of an International Commission as proposed by the League of Nations Conference, not only from the scientific point of view, but also from that of educating the general public and the administrators. Money is essential and public interest must be directed to the economics of the problem. From this point of view the veterinary side is of enormous importance. A scheme that suggests the killing of big game when the smaller animals would remain is contrary to common sense but a practical policy, such as that of Mr. Swynnerton, should obtain public support.

Before the Conference ended resolutions were passed recommending, among other things, that a similar conference should be held in London every five years; that meetings of entomologists and other scientific officers should be held in the Dominions and Colonies for the discussion of mutual problems; and that the work of the Imperial Bureau of Entomology should continue on the present lines and be somewhat extended in connexion with the export to Overseas Governments of beneficial parasites.

The Conference concluded with a dinner given by the Government in honour of the delegates, at which Mr. L. C. M. S. Amery, Secretary of State for the Colonies, presided.

Photographic Studies of Solar Prominences.[1]

THE invention of the spectroheliograph, more than thirty years ago, made it possible to study in detail photographs of the prominences, those strange and beautiful forms rising from the chromosphere which were first made familiar to readers of NATURE by the drawings of Lockyer in the 'seventies. Systematic photographic work does not appear to have been initiated until it was taken up at Kodaikanal in 1905, and the Rumford spectroheliograph appears also to have begun recording prominences at about this period; but until recent years very little has been published regarding their movements. This is no doubt largely due to difficulties imposed by atmospheric conditions, for it is very rarely possible to secure a series of photographs of the same prominence at short intervals of time and with equally good definition in all the images. In the memoir under notice this is apparent in the statement that in about 4000 plates examined "very little material suitable for the study of the motions of prominences was found." We must congratulate Mr. Pettit on the very interesting results he has nevertheless extracted.

The work relates very largely to the eruptive prominences, which are defined as "those which rise from the chromosphere in a more or less vertical direction, and are dissipated in space at enormous altitudes." It had already been shown by observers of eruptions that the velocity of ascent increases with the height, and photographs of prominences of this class obtained at Kodaikanal and in Kashmir appeared to show a continuously accelerating velocity, indicating a force of repulsion from the sun, analogous to that which gives an accelerating velocity to the gases in comets' tails. The author, however, from a careful study of the great prominence of May 29, 1919, considers that the force in this case was discontinuous, the outward velocity increasing by a series of sudden impulses, between which the motion was uniform. Other prominences observed later also displayed this very remarkable characteristic, and Mr. Pettit was led to examine all recorded observations of eruptive prominences, visual and photographic. The results are set out in 24 diagrams, giving the heights as ordinates and times as abscissæ. The evidence thus presented appears strongly favourable to the principle of uniform motion and sudden impulses, for many of the diagrams indicate this very clearly although others, *e.g.* No. 22, would seem to indicate a continuous acceleration. Of three cases which come within the knowledge of the writer of the notice, two decidedly favour continuous acceleration. These are numbered 8 and 9 in Fig. 3. In No. 8 there is an error in the height given at 9 h., which should be 110,000 instead of 130,000 km. By substituting this height in the diagram, it appears that a continuous curve would better fit the observations than that shown. In the case of the prominence of May 26, 1916 (Fig. 3, No. 9), measures of the negatives published in Kodaikanal Observatory Bulletins III., 215, are not used in the plot, but instead a set of measures from half-tone prints. Had the original measures been used, a continuous curve would have resulted. Evidence in favour of uniform motion is admitted in the case of No. 2, which was photographed at Kodaikanal, but here the time interval is short, and no change of velocity is indicated from three observations of the height.

Obviously this question of the character of the motion is of the greatest interest and significance, and it will no doubt be exhaustively studied in future eruptions.

The material supplied by the Rumford spectroheliograph has enabled Mr. Pettit to study successfully both lateral and internal motions of prominences. Lateral motions are defined as "the motion of prominences which rise from the sun's surface and, passing over a trajectory, generally re-enter the chromosphere." A very curious example is recorded

[1] "The Forms and Motions of the Solar Prominences." By Edison Pettit. Publications of the Yerkes Observatory, vol. 3, part 4, University of Chicago Press.

in which this trajectory appears as a circle of radius 73,500 km., and the motion along the circumference increases from 5 to 95 km./sec.

The tendency of prominences to form long horizontal streamers connecting one with another, or curving down towards the chromosphere, is familiar to all who have observed these objects. Mr. Pettit has found that motion takes place along these narrow filaments, which represent, therefore, stream-lines of luminous gas, and these lines often appear to converge towards "centres of attraction" in the chromosphere. The large prominence of May 29, 1919, afforded rich

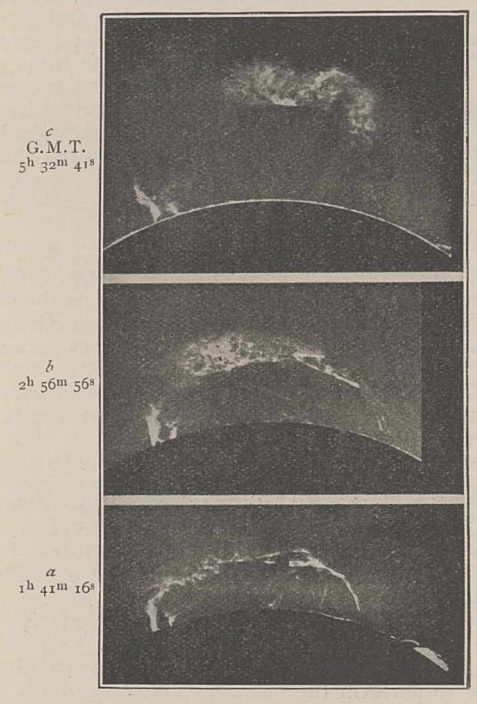

FIG. 1.—The great prominence of May 29, 1919.
Scale: *a*. 1 mm. = 18,652 km.; *b* and *c*. 1 mm. = 16,832 km.
From "The Forms and Motions of the Solar Prominences."

materials for a detailed study of these movements. One of the illustrations is here reproduced (Fig. 1).

As regards the supposed attraction of sunspots for prominences, Mr. Pettit finds many examples of knots in streamers, or the streamers themselves, moving inwards towards a spot-region, and a few in the reverse direction. Previous observations at Kodaikanal showed a predominance of outward movements.[2] That these filaments or knots actually enter the umbræ of spots remains uncertain, and no case is recorded of an entire prominence being thus swallowed up. The streamers of the great prominence of May 1919, although they converge towards a sunspot, would appear to fall short of it by about 4° of latitude (Fig. 7), and at a later stage (Fig. 8) they seem to be repelled from the spot. Other "centres of attraction" for prominence streamers are shown to exist in regions remote from spots, and there is evidence that this attraction is felt far out into the coronal region.

The question whether gravity plays a part in the descent of matter in the streamers is investigated,

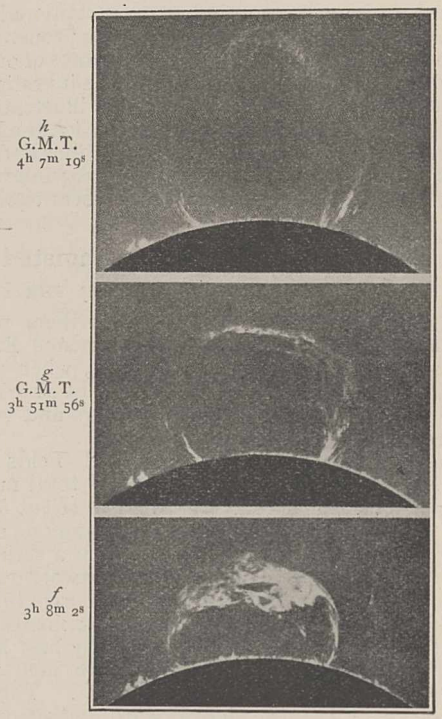

FIG. 2.—The prominence of July 15, 1919.
Scale: 1 mm. = 19,144 km.
From "The Forms and Motions of the Solar Prominences."

and it is found that, in general, velocities are in the neighbourhood of one-third to one-fourth of that which gravity ought to give them. The velocity of ascent in the eruptive prominences seldom exceeds 400 km./sec., although line-displacements have been recorded which indicate much higher speeds.

The memoir concludes with a theoretical discussion of the nature of the repulsive force acting on prominences. Radiation pressure is rejected as inadequate, and the periodic ejection of showers of electrons from a disturbed area in the photosphere is suggested tentatively. J. EVERSHED.

[2] Monthly Notices of the Royal Astronomical Society, 73, 422.

Industrial Fatigue.

THE fifth annual Report of the Industrial Fatigue Research Board (H.M. Stationery Office, Price 1*s*. 9*d*.) has recently been issued. Its contents are nearly equally divided between six articles contributed by the Board's principal investigators and the report proper describing the Board's activities during 1924. Perhaps the most striking development in that period has been in the direction of the increasing laboratory research work, now conducted for the Board in the Universities of Oxford, Cambridge, London, Glasgow, and Manchester, and concerned with accuracy of movement, muscular skill, repetitive work, weight-carrying, dynamic and static muscular effort, rest pauses, etc. The human factors relevant to accident causation, ventilation, illumination, and the like are also being studied. Research into vocational guidance has been undertaken in collaboration with the National Institute of Industrial Psychology, and into the design of machinery in conjunction with the Department of Scientific and Industrial Research. Three reports of specific investigations were published by the Board during 1924,

dealing with rest pauses, repetitive work, and posture; and two other reports have been issued, one presenting a synopsis of the results of the Board's previous investigations in various industries, and the other describing the uses and limitations of statistical methods in such research.

Those who are unacquainted with these and with the twenty-four earlier reports of the Board will obtain an excellent idea of the Board's invaluable work by a study of this annual report. The special contributions by Mr. Wyatt, Miss May Smith, Mr. Farmer, Miss Newbold, Dr. Vernon, and Mr. Weston concern learning curves in industry, exceptional work curves, differential tests in relation to proneness to accidents, sickness statistics, the significance of output, and the value of personal evidence in the investigation of industrial efficiency. These well illustrate the various problems and difficulties with which the Board is confronted. The numerous investigations and committees of the Board, and the extremely interesting and lucid language of the annual report, bear testimony to the devotion, ability, and organising power of its secretary, Mr. D. R. Wilson.

The survey, with which the Report concludes, of the past activities and of the present position of the Board is especially noteworthy. Stress is there laid on the fact that such indications "as emerge from the investigations undertaken by the Board and the National Institute of Industrial Psychology are surely worthy of serious attention on the part of industry, if only for the reason that, from the very method of their assessment, strong evidence exists that they will benefit the employer no less than the workman." It is surely lamentable, then, to read on pp. 16 and 17 of the Report that the Jute Spinners and Manufacturers' Association recently declined "to participate in any inquiry or even to afford facilities for a preliminary survey" by the Board in that industry, although the Board had been expressly invited by the Jute Trade Board to undertake an investigation into the effects of fatigue, and the workers desired that it should be carried out.

Rothamsted Experimental Station.

Opening of the Plant-Pathology Laboratories.

THE annual meeting of the subscribers to the Society for extending the Rothamsted Experiments was held on Thursday, June 18, when at the invitation of Lord Clinton, chairman of the Lawes Agricultural Trust, about sixty members and visitors attended.

In the morning the experimental fields were inspected. As for some years past the total number of plots has exceeded 500, it is usual to select for the annual inspection a limited set illustrating one or two special points. On the present occasion a series was chosen to illustrate certain contrasts between modern and early methods of planning field experiments. Lawes' and Gilbert's early field experiments were laid out on the parallel strip system, the best known example being the classical Broadbalk field which has grown wheat every year since 1843. The strip system was simple and straightforward, and adequately showed up the large differences in yield between the various manurial dressings, especially when the experiment was repeated over a large number of years to eliminate the variable effect of season. The next stage was the "chess-board" plan in which the parallel strips of plots receiving different manures were crossed at right angles by strips of other manures. This method was adopted in the Hoos field permanent barley experiments commenced in 1852, and the arrangement permits of a greater number of comparisons between given manures, alone, and in various combinations.

Many of the broad generalisations, now an integral part of farming practice, were developed from the Broadbalk and Hoos experiments. These two fields are still giving exceedingly valuable information, but they are not suitably arranged to provide definite answers to many modern problems, in the majority of which the maximum difference expected between control and treated plots is a few bushels of corn or hundredweights of roots. It therefore becomes essential to reduce the experimental error as much as possible. The first step is to have a considerable number of small plots under each treatment, and to harvest each plot separately. Further, in order to allow for the inherent variation of fertility in the land, the results are examined by statistical methods devised specially for this purpose. It is an essential condition of such an examination that the plots should be distributed not systematically but at random. From the viewpoint of visitors this complicated system is perhaps not so striking as the older plots, but it has the great advantage of giving a reasonably accurate result in a fairly short period of time. As an illustration of the method, the visitors were shown the experiments on the effect of varying the amount and time of application of nitrogenous top-dressings to the oat crop.

After lunch, Lord Clinton in a short address referred to the close touch now maintained between agricultural research institutes and modern farming problems, and to the facilities for the fundamental study of plant diseases now available at Rothamsted. Sir John Russell then gave a brief account of the type of problem that would be investigated in the new laboratories, and also directed attention to the economic importance of such work.

Lord Bledisloe expressed his pleasure at being invited to perform the opening ceremony of the new plant-pathology laboratories, because they were erected during the period when he was chairman of the Lawes Trust. In reviewing the history of the Station, he was impressed by the rapid application to farm practice of the results obtained by Lawes and Gilbert. As a result the wheat production increased in twelve years from an average of 22 bushels to 32 bushels per acre. He was further impressed by the loss sustained by farmers due to pests of various kinds attacking the crops. Although it was not easy to arrive at an accurate estimate of such losses, the most reliable figures put it at no less than 10 per cent of the total value of crops in Great Britain. It was evident that the Ministry of Agriculture, in defraying the cost of erection and equipment of the extensive new plant-pathology laboratories at Rothamsted were alive to the importance of research work in plant diseases. He had great hopes that effective preventive and remedial measures would soon be developed as a result of the facilities now provided.

At the conclusion of the address Sir Thomas Middleton moved a hearty vote of thanks to Lord Bledisloe, who afterwards unlocked the door of the new building. Members of the entomological and mycological departments then conducted the visitors around the laboratories. In addition to a range of research laboratories, there are a number of rooms for special operations, such as pure culture and constant temperature work, and a separate building fitted up for use as an insectory.

University and Educational Intelligence.

CAMBRIDGE.—The Harkness Scholarship for geology is awarded to A. J. Galloway, King's College; the Frank Smart Prizes are awarded to A. R. Clapham, Downing College, for botany, and to G. E. Hutchinson, Emmanuel College, for zoology; the Wiltshire Prize for geology is awarded to M. Black, Trinity College.

Sir David Lionel Goldsmid-Stern-Salomons, Bart., has left by his will 5000*l.* to Gonville and Caius College for the fund for increasing the College buildings, and 1000*l.* to augment the Salomons Engineering Scholarship Fund. He has left to the University all his scientific instruments and medical apparatus, all models and human specimens suitable for instruction, his collection of crystals and other apparatus used for polariscope work. The Broomhill magnet and the apparatus with it is bequeathed to the Royal Institution, London.

ST. ANDREWS.—The honorary degree of LL.D. has been conferred upon Prof. F. G. Donnan, professor of inorganic and physical chemistry in the University of London, and upon Mr. R. T. Gunther, fellow of Magdalen College, Oxford.

THE Medical Research Council has awarded Rockefeller Medical Fellowships, tenable in the United States of America during the academic year 1925–1926, to the following: Dr. D. Campbell, Pollok lecturer in pharmacology and therapeutics, University of Glasgow; Mr. W. H. Craib, house physician, Guy's Hospital, London; Dr. Katherine H. Coward, assistant in biochemistry, University College, London; Mr. W. S. Dawson, senior assistant, Maudsley Hospital, London; Mr. H. W. Florey, John Lucas Walker Student, University of Cambridge; Mr. A. D. Ritchie, lecturer in physiological chemistry, University of Manchester; Mr. G. P. Wright, Macgregor Student and demonstrator in histology, University College, London. Dr. Craib, Mr. Florey and Mr. Ritchie have been appointed on modified conditions while holding scholarships or emoluments from other sources. Mr. Ritchie's fellowship is being held during a short period of work in Canada this summer.

FISCAL support of State universities and State colleges is discussed in great detail in Bulletin, 1924, No. 28 of the United States Bureau of Education. There is great variation as between the different institutions in the ratio between student fees and State appropriations. In 1921 the University of Texas received eleven dollars through State appropriations for every dollar received from student fees, while at the University of Wisconsin the ratio was 2¼ to 1. The line between free public higher education and payment of part of the cost by the student has been generally lowered during the past twenty years from the beginning of the professional courses to the beginning of the undergraduate courses, and the tendency of fees for both academic and general and professional courses is to increase. The writer of the bulletin assumes that the State universities will profit much from gifts of alumni for special purposes as they become older, but it does not now appear that they can hope to meet a large part of their operating expenses from endowments, the brunt of which will continue to fall on the State and the students.

ERRATUM.—The name P. R. Cuvati in the issue of June 27, p. 997, col. 1, line 6, should be P. R. Awati.

Early Science at Oxford.

July 6, 1686. Some of ye Society gave an account that about noon that day, they saw *Venus* near ye Moon without ye help of a Telescope, when the Sun shone very clearly, and that many people in ye streets observed ye same thing.

Then was read a specimen writ by Mr. John Adams (who has allready spent diverse years in a general Survey of England) concerning the *description* of particular *parishes*, who desired ye opinion and advice of ye Society what therin may be fit to pursue, what to omit of it, or what other remarks to adde.

July 8, 1684. An account of ye weather at Dublin, in May last, taken, in a scheme according to Dr. Lister's Method, by Mr. Molineux, was presented by him to this Society. Ordered, that ye thankes of this Society be returned to Mr. Molineux for this Obligation. A Letter from Mr. Maunders, dated July 2, and giving an account of ye very great damage, lately done, to some parts of Somersetshire, by caterpillars, was read.

An account of a monstrous child, born, not long since in Jutland, with 2 draughts of that Child were presented.

Two letters written, some years since, by Mr. Lister, to Dr. Oldenbourgh were read: one concerning ye great age of severall persons in Craven; ye other concerning ye projection of ye threds of Spiders, and of bees breeding in cases made of leaves; as also concerning a viviperous flye. Mr. Todd promises an account of ye most aged persons in Cumberland; and Mr. Crouch, at ye request of ye Society, engages to examine ye Register which gives an account of Mother George's age.

A Paper was presented, containing ye design of some learned Gentlemen in Somersetshire, to write ye naturall, civil, and ecclesiasticall History of that County.

July 13, 1686. In a letter to Mr. President, Mr. Halley promises to send an extract of ye Journal of ye Royal Society for ye time we want it, and for ye future to send us once a fortnight what shall occur there. In a second letter he gives an account that ye Royal Society will allow him £50 to measure a *degree* of ye earth, and that he intends to take ye latitudes with an instrument of 20 foot radius, with telescopic sights. He adds that he has seen a Calico shirt brought from India which is *woven* without a seam all of one peice.

July 14, 1685. After some interruption of our meetings by reason of ye Rebellion, on this day, (Dr. Smith being in ye Chair), three letters from Mr. Aston were read.—The ways of making Prince's metall mention'd in ye letter of July 2 were ordered to be tryed, which Mr. Ballard undertook to do.

Mr. St. George Ash, Secretary of the Dublin Society, sent ye Minutes of that Society for ye month of June: together with a paper enclosed in it, drawn up by Mr. Smith, Fellow of Trinity College, by way of answer to Mr. Molyneux's Quæries concerning Lough-Neagh, which paper with very good reason ascribes a petrifying quality to ye Earth, but not to ye Water of that Lough. The thankes of this Society were ordered to Mr. Ash and Mr. Smith for these communications.—Mr. Aland's discourse concerning ye longitude, and an account of ye monstrous fish mentioned in ye Dublin Minutes, are desired to be sent us.

Dr. Cony presented ye Society with a telescope in ye name of Thomas Hardresse of Rochester Esqr. Ordered that ye Secretary send ye most humble thankes of this Society to Mr. Hardresse for this very generous present, and that it be carefully preserved in their Repository.

Societies and Academies.

LONDON.

Royal Society, June 25.—D. H. **Black**: β ray spectra of thorium disintegration products. Using comparatively strong sources of thorium-B in equilibrium with thorium-C and thorium-D, the β ray spectra of these substances have been re-measured in order to bring them into line with the standard spectrum of radium-B. Several new lines were found. Of these, one group is of great interest on account of the fact that, despite their high energy (2·5 million volts), they are due to the expulsion of electrons from the K, L, and M levels of an atom by one γ ray.—C. F. **Elam**: Tensile tests of crystals of an aluminium zinc alloy. The crystals, containing 18·6 per cent. zinc, resemble pure aluminium in structure and contain the zinc in "solid solution." They are harder and less ductile than pure aluminium. Fracture occurs on one or more planes at approximately 45° to the axis. These planes are closely related to crystallographic planes. Slip planes are sometimes parallel to planes of fracture.—G. **Shearer**: On the distribution of intensity in the X-ray spectra of certain long-chain organic compounds. In the X-ray "spectra" of substances the molecules of which contain long open chains of carbon atoms, there is a certain large spacing corresponding to planes at distances apart closely related to the length of a single molecule or of two, end to end. A large number of successive orders of reflection from this plane can be observed, and their distribution of intensity is calculated on certain simple assumptions as to the distribution of scattering material along the length of the molecule. It is thus possible to fix with reasonable accuracy the position in the chain of the CO group in such series as the ketones and the esters; this appears to open up a new application of X-ray methods to chemical analysis. Further work on these lines may throw light on the relative scattering power of the various atoms and atomic groups.—C. F. **Jenkin**: High-frequency fatigue tests. High-frequency fatigue tests on copper, Armco iron, and mild steel were obtained at frequencies so high as 2000 periods per second, and unsuccessful experiments were made up to 5000 periods per second. There is a small rise in the fatigue limit as the speed is increased. The dependence of the fatigue limit on the frequency has, however, an important bearing on the theory of fatigue failure. The term "fatigue limit" is used here to denote the greatest alternating stress which can be applied to a material for an indefinitely large number of periods without causing fracture.—L. W. **Bryant** and D. H. **Williams**: An investigation of the flow of air around an aerofoil of infinite span. The stream-lines deduced were compared with those for inviscid flow obtained by means of an electric tank in which the equipotential lines were equivalent to stream-lines in a perfect fluid. Except for a narrow trailing "wake," the lines of viscous flow approximate to those for an inviscid fluid, when a circulation equal to that experimentally determined in the wind tunnel is superposed upon the flow around the aerofoil without circulation. The boundary layer around the nose and over the under surface of the aerofoil is very thin. Velocities deduced from observed pressures on the surface agree very well with velocities measured in the free stream, except over the upper surface, where "wake" begins to develop.—G. I. **Taylor**: Note on the connexion between the lift of an aerofoil in a wind and the circulation round it (Appendix to preceding paper). The connexion between the lift force on an aerofoil and the circulation round it is independent of the contour chosen if the flow is irrotational, and also if the flow is not irrotational provided that a special type of contour is used, according to Messrs. Bryant and Williams. Their contours happen to be of the special type, so the accuracy with which the observed lift force agrees with that predicted from measurements of circulation is no indication that the flow is in fact an irrotational motion with circulation.—T. H. **Havelock**: Wave resistance: the effect of varying draught. The effect of finite draught is considered; in particular, calculations are made when the ratio of draught to length is one-twentieth and one-tenth, a range which covers approximately ship models. The theoretical curves show a reasonable agreement with experimental results.—C. V. **Raman** and L. A. **Ramdas**: The scattering of light by liquid boundaries and its relation to surface tension. Part III.—W. H. **George**: An electrical method for the study of impact applied to the struck string. The two impinging bodies close, during the impact, a simple electrical circuit which includes an oscillograph. From the current variations shown in the oscillograph record, the variations in mechanical pressure during the impact is derived. With a struck string there are important fluctuations in the pressure between the hammer and string, depending markedly upon the position of the striking point along the string. At some places there is a momentary complete separation of hammer and string. These results are inconsistent with the older theories of the struck string, but are consistent with the newer theories. The ballistic galvanometer method to determine the duration of the impact upon the struck string is, in general, invalid.—F. H. **Constable**: The mechanism of catalytic decomposition. A quantitative theory based upon the series of papers entitled "The Catalytic Action of Copper" (Proc. Roy. Soc., A, vols. 98 to 107) is developed. The dehydrogenation of alcoholic substances by copper occurs in stages. Reaction only occurs in a unimolecular layer in which the $-CH_2OH$ groups are in contact with the copper surface. Activation of the alcohol molecule by the catalyst consists in increasing the distance between the H atom and the O atom in the hydroxyl group. Quantitative treatment from this point of view leads to results which are not in accord with experiment. Application of the theory of probability to the conception of a "reaction centre" enables the number of centres present to be connected with the heat of activation of each by an exponential relation. The equation obtained is in accord with experience in so far as it can be tested.—S. A. **Emerson** and L. C. **Martin**: The photometric matching field.—II. Peripheral stimulation of the retina with white light may cause a reduction in the limen of contrast perception at the fovea. With monochromatic lights, using the same wave-length in centre and surround, initial reductions followed by a rise in the limen are found with increasing brightness of surround at all wave-lengths, but the reductions are small in the red as compared with the blue end of the spectrum. The effects may be partly due to reflex actions associated with the retinal rods.—G. S. **Adair**: Partial osmotic pressures and membrane equilibria. Methods for calculating partial pressures are described, based on a long unrecognised equation for membrane equilibrium developed by Gibbs. The modified form of Dalton's law applies to certain hæmoglobin solutions over a wide range of concentrations, not necessarily restricted to the very short range where the pressure is proportional to the concentration. The partial

osmotic pressure of hæmoglobin is relat d to the concentration by a form of Van der Waals' equation.—Mary W. **Porter**: A contribution to the study of the optical properties of mixed crystals. In mixtures of ammonium- and rubidium-magnesium chromates: (1) Variation of principal refractive index for vibrations along the symmetry axis is directly proportional to composition as expressed in volume or molecular percentage. (2) The other two principal indices are also continuous functions of the composition, but are not directly proportional. The general result extends the work of Lavenir and Dufet on orthorhombic mixtures.—H. **Gregory** and C. T. **Archer**: Experimental determination of the thermal conductivities of gases.—D. B. **Deodhar**: On atmospheric radio-activity and Indian weather.—J. R. **Partington** and A. B. **Howe**: The ratio of the specific heats of hydrogen. The determination of the ratio of the specific heats of hydrogen was undertaken by a method of adiabatic expansion previously used with air and carbon dioxide. The mean of nine determinations with pure hydrogen at atmospheric pressure and temperature gave $\gamma = C_p/C_v = 1{\cdot}4113$, and the values of C_v (4·832 gm. cal.) and C_p (6·820 gm. cal.) were calculated from this value and $C_p - C_v = 1{\cdot}9875$.—A. **Cary** and E. K. **Rideal**: The behaviour of crystals and lenses of fats on the surface of water.—Part I. In the process of "surface spreading," on water and solutions of N/100 hydrochloric acid, of organic compounds containing a long chain terminating in a polar group, unimolecular films spread from crystals as well as lenses, a definite equilibrium surface tension or two-dimensional pressure, characteristic of the compound in question, being established. Spreading oil films appear to be pushed out from the source (lens or crystal) by the further entry of molecules into the surface layer, rather than pulled out over a surface by the attraction of the uncontaminated water.—G. H. **Henderson**: The capture and loss of electrons by α particles. Singly charged α particles were measured by an ionisation method. The ratio of doubly charged to singly charged particles in equilibrium is the same in different materials, such as gold, mica, aluminium, etc. With this ratio for any material expressed as the nth power of the velocity, the value of n increased as the velocity decreased.—A. S. **Parkes**: The effects on fertility and the sex-ratio of sub-sterility exposures to X-rays.—R. N. **Chrystal**: The genus Dreyfusia (order Hemiptera, family Chermesidæ) in Britain and its relation to the silver fir.—T. **Moran**: The effect of low temperatures on hens' eggs.—T. C. **Angus**: The electrical characteristics of an arc lamp (direct current) measured by biological effect.—R. J. **Lythgoe** and J. R. **Pereira**: Muscular exercise, lactic acid, and the supply and utilisation of oxygen.—Part XI. Pulse rate and oxygen intake during the early stages of recovery from severe exercise.—J. R. **Pereira**: Muscular exercise, lactic acid, and the supply and utilisation of oxygen.—Part XII. A note on the technique of determining the resting oxygen intake while breathing concentrated oxygen mixtures.—Mary E. **Laing**: The composition of soap films.—G. R. **Goldsbrough**: Torsional vibrations in reciprocating engine shafts.—D. **Brunt**: Periodicities in European weather.—S. **Barratt**: The absorption spectra of mixed metallic vapours (II.).—S. R. **Savur**: On the stress-optical effect in permanently overstrained celluloid.—O. W. **Richardson**: Structure in the secondary hydrogen spectrum (II.).—A. **Cary** and E. K. **Rideal**: The behaviour of crystals and lenses of fats on the surface of water (II. and III.).—J. E. **Jones** and P. A. **Taylor**: Some theoretical calculations of the physical properties of certain crystals.—C. **Chree**: The relationship between the "solar constant" and terrestrial magnetism.—J. A. **Carroll**: The vacuum spark spectra of some of the heavier elements and series classification in the spectra of ionised atoms homologous with copper, silver, and gold.—Sir J. C. **Bose**: Physiological and anatomical investigation of *Mimosa pudica*.—J. F. **Fulton**: Fatigue and plurisegmental innervation of individual muscle fibres.—G. **Matthai**: Colony formation in astræid corals (I.).

Royal Anthropological Institute, May 19.—R. Ruggles **Gates**: Mendelian inheritance in man. Many abnormalities in man are inherited as simple Mendelian differences, and this is to be expected, since they must have arisen as single mutations. Such are brachydactyly and many other digital abnormalities, which are usually inherited as dominant characters. There is evidence that even slight abnormalities may sometimes be lethal in their effects when present in the homozygous condition. Cataract is usually inherited as a dominant, while such conditions as albinism and alkaptonuria are recessives. Colour-blindness, hæmophilia and some other conditions are usually sex-linked in inheritance, their history following exactly the course from generation to generation taken by the sex chromosomes. But various exceptions are found; and the same character may be differently inherited in different families, according to which part of the germ plasm was originally altered. The cephalic index has long been regarded as an important racial character. Recent investigations of Frets, Hildén, and others lead to the view that multiple, cumulative size factors are involved and that brachycephaly in general is dominant over dolichocephaly. Age, sex, nutrition, stature and climate affect the head form. Interracial crosses appear frequently to give 2-peaked curves for cephalic index in later generations. Records of crosses between Indians and whites, obtained in Northern Ontario, indicate that skin-colour segregates and that eye-colour is inherited independently of skin-colour.

PARIS.

Academy of Sciences, June 2.—A. **Haller** and F. **Salmon-Legagneur**: The action of methyl magnesium iodide on the esters of the α-mononitrile of camphoric acid. When the reaction takes place in etherial solution the corresponding tertiary alcohol is produced: in toluene solution the nitrile group also takes part in the reaction, a ketone-alcohol being produced.—H. **Vincent**: The plurality of the toxins of the coli bacillus and the experimental bases of anticolibacillus serotherapy. Evidence is given of the existence of toxins of *B. coli communis*, differing in their thermostability and action on animals.—de **Sparre**: The velocity of propagation of the ram stroke in armoured concrete mains.—Amé **Pictet**, Werner **Scherrer** and Louis **Helfer**: The presence of argon in the gases from the alcoholic fermentation of glucose. Observations are given showing that in the alcohol fermentation of glucose, argon is evolved. It remains to be proved if this gas pre-exists in the yeast and in what form.—C. **Sauvageau**: The development of *Leathesia difformis*.—Benjamin **Jekhowsky**: The generalisation of Cauchy's numbers.—Stefan **Banach**: A characteristic property of orthogonal functions.—P. J. **Myrberg**: Discontinuous groups of linear substitutions.—C. **Dévé**: An apparatus for microscopic reduction entitled "Pangraphic." A description of a simplified pantograph, without articulation.—Bernard **Lyot**: Variations of the polarisation of Mars in the course of an

atmospheric disturbance. — Jean **Boccardi**: The rotation of the interior planets.—H. **Noirel**: Determinations of the intensity of gravity made in the Republic of Ecuador during the expedition of the Service géographique de l'Armée (1899–1906).—Mlle. E. **Gleditsch** and E. **Botolfsen**: The X-ray spectrum of praseodymium, neodidymium, and samarium. Tables are given showing the wave-lengths of seven lines for each metal.—J. **Heyrovsky**: The physical signification of electrolytic solution pressure.—Eugène **Delauney**: A new method of quantitative analysis by X-rays. Various elements absorb a monochromatic bundle of X-rays to different extents. Details of the application of the method to solutions of barium and strontium chlorides, and of potassium chloride and bromide, are given.—J. L. **Costa**: The precise determination of the atomic mass of lithium 6 by Aston's method. Taking He = 4·000, the mass of the lithium (6) atom was found to be 6·010 ± ·002.—René **Audubert** and Henri **Rabaté**: A method of determination of the granulometric distribution of dispersed systems.—Ch. **Courtot** and R. **Geoffroy**: 2.7.9.9′-tetrahydroxy-fluorene.—R. **Lautz** and A. **Wahl**: The arylaminonaphthoquinones. The arylaminooxynaphthalene sulphonic acids.—L. **Cayeux**: The existence of diatomaceous silex in the flints of the coarse limestone in the neighbourhood of Paris. The silex consists of petrified organic residues. Remains of foraminiferæ, radiolaria, ostracods, and gasteropods were found.—J. **Orcel**: A white chlorite from Madagascar.—Fernandez **Navarro**: The meteorite of Olivenza (Spain). This was seen to fall on June 19, 1924. The predominant mineral is olivine, but the meteorite is remarkable for the small proportion of nickel-iron.—Jacques de **Lapparent**: The two forms of hydrocarbons in bituminous schists.—H. **Bouygues**: The axillo-cotyledon facies of the Soissons bean.—Alfred **Labriet** and Raoul **Husson**: The principle of vocal accord, or a contribution to the elaboration of a theory of the normal emission of the singing voice, and the synthesis of the corresponding vocal mechanism.—P. **Mazé**: The influence of fluorine and iodine on the reproductive functions in rats and on the growth of the young. Experiments on the necessity of the presence of fluorine in the diet of rats to ensure reproduction.—T. **Kahn**: Active protoplasmic mass and reserve albumen.—Ch. **Richet**, jr., and R. **Monceaux**: Modifications caused by cooking in the metabolism of meat. From experiments on dogs it is concluded that the metabolism of raw meat is more perfect than that of cooked meat. In diseases of the liver it is advantageous to administer raw meat: in renal affections, however, well-cooked meat is indicated.—J. **Benoit**: Compensating hypertrophy after unilateral castration in the domestic cock.—E. **Fauré-Fremiet** and J. **Murakami**: The amæbocytes of the earth worm in the quiescent and in the active state.—H. **Hérissey**: Asperuloside, a new glucoside extracted from the wood-ruff. The new glucoside has been prepared in crystals, contains no nitrogen, and gives on hydrolysis a reducing sugar and asperuligenol.—Alphonse **Labbé**: Four generations of *Artemia arietina*,—MM. **Mouriquand**, **Leulier**, **Michel**, and **Idrac**. C. avitaminosis and cholesterinæmia.—Raoul **Bayeux**: Structural modifications of the lung under the influence of great barometric decompressions. The essential primitive lesion of the lung determined by a sudden fall in the atmospheric pressure is the parietal hypertrophy of the alveolæ; all the cardio-vascular phenomena are secondary to this initial lesion.—F. **Henrijean**: The signification of the electro-cardiogram.

Official Publications Received.

Falmouth Observatory. Meteorological Notes and Tables for the Year 1924. By Joshua Bath Phillips. Pp. 10. (Falmouth.)

The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor for the Session 1923–1924. Pp. 11. (Leeds.)

Mitteilungen der Naturforschenden Gesellschaft in Bern. Aus dem Jahre 1923. Pp. lxxviii+195. Aus dem Jahre 1924. Pp. lxii+156. (Bern: K. J. Wyss Erben.)

Proceedings of the Edinburgh Mathematical Society. Vol. 43 (Session 1924–25), Part 1. Edited by Dr. T. M. MacRobert and Prof. H. W. Turnbull. Pp. iii+84. (London: G. Bell and Sons, Ltd.) 5*s*. net.

Diary of Societies.

SATURDAY, JULY 4.

INTERNATIONAL CONGRESS OF RADIOLOGY (at Central Hall, Westminster), at 10 A.M.

BRITISH MYCOLOGICAL SOCIETY (Phytopathological Excursion to Cambridge).—Prof. Sir. R. H. Biffen and F. L. Engledow: The Inheritance of Disease Resistance.—F. T. Brooks and W. C. Moore: Silver-leaf Disease.—N. J. G. Smith: Helminthosporium Disease of Cereals.—D. Weston: The Control of Bunt in Wheat.—R. C. Woodward: Apple Mildew.—Mrs. M. N. Kidd: Fungal Invasion in Apples in Relation to Senescence.—S. M. Wadham: Clover Rot.—A. Smith: Perennial Rust Mycelia.—Prof. Nuttall, Dr. Hare, and Mr. Tait: Fungi Pathogenic to Man.

PHYSICAL SOCIETY OF LONDON (at Oxford).

PHYSIOLOGICAL SOCIETY (at Oxford).

MONDAY, JULY 6.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—G. L. Purser: The Alimentary and Respiratory Systems of *Calamoichthys calabaricus*, Smith.—W. J. M. Menzies: Salmon (*Salmo salar*) of the River Moisie, Eastern Canada.—Dr. W. W. Taylor: Precipitation of Sols by Polyvalent Ions.—J. A. Warren and W. A. Tait: Analysis of Rainfall Records in Glendevon Catchment Area during the years 1914–1920.—Prof. A. A. Lawson: A Contribution to the Life-History of Bowenia.—Dr. E. Neaverson: Ammonites from the Upper Kimmeridge Clay.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

FARADAY SOCIETY (Annual General Meeting) (at Chemical Society), at 5.15.—At 5.30.—A. L. Marshall: The Electrodeposition of Zinc from Acid Zinc Sulphate Solutions.—F. L. Usher: The Nature of the Interfacial Layer between an Aqueous and a Non-Aqueous Phase.—J. B. O'Sullivan: The Application of the Quinhydrone Electrode to the Measurement of P_H Values in Solutions containing Copper Ions and other Divalent Ions.—J. A. V. Butler: Co-ordination and Valency.—E. D. Campbell: A Chemical Theory of Remanent Magnetism.

ARISTOTELIAN SOCIETY (at University of London Club, Gower Street), at 8.—Miss L. S. Stebbing: Logical Categories.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).

TUESDAY, JULY 7.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University). — Sir Frederick Mott: Presidential Address.

INSTITUTION OF MECHANICAL ENGINEERS (Summer Meeting) (at Newcastle-upon-Tyne). (Continued on July 8, 9, 10.)

WEDNESDAY, JULY 8.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University). — Dr. G. A. Auden: Encephalitis Lethargica and its Psychological Implications.

THURSDAY, JULY 9.

DIESEL ENGINE USERS' ASSOCIATION (at Town Hall, Maidenhead), at 3.—C. O. Milton: The Working of the Ruston Mechanical Injection Engine.

TUBERCULOSIS SOCIETY OF SCOTLAND (at 6 Drumsheugh Gardens, Edinburgh), at 4.30.—Prof. H. Moellgaard and Prof. K. Faber: The Sanocrysin (gold) Treatment of Tuberculosis.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).—Dr. Graves: Incidence of Chronic Sepsis in Mental Disease.—Dr. Pickworth: The Iodine Content of Thyroid Glands.

FRIDAY, JULY 10.

MEDICO-PSYCHOLOGICAL ASSOCIATION OF GREAT BRITAIN AND IRELAND (at Birmingham University).—Dr. A. M. McCutcheon: The Institutional Treatment of Mental Deficiency.—Dr. W. A. Potts: Delinquency.—Dr. H. Smith: The Psychopathic Personality.

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