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Mineralogy at Cambridge.

THE position of mineralogy in the studies of the University of Cambridge is the subject of a report by a syndicate appointed by a Grace of the Senate dated May 12, 1928, in accordance with a recommendation made on the election, for a term of five years, of the present professor of mineralogy in 1926. The Syndicate held five meetings, at some of which the professor of mineralogy was present by invitation. The members also had before them a memorandum on the history and present position of the Department by the professor of mineralogy (published as an appendix to the report), and a memorandum on the study of structural crystallography in Great Britain and on the Continent prepared by the University lecturer in that subject. The University reader in petrology was a member of the Syndicate. The main recommendations which have been put forward were reported in a note in NATURE of May 18, p. 780.

The foundation of the Woodwardian professorship provided for the teaching and development of mineralogy as well as geology, but apparently not to the satisfaction of a great enthusiast, Edward Daniel Clarke, at whose instance the present chair of mineralogy was founded in 1808. This originated the separation of geology and mineralogy, which resulted in their representation as independent subjects in the Tripos. Under Clarke's successors, however, crystallography became the main subject taught by the professors of mineralogy. Petrology was practically ignored, and when the study of thin sections of rocks with the polarizing microscope opened up great possibilities in this branch of the science, it was left to the department of geology to develop the new method. Thus an important part of mineralogy came again under the Woodwardian professor and has remained separated from the department of mineralogy. This separation, the Syndicate truly remarks, has adversely affected both studies.

More recently, the great advance in the development of crystallography due to the X-ray analysis of crystal structure has made crystallography still more dominant in the department of mineralogy and further accentuated its separation from petrology and economic mineralogy. The Syndicate believes that the future development of crystallography "lies mainly in fields bordering upon both physics and chemistry". It is convinced that crystallography and mineralogy (and petrology) cannot be adequately developed in one

department, but it does not think that they can be separately catered for in existing departments. It accordingly recommends a new grouping of the subjects, for which the department of mineralogy is to be replaced by two departments, crystallography being taught in one, and mineralogy and petrology in the other. It is recommended that the department of mineralogy and petrology should be in "the closest possible relation with the department of geology" and that "the teaching of such crystallography and crystal physics as is required by students of mineralogy and petrology should be provided by the department of crystallography". The successful carrying out of these particular recommendations will depend mainly on the cordial co-operation of the three professors concerned. As regards the staffing of the two departments, the minimum establishment proposed—a professor, lecturer, and demonstrator in each—is actually less than the number at present engaged in teaching mineralogy, crystallography, and petrology in the University. The only innovation proposed is the foundation of a professorship in place of the post at present occupied by the University reader in petrology.

For the success of the new departments the Syndicate thinks it essential that the subjects taught in both shall be separate subjects in Part I. of the Natural Sciences Tripos. These separate subjects are, however, not regarded as of sufficient importance to rank equally with the existing subjects in that examination, yet they are too important to be crowded into the already overburdened curriculum of geology, physics, and chemistry. The solution offered is to create 'half-subjects'. Under this scheme crystallography, the scope of which is outlined, is to be an independent subject but to carry a smaller maximum of marks than the existing subjects: mineralogy and petrology either to be treated similarly or—at the students' option—to be allowed to be an alternative to palæontology in the existing subject of geology. Thus a student offering chemistry and physics could take crystallography without mineralogy, while students offering geology could omit palæontology and take mineralogy and petrology "and such crystallography and crystal physics as is required", or they could include palæontology and take both mineralogy and petrology and also crystallography, and one (or more) of the existing subjects.

Finally, the Syndicate has considered accommodation. The creation of an additional department demands a new building, and the recommendation is to build new laboratories and a museum for mineralogy and petrology adjoining and communicating with the Sedgwick Museum. Crystallography could then be adequately developed in the rooms at present occupied by mineralogy. This would involve considerable capital expenditure, and, in a note to the report, the Financial Board points out that this "could only be provided at the expense of existing University activities". It may be thought that in recommending a plan the adoption of which depends on the provision of a new building, the Syndicate has doomed its report to rejection. But the memorandum on accommodation submitted by the professor of mineralogy, and the remarks of the Syndicate on the lack of laboratories for the study of petrology in the Sedgwick Museum, are convincing proof that the present accommodation is lamentably inadequate and unworthy of the University. Proper accommodation to allow the development of crystallography, mineralogy, and petrology has been an urgent need for the past ten years, and the Syndicate has done good service by bringing this need prominently to the notice of the University.

If the means to meet this need cannot be found, the main recommendations of the Syndicate for the creation of two departments will inevitably be postponed. There would remain the possibility of the suggested changes in the Natural Sciences Tripos, which do not actually necessitate the splitting up of the present department of mineralogy. The introduction of these changes might be sufficient to effect that close co-operation between mineralogy and geology which the Syndicate desires, and then, as is remarked, "the fact that [mineralogy and petrology] are taught in separate departments might be no more than an inconvenience". With suitable modifications in the scheme of lectures, students of physics and chemistry could take crystallography as a subject without the necessity of learning descriptive mineralogy.

The report was discussed during last term by the appropriate Boards in the University, and the results of their deliberations will be awaited with interest. The adoption of a definite policy with regard to mineralogy cannot long be postponed, as any changes decided on must take effect from 1931, when the chair of mineralogy will be vacated by the present professor, who succeeded W. J. Lewis in 1926 after thirty-one years' devoted service to the department over which his two immediate predecessors had ruled for almost a century.

Industrial Catalysis.

Catalytic Processes in Applied Chemistry. By Prof. T. P. Hilditch. (Monographs on Applied Chemistry, Vol. 2.) Pp. xx + 360. (London: Chapman and Hall, Ltd., 1929.) 16*s.* net.

IN the field of fiction it is usual to find an occasional volume in publishers' announcements labelled as the book of the year. Such title might, in our opinion, be applied with justice to Prof. Hilditch's latest production in the field of chemistry. Eminently readable, lucid, accurate, and authoritative, and in addition well presented by the publisher, it comes near to realising our ideal of what an advanced text-book should be, having in mind always that it is written to promote the application of science in industry.

Though the recognition of catalytic action is more than a century old, it is only during the last thirty or forty years that the subject has received detailed study, whilst its present status as the fashionable form of applied chemistry is only a post-War growth. Indeed, as Hilditch points out, until about 1920–25, there was a distinct conflict of opinion as to the mechanism by which a solid catalyst effected chemical changes in solids or liquids. The rival views were the physical, which assumes the property of concentrating gases in a layer at solid surfaces, and the chemical or intermediate compound theory. Whilst the latter is generally accepted, there is, as always, truth in both theories, and to-day the physicists have come to the conclusion that the adsorption processes concerned in catalysis are conditioned by forces indistinguishable from chemical affinity and are mainly concerned with unimolecular layers. At the same time, the chemists have come to appreciate that an association of the organic molecules with the solid catalyst occurs, which is at least equal in general character to, for example, the association between hydrogen and a catalyst.

Thus the process preparatory to the chemical change is now fully understood and there remains to investigate the next stage, how the energy necessary to effect the change is applied.

The book starts with a classified list of processes and of products, making easy reference for those interested in a particular reaction. After a brief note on the general development, there comes a very clear and concise chapter on the theoretical aspects of catalysis at solid surfaces, which goes on to deal with catalyst poisons and catalyst stimulants, and is followed by a special section on the action of enzymes, the study of which has done much to promote the understanding of catalytic action.

The more technical section, after an introductory chapter, deals in turn with the various industrial applications of the principles of catalysis. Necessarily, the reference to any one process is brief, but it is fully adequate to cover the principles and special problems involved, and the description is all the better for being concise and not cumbered by lengthy extracts from patent specifications, which, as we are at last beginning to learn, are far from being a model of scientific literature or accuracy.

Amongst the subjects considered are the production of hydrogen, methane, methyl alcohol, etc., from water gas, and the synthesis of ammonia, cyanamide and urea, achievements which have resulted in the erection of plants the capital cost of which runs into tens of millions and will change the whole future of agriculture. The conversion of ammonia into nitric acid, by means of platinum or ferric oxide plus bismuth catalysts, will soon make the older methods for the manufacture of this acid obsolete, and cheap nitric acid may have much wider application than at present.

Contact sulphuric acid is already an old catalytic industry, but there is no end to invention in this field. We pass over chlorine manufacture and coal gas purification to the new field of synthetic organic aldehydes and ketones obtained by the dehydrogenation of alcohols. Such products are not only valuable solvents, but they are the starting-points of further syntheses, such as that of acetic acid, which as cellulose acetate becomes the raw material for a synthetic textile which has already begun to effect a social revolution.

Hydrogenation was one of the earliest of successful catalytic processes and bid fair at one time to effect a revolution in the fat industry; it is now being extended to deal with benzenoid compounds. Active charcoal as a catalyst is still in its infancy—it is a direction in which we prophesy great developments.

A considerable section is devoted to fermentation processes, which now involve the production on an ever-increasing scale of such substances as glycerine, acetic, butyric and lactic acids; of butyl alcohol and acetone, as well as vinegar, amyl alcohol and ordinary alcohol.

We have indicated the scope of the book, partly with the object of showing to what extent the principles of catalysis are being applied in industry to produce substances of ever-growing importance, which a few years ago were scarcely of interest outside the laboratory. It is in this direction that

the potentialities of the subject are greatest, and within the next ten years we may confidently look for astounding progress. Prof. Hilditch's book may well form the 'Bradshaw' for such journeyings into the future, and we believe it will be found to be equally trustworthy. E. F. ARMSTRONG.

Early Science in the United States.

History of the Sheffield Scientific School of Yale University, 1846–1922. By Prof. Russell H. Chittenden. Vol. 1. Pp. ix + 298 + 36 plates. Vol. 2. Pp. x + 299-610 + 57 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1928.) 45*s*. net.

THESE two large and handsome volumes on the scientific department of Yale University begin with an interesting survey of the position of science in education in the first half of the nineteenth century. Dr. Chittenden gives pride of place to British scientific workers, mentioning Humphry Davy, Faraday, Dalton, Bell, Herschel, and Lyell before he passes on to the French. But when we turn to the provision of laboratories and to the place taken by science in the public education of the different countries, the story is different. France and Germany—the former on the mathematical and the latter on the chemical side—were far in advance of Britain, and it may be doubted whether the leeway has yet been made up completely. The list given on p. 18 of institutions for higher scientific and technical training in Paris in the 'thirties is amazing, and at the same time one had the famous laboratories of Liebig at Giessen and Munich attracting chemical students from all over the world. England was from that point of view far in arrear and long remained so.

It is a curious and notable fact that the United States, the youngest branch of the Western family, and endowed with the richest supply of untapped natural resources, should have clung to the most antiquated methods of higher education and been most reluctant to alter them. "There was a deep-seated aversion", Dr. Chittenden tells us, "to new ideas, especially if the latter threatened to diminish in any degree the amount of time available for the dead languages, and science, so far as it was understood, was considered of relatively small importance, and to have little educational value." He has analysed the old course of instruction at Yale, Harvard, and Williams College for the year 1845, and shows the enormous preponderance of Latin and Greek, with some mathematics, and an occasional dash of botany, chemistry, or geology.

The change, so far as Yale is concerned, was mainly due to Benjamin Silliman, who was appointed professor of chemistry at Yale in 1802. Immediately after his appointment he was allowed periods of absence to visit other places where he could meet men and study institutions likely to help him in his work. In America at that time Philadelphia was the most advanced centre of scientific knowledge, especially of chemistry. Benjamin Franklin had founded there in 1727 both the American Philosophical Society and also the University of Pennsylvania, and at the latter place Benjamin Rush, "the father of chemistry in America", was teaching. There also Silliman met Priestley, who had fled from England on political grounds. But he went on to Europe and made friends in England with Sir Humphry Davy and Sir David Brewster, besides collecting physical and chemical apparatus and the latest books on scientific subjects. Thus prepared, he returned for his long period of professorial work at Yale. Silliman held his post with increasing success up to 1845, and was undoubtedly the founder on the spiritual side of the Yale School of Science, to which shortly after his retirement an adequate material home was provided by the munificence of a railway constructor named Sheffield, from whom it takes the title of the 'Sheffield Scientific School of Yale University'.

The years, however, of Silliman's professorship were passed amid the hardships of inadequate funds and cramped quarters. For fifteen years he had as laboratory only a part of the cellar of the Lyceum building, a space with raised seats and a lecture table for experiments. Yet even here he managed to do work which placed him in the front rank of the American chemists of his day, and in those same years Olmsted succeeded at Yale in making the first observation of the return of Halley's comet, in 1835, and Morse, a graduate of Yale, designed his electric telegraph.

In 1846, the year following Silliman's retirement from teaching, though he still remained active in other spheres, the Smithsonian Institution was created by Act of Congress under the terms of the will of "James Smithson, of England, for the increase and diffusion of knowledge among men". A decade later, Mr. Sheffield came on the scene with money for buildings and endowment, and the determination to give the institution a practical turn. As railway engineer he provided amply for engineering; North, Silliman's first colleague, represented agricultural chemistry, and the volumes before us describe all the other branches which afterwards grew up and the leading men who have adorned them.

The second volume, with its plates representing some six or eight magnificent buildings devoted to different branches of science and called after some wealthy benefactor or distinguished teacher, is eloquent testimony to the noble emulation of the American citizen when his sympathies are once aroused. Yale and its school of science have been justified of their sons. F. S. M.

Treatises on Astronomy.

(1) *Faculté des Sciences de Paris : Cours d'astronomie.* Tome 3 : *Astrophysique.* Par Prof. Jean Bosler. Pp. v + 723 + 47 planches. (Paris : Hermann et Cie, 1928.) 140 francs.

(2) *Trattato di astronomia siderale.* Per Prof. Giuseppe Armellini. Vol. 1 : *Parte generale.* Pp. xi + 94. (Bologna : Nicola Zanichelli, 1928.) 85 lire.

THE problems presented by the need for specialisation in science have been evident long enough to become a commonplace, but recent years have seen them grow rapidly more acute and insistent. In physics, for example, the yawning gulf grows daily more apparent, and, by a curious paradox, the more desperate the efforts made to find a unifying scheme for all physical phenomena, the more extravagant and impossible become the demands on a single mind attempting to cope with all the problems of the subject. How a man like the late Lord Rayleigh, if spared beyond the allotted span, would have kept abreast of modern developments, is uncertain, though he would doubtless have found some way of doing so. What seems quite clear is that, without going outside the familiar range of his own thought, he could have continued to enrich the science by invaluable contributions of characteristic quality. As new fields are added, the old do not become less worthy of cultivation. The danger of neglect must be avoided, even by recognising the need for distinct classes among the husbandmen.

If, however, this be so in the case of a fundamental and relatively self-contained science like physics (which yet has its debts as well as its gifts to other sciences), what is to be said of astronomy, which draws fresh nourishment from every scientific flower ? So late as the beginning of this century, it was still possible for a young astronomer, starting out with a fair stock of mathematical and physical knowledge, to keep pace with the current literature of his subject as it appeared. No doubt he might become professionally immersed in the technicalities of (say) meridian astronomy and neglect to follow the advances in solar physics or dynamical astronomy. He may even have been wise to concentrate all his attention on one line of research. But such a course was a matter of his own taste and concern, not forced upon him. To-day the position is undeniably changed, and even the most omnivorous, after wading through all the courses of a meal no less lavish than formerly, can scarcely be expected to do equal justice to the new dish provided by atomic physics. However willing the spirit, the flesh is weak. A division of interest is inevitable, and all that is now possible is to mitigate so far as possible the evil effects of isolation. The changing circumstances will be accepted reluctantly by some who cherish breadth of outlook, but now *il faut cultiver nos jardins.*

With all this has gone a certain change in astronomical literature. Thirty years ago and less, the young astronomer had little in the way of books (with such notable exceptions as Chauvenet) to help him. He had to plunge into the sea of original papers for what he wanted, and it was good for him. The trained astronomer, brought up in this way, did not feel the want, but the absence of suitable books would have proved a distinct difficulty in establishing an academic course in astronomy similar to those provided for the study of physics.

Of course, there have long been books on astronomy which might be classed as text-books or popular works according as the didactic purpose or popular interest was predominant, but the serious student did not look to them for instruction. Among the more eminent members of the class may be recalled Laplace's "Systéme du Monde", still famous for the germ it contains of modern theories of cosmogony. Sir John Herschel's "Outlines of Astronomy" is another example, and Newcomb's "Popular Astronomy" yet another, still kept alive by repeated revision. All these, and doubtless others, had notable qualities, but they stand out from a general poverty for which there were reasons. A work intended for the serious student commanded a market too small to be attractive. The professional astronomer, on the other hand, was generally too fully occupied to cater for the popular taste ; to have done so was apt to be frowned upon as a dereliction of duty. But times are changing, and as the subject matter of astronomy becomes enlarged, it is recognised more clearly that an endeavour to place the results of research in an intelligible form before a wide public has not merely an excuse but is a positive duty. The stream of original work grows no less, but convenient and orderly presentments of its results appear with growing and welcome frequency.

(1) Something of this line of thought is suggested by the works under review. Prof. Bosler's book on astrophysics appears as the third volume of a course on astronomy, of which the first two volumes contain a treatise on spherical and practical astronomy by Prof. Andoyer and M. Lambert. Like these, it had its origin in lectures delivered at the Sorbonne, and it forms in a sense a natural sequel dealing with the newer branch of the science, but it can be treated as a quite independent work. It is a little difficult to classify under the head of a text-book, popular handbook, or work of reference, because it has something of the qualities of all three. As a text-book based on academic lectures, it puts into the hand of the student an adequate introduction to the subject of astrophysics. But the general reader, and in particular the amateur astronomer, who is no dismayed by an occasional mathematical formula, will find the descriptive matter relieved by well-chosen illustrations finely reproduced. The references to recent literature are copious but do not pretend to be exhaustive. This will not prevent the book from being very useful to the working astronomer, at least to those whose work lies in other fields.

Prof. Bosler's book is too long for detailed discussion, but a general idea of its contents can be given. After an introductory section on instruments and methods, the work is divided into three parts, each of about two hundred pages in length. These are devoted respectively to solar physics, the physical characteristics of the members of the solar system, including comets, and to the stars and nebulæ. Thus it is to the solar system, which can be studied in fuller detail, that the greater amount of attention is given. But the space allotted to stellar problems is sufficient for the presentation of the main lines of current thought in a rapidly growing subject. The full indexes provided will greatly assist reference to the contents of a bulky volume.

(2) By a coincidence which in itself illustrates the new tendency in the form of astronomical literature suggested above, the first volume of a treatise on sidereal astronomy, by Prof. G. Armellini, appears at the same time as Prof. Bosler's work. This contains a general description of the sky, followed by a discussion of stellar photometry and spectroscopy. A second volume will be devoted mainly to the physical constitution and evolution of the stars, and a third to stellar statistics and the constitution of the universe. In method of treatment and style of production there is considerable resemblance between the work of the two authors, and in bulk the Italian treatise when complete bids fair to exceed the single French volume. Naturally, on several topics the two will overlap and afford an interesting comparison, but the predominant place assigned by Prof. Bosler to the solar system will ensure their independent value on complementary lines. The appearance of Prof. Armellini's concluding volumes will be anticipated with interest, and will give a more convenient opportunity of reviewing his work when it can be seen as a whole. H. C. P.

Vital Rays.

Zellteilung und Strahlung. Von Dr. T. Reiter und Dr. D. Gábor. (Herausgegeben von der Zentralstelle für wissenschaftlich-technische Forschungsarbeiten des Siemens-Konzerns.) Pp. iv + 184 + 3 Tafeln. (Berlin: Julius Springer, 1928.) n.p.

IT is now several years since Gurwitsch claimed that growing roots emit some sort of influence which induces cell division in a neighbouring root properly oriented, that is, with its axis a prolongation of the axis of the growing root. The claim seemed improbable, and many misconceptions existed regarding the experimental work on which it was based and the nature of the claim. But the pervasiveness of various kinds of radiation has since been shown by physicists, and the possibility that various types of radiation (in addition to those of light-producing organs) can arise in the tissues of organisms must now be faced. Gurwitsch and his co-workers have extended his results, and confirmatory experiments have been made by Wagner, Magrou, and others. There is thus a considerable body of experimental work bearing on this subject, although Gurwitsch's theory of 'mitogenetic rays' has been adversely criticised by Guttenberg and others.

Many of Gurwitsch's experiments were done with onion bulbs and their roots, but these hypothetical rays have also been found to emanate from stem tips and other tissues, yeast cells, the macerated bases of onion bulbs, the eggs of amphibians, the heads of tadpoles living or macerated, and various other sources. As regards roots, they are supposed to arise not from the meristematic zone but from the base, and to pass out at the tip of the root because of internal reflection at its surface. Narcosis with chloral hydrate is supposed to inhibit the production of these rays, and just as light-production in organisms is assumed to be due to a reaction between luciferin and luciferase, so Gurwitsch assumes that these rays arise when 'mitotin', which is killed by heat, unites with 'mitotase', which survives a temperature of

60°. It has since been claimed that in full-grown animals only the blood produces these rays, and more recently that the tissues of malignant tumours emit them.

From physical experiments it is concluded that the rays can undergo reflection, refraction, and diffraction, like the ultra-violet, and that the wave-length is about 190-230 $\mu\mu$. Using experimentally produced rays of the same wave-length for comparison, it is claimed that onion roots are 250 times more sensitive to the 'mitogenetic rays' than a photographic plate.

In the work of Reiter and Gábor, many of these hypotheses and conclusions receive support. They used Gurwitsch's method of counting the number of dividing cells on the side of the root exposed to the 'rays' and comparing it with that on the unexposed side, but they appear to have used mainly cross-sections while Gurwitsch used longitudinal sections of the exposed roots. Their research apparatus and methods are described in detail, so it should be possible to repeat the experiments. They attempt a detailed mathematical analysis of the normal growth zones and cell-division cycles of a root meristem before taking up the study of 'induction effects'. They consider that the term 'mitogenetic rays' takes too narrow a view of their nature and effect, and suggest that such rays when emitted by biological objects should be known as Gurwitsch rays.

The experimental results of Reiter and Gábor are given in detail, and a few of their conclusions may be mentioned. They confirm the conclusion of Gurwitsch that an 'induction effect' may be produced on onion roots by various biological objects, and that this is due to rays from various living or pulped tissues, while non-growing (*ausgewachsenen*) tissues do not show the effect. Malignant tumours produce the 'rays', but benign tumours do not. There is some evidence that the rays affect a photographic plate, but this requires confirmation.

Macerated onion bulb tissue produces the radiation only in light, while onion bulbs, tadpoles, and malignant tumours produce it also in darkness. Monochromatic light of wave-length about 340 $\mu\mu$ produces the induction effect, which is not so strong with rays of 280 $\mu\mu$. Acceleration and retardation effects are obtained with amphibian eggs and larvæ by subjection to monochromatic ultra-violet light, the effects varying with the wave-length and the age of the animal. In certain cases radiation of wave-length 334 $\mu\mu$ caused the parthenogenetic development of amphibian eggs.

These and similar results, in which it appears to be possible to treat the radiations from certain active tissues as ultra-violet rays are used in experiment, opens the whole question of the production of radiations by living tissues or substances, a hypothesis which, if substantiated, would have far-reaching effects. Haberlandt (*Biolog. Zentbl.*, Bd. 49, Heft 4) has recently published experiments which he believes support his view that the stimulus to mitosis has a chemical basis, rather than a physical one, in the supposed Gurwitsch rays. It is possible that these views are complementary, both containing some element of truth.

R. RUGGLES GATES.

Our Bookshelf.

Tables annuelles de constantes et données numériques de chimie, de physique, de biologie et de technologie. Publiées sous le patronage de l'Union de Chimie pure et appliquée par le Comité international nommé par le VII[e] Congrès de Chimie appliquée (Londres, 2 juin 1909). Vol. 6: *Années 1923–1924.* Première partie. Pp. xxxiv + 679. Deuxième partie. Pp. xxix + 681-1675. (Paris: Gauthier-Villars et Cie; New York: McGraw-Hill Book Co., Inc., 1927–1928.) Paper, 530 fr.; cloth, 610 fr.; 25 dollars.

THESE two books form Volume 6 of the now well-known "Annual Tables", published under the auspices of the Union of Pure and Applied Chemistry. During the War, the annual nature of the publication became a misnomer, but the arrears are gradually being overtaken, and the present volumes contain the data for 1923 and 1924. It is a sign of the increasing output of scientific research that they occupy as much space as was required for the data of the previous three years.

The object of the tables is to collect together all numerical data published during the period covered by the volume, and this ambition is, to a very high degree, fulfilled. Some forty collaborators are employed, and they search nearly 500 publications, so that very little can escape their net. This net is, in any case, spread very wide. The tables do not restrict themselves entirely to new experimental data; such numerical quantities as schemes of energy levels in atoms (which rely on previous measurements of critical potentials and of spectra) are included, as also are calculated tables for determining the inductances of coils. Short statements of the conclusions drawn by investigators from their measurements are also included, and frequently add considerably to the value of the work.

Now that the series has reached Volume 6, the search for a determination of a constant occupies considerable time, and users of the tables will be grateful for the promise made to produce an index covering Vols. 1-5.

The contents and arrangement of the present volumes are very similar to those of previous years, but an innovation is the translation into English

of all tables and explanatory matter in the sections on metallurgy and engineering. New sections are also added to deal with photography, with wireless telegraphy and related subjects, and with geophysics. The latter in particular is quite a long section and, like the one on biological measurements, will present in convenient form a mass of data which the non-specialist would find difficult to discover without some such help as is afforded by these tables.

Several of the sections have also been issued separately. J. H. A.

The Book of Remarkable Machinery. By Ellison Hawks. Pp. 296+40 plates. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1928.) 7*s.* 6*d.* net.

THE writing of books on modern machinery suitable for boys of a mechanical turn of mind, or for others wishing to know something of the marvels effected by invention, is a difficult problem. Descriptions of new machinery contained in the technical journals often run to considerable length and are accompanied by complicated drawings, absolutely necessary, but requiring the closest attention of an experienced engineer. To attempt to compress into one book descriptions of many machines, ranging from steam engines to printing machines, from machine tools to toffee-wrapping machines, is to undertake a task which is bound to lead to criticism.

Mr. Hawks, however, has been fairly successful in initiating us into some of the mysteries of the forge and factory, and with a fine set of illustrations he has given some explanations which can be readily followed. In other cases the matter is too brief to be of much value, and such statements as that on p. 58, where we are told that the steam from a triple expansion engine exhausts into the condenser at 8 lb. per sq. in., and that on p. 131, that a steel rod 1 in. square will withstand a stretching strain of 150 tons, while a cast-iron bar of similar dimensions will withstand a strain of only 20-30 tons, are examples of the errors one unfortunately finds only too often in popular books on engineering. In such books the matter should be accurate, the explanation clear, and the treatment full enough for its purpose.

Through the Apennines and the Lands of the Abruzzi: Landscape and Peasant Life. Described and drawn by Estella Canziani. Pp. xiv+339+24 plates. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1928.) 25*s.* net.

IN the last resort it would be difficult to decide whether the award of merit should go to Miss Canziani's paintings or her letterpress in this delightful account of a visit to the Abruzzi just before the War. Both alike are a spirited and detailed record of a primitive culture which no longer survives intact in post-War conditions. When Miss Canziani visited the country she was warned that it was not safe owing to brigandage. Though she did not encounter that peril, the attitude of the peasants at times seems alarming, to the reader at least, even if Miss Canziani takes it calmly enough.

This, however, and the discomforts, even hardships, of her journey are not matters upon which the author dwells. Her interest lies in the customs and beliefs of the people of this most primitive area of Italy. If it were not for the names of the saints and the prominent position held by the parish priest, it would be difficult to believe this a Christian country. Virtually, indeed, it is as pagan as any part of Africa over which Christianity has done no more than spread a veneer. Take, for example, the festival of Domenico, when the Serpari, descendants of Circe, who handle snakes with impunity, cast serpents in hundreds on the image of the saint as it is carried through Cocullo. This, perhaps, is extreme, but it is not atypical. The strength and at the same time the rational character of the belief in the were wolf is indicated by the statement that those who are about to become were wolves shut up their own sheep for protection before the change to the wolf form takes place. Witches of course abound, and charms against the evil eye are everywhere. Miss Canziani's work is a valuable contribution to European folklore, which will need prolonged study before its interest is exhausted.

Elements of Geophysics: as applied to Explorations for Minerals, Oil, and Gas. By Dr. Richard Ambronn. Translated by Dr. Margaret C. Cobb. Pp. xi+372. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 25*s.* net.

PROBABLY at the present time there is no one competent to write a really good text-book on applied geophysics, but the strong demand for information on the subject has stimulated the production of many books, which fall short of the ideal in very different degrees. Dr. Ambronn's work is perhaps nearer perfection than most, though still very far off. Extreme sketchiness of treatment is inevitable when the attempt is made to deal with the historical, theoretical, and instrumental sides of so wide a subject in 284 pages of text. The author has clearly endeavoured, however, to master his subject and to present it from a scientific point of view, without any axe to grind or any special methods to advocate. The extent of his reading is indicated by the fact that more than sixty pages of the book are occupied by a list of references to authors; judging from the section of this literature known to the reviewer, half of these references might have been omitted with advantage.

It will be long before this great material is properly digested and presented in the form best suited for practical purposes, and the author has not made any very marked step in this direction, though his work may facilitate the process when undertaken in the future by himself or others. The book, however, is likely to have a wide sale among commercial geologists, and justifiably, for there can be few who will fail to glean some useful information from its pages.

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.*]

Magnetostriction of Diamagnetic Substances in Strong Magnetic Fields.

THE change in shape of a body, when magnetised, may be accounted for by two causes. First the stresses produced by the magnetic forces act on the magnetic poles of the magnetised body. This effect, which we shall call the *classical magnetostriction*, is in a given magnetic field completely determined by the magnetic susceptibility and the elastic constants of the body. In general it will result in a contraction for diamagnetic substances and an expansion for paramagnetic ones. The classical magnetostriction is very small even for a strongly diamagnetic substance like bismuth, where $\delta l/l$ in a field of 300 kilogauss is only $1{\cdot}3 \times 10^{-6}$. It is evident that the discovery of an effect of this order would amount to a verification of the classical theory of magnetisation and would afford no new information on the property of the substance.

On the other hand, in a sufficiently strong magnetic field we must expect another phenomenon to happen, namely, an observable change of the shape of the body which is due to the distortion produced by the field on the binding forces between the atoms. This we shall call the *atomic magnetostriction*. After the modern picture (Heitler and London) of the homopolar binding forces which are essentially of an electrodynamical origin, such an atomic magnetostriction must occur in metals and other homopolar substances. The question is only of the magnitude of the phenomena, which probably must be small as it has not yet been observed in dia- or para-magnetic substances in weak magnetic fields.

To find whether such magnetostriction occurs in strong magnetic fields, such as are available in our laboratory (*Proc. Roy. Soc.*, **115**, p. 568; 1927), a special method has to be developed, since the field can be produced only for a very short time, during which the experiment has to be performed. We were successful in devising a method which enabled us to observe changes of length of the order of 10^{-7} occurring in a rod, placed in the coil parallel to the lines of magnetic force, the duration of the field being about a hundredth of a second and its magnitude up to 300 kilogauss. This method proved to be very accurate, since, when the experiment is performed in one-hundredth of a second, the disturbances produced by accidental thermal variation in length of the rod are negligible.

The first substance which was investigated was an extruded bismuth rod, and it showed a small contraction which was only slightly larger than that expected on the classical magnetostriction. But when the bismuth rod was grown in a crystal a larger effect was easily observed, which could be due only to the atomic magnetostriction. A more detailed investigation showed that, when the trigonal axis was parallel to the field the rod expanded; when the axis was perpendicular to the field the rod contracted. The contraction and expansion in the same magnetic field are practically equal, so that in an extruded polycrystalline rod they compensate each other, and this accounts for the absence of the effect as observed with this rod. We were also able to trace an atomic magnetostriction in other diamagnetic substances besides bismuth, but the effect was about ten times smaller and more difficult to study. We have therefore chosen bismuth as the first to be studied more carefully. The experiments are still in progress, but it seems clear that at room temperature the contraction and elongation vary according to a square law with the field, and in a field of 300 kilogauss the length changes by 5×10^{-5} (larger than is observed in ferromagnetic substances). The temperature has a strong effect, and at the temperature of liquid nitrogen the atomic magnetostriction increases several times.

These results explain why the previous attempts to find magnetostriction in bismuth failed (E. Van Aubel, *Phys. Rev.*, **16**, 60; 1903). In this experiment the largest field used was only 3 kilogauss, so that even with a crystal of bismuth the magnetostriction will be only 5×10^{-9}, but as actually polycrystalline rods were used, the effect will be only of the order of 10^{-10}, and this is too small to be measured.

The general picture of the phenomenon appears to be as follows. The cell of a bismuth lattice is very similar to a cube slightly pulled out along one of its long diagonals, which coincides in direction with the trigonal axis. In a magnetic field apparently the cube becomes still more stretched in the same direction.

From the general theory of magnetostriction (Helmholtz, *Ann. de Phys.*, **13**, 385; 1881) we must necessarily expect that such a deformation of the lattice if produced by pressure will result in an increase of the diamagnetic susceptibility perpendicular to the crystal axis and in a decrease along the axis.

The main physical interest of the phenomenon is that it may conceivably throw more light on the nature of the homopolar bonds. At present, from the general aspects of the phenomenon in bismuth, it is probable that under the influence of the magnetic field the bonds between the atoms which lie farther apart weaken, whilst those of the closer atoms are strengthened. If this view is correct, we must expect to observe larger atomic magnetostriction in the substances where the atoms are not symmetrically bound, such as tin, tellurium, graphite, and others.

P. KAPITZA.

Magnetic Laboratory,
Cavendish Laboratory,
Cambridge, June 21.

A New X-ray Effect.

IT is a remarkable but as yet imperfectly understood fact that crystalline graphite has a diamagnetic susceptibility many times greater than that of carbon in other forms, either by itself or in combination. In the hope of elucidating this phenomenon, we were led to make a careful study of the X-ray diffraction patterns of purified graphite, using a narrow pencil of the K radiation of copper, and taking special pains to avoid fogging of the plate in the vicinity of the primary beam, either by stray radiation or by photographic halation. The diffraction photographs obtained with powdered graphite in this way show a new and hitherto overlooked phenomenon (Fig. 1). We find a notable amount of scattered radiation in the area surrounding the primary beam, terminating sharply at the first diffraction ring, and reappearing with a much smaller though quite sensible intensity in the area between the first and second diffraction rings.

These observations contradict the general belief that crystals or coarsely crystalline powders do not show any appreciable X-ray scattering at small angles with the primary beam (Hewlett, *Physical Review*, **20**, 688; 1922). Our experiments show the effect to become distinctly more noticeable when graphites of

increasing degrees of fineness obtained by sedimentation were used. Blank exposures taken without the graphite, and powder patterns taken with other organic crystals (for example, hexamethylene tetramine), do not exhibit the phenomenon; it cannot therefore be ascribed to the presence of white radiation or to stray X-rays. The peculiar distribution of the scattering, and especially its relation to the position of the diffraction rings, appear to us definitely to exclude the possibility of the effect being due to any admixture of adsorbed impurities or of amorphous carbon with the graphite.

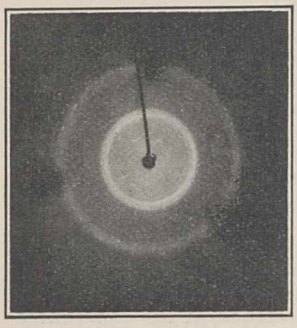

FIG. 1.

We are inclined to attribute the effects noticed by us to the fact that more or less loosely associated with the crystal lattice of graphite there are also certain mobile electrons which endow the substance with its high electrical conductivity. The success of Pauli, Sommerfeld, and others in developing the electron theory of paramagnetism and of metallic conduction on the basis of the Fermi-Dirac statistics suggests that even though graphite is strongly diamagnetic, certain electrons in it must possess large velocities, and hence cannot be regarded as an integral part of the lattice in respect of X-ray diffraction. They would therefore necessarily give rise to a scattering at small angles with the primary beam. The influence of particle size presumably depends on the magnitude of the free path of the electrons. We may interpret the increased intensity of the scattering with the finer powders as due to the distribution of the conduction electrons in the crystals becoming more and more completely chaotic with diminishing particle size. Such an interpretation is at least rendered plausible by the fact, discovered in a subsidiary investigation by Raman and Vaidyanathan, that the diamagnetic susceptibility of graphite is markedly a function of particle size, diminishing steadily to a small fraction of its full value with increasing subdivision of the substance.

C. V. RAMAN.
P. KRISHNAMURTI.

210 Bowbazar Street,
Calcutta, India, June 6.

Progressive Lightning.

ON NOV. 20, 1926, NATURE published an article by me with the above title, in which I described an instrument which I had constructed in the year 1900, for investigating the progress of a lightning flash; and in the issue of Sept. 1 of last year I gave an account of the first successful photograph with it. This I obtained at the Loomis Laboratory in August last. In this later publication I indicated an improved form of instrument in which two films are carried past two fixed lenses at the same speed in opposite directions, so as to give rise to opposite aberrations of the two images of the flash. From the distortions of the images so found, the rate and mode of progress of the flash could be determined.

Since September of last year I have very greatly improved and simplified the design of the apparatus, and I am proceeding now to make the patterns for the necessary castings. I shall be getting four sets of castings and eight objectives, reflecting prisms and ball bearings, so that I may have one set for myself, one for Dr. Simpson, and one each for Mr. Loomis and Prof. R. W. Wood, in the hope that the two last named will have a better chance of securing a successful result in the frequent summer storms in America. My object in asking NATURE to publish now a description of the proposed new instrument is to attract the interest of other experimentalists, for the provision of extra castings and other gear is more advantageously made all at once than piecemeal, and the working up of the parts to the finished instrument is a small matter. I may say that I have heard from Prof. Adolf Matthias, of Charlottenburg, that he is going to make up an instrument rather larger than the one which I am making, which he hopes to take to a good district for lightning this year. For this purpose I have already given him, for his own use, a description of the latest design. I am glad to find that he is of my opinion that results obtained by this method are unassailable.

The chief objection to the instrument proposed in NATURE of September last is the use of pairs of films. These are replaced in the present design by a single film, and by the aid of right-angled reflecting prisms set so as to turn the beam of light through a right angle the two images are formed on the same film.

The accompanying diagram (Fig. 1) is sufficient to illustrate the design. *D* is an aluminium drum turned

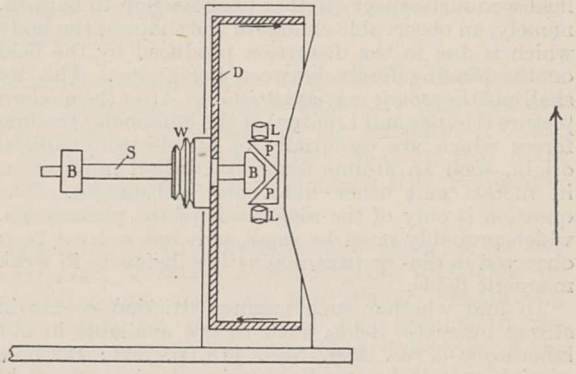

FIG. 1.

inside and out mounted on a shaft *S*, with pulley wheel *W* and carried on ball bearings *B B*. The drum may be driven by multiplying gear by hand or by motor directly coupled if preferred.

The shaft is directed towards the place where lightning ↑ is expected. The reflecting prisms *P P* and objectives *L L* form reversed images ← → on a film within the drum, and so the motion of the film gives rise to opposite aberrations. I have to thank Prof. Conradi, with whom I discussed the design last winter, for the suggestion to put the optical works within the drum instead of outside, as I was preparing to do. This has both optical and mechanical advantages. I am making the instrument to take standard Kodak films 30 in. × 2¾ in., which can be got anywhere. A drum such as this can easily be made to carry the film past the fixed images many times as fast as I carried the images over the fixed plate in my first apparatus. The film should, of course, be shielded from diffused light except at the places where the images will be formed. It would then be possible to run the drum until such a number as eight or ten flashes have been seen to be caught by the aid of a viewing prism, and no harm should result from general fog. I found with my revolving lens system that several bright flashes might supervene with none caught on the plate without serious fog, and the plate was not so shielded.

With such a camera as I have indicated above, there is good reason to expect that it would be possible to detect the crawling of the lightning from point to point in its length, for, in the much less powerful instrument which I used in America, the two images of a flash were clearly different in shape, indicating the progression of the flash.

It is evident that the optical parts could be carried on an overhung shaft and be rotated within a fixed drum, or by the aid of concentric shafts both optical parts and drum could be made to rotate in opposite directions to obtain increased aberration if desired. But I prefer the simpler plan described in the first instance. C. V. BOYS.

66 Victoria Street, S.W.1.

Striations in High Frequency Discharges.

IN the course of an investigation dealing with the origin of the electrodeless discharge, high frequency striations have been observed in iodine vapour which are apparently unlike those recently described either by McCallum and Perry (NATURE, Jan. 12, p. 48) or Mukherjee and Chatterji (NATURE, April 20, p. 605). From the accompanying photographs it will be seen

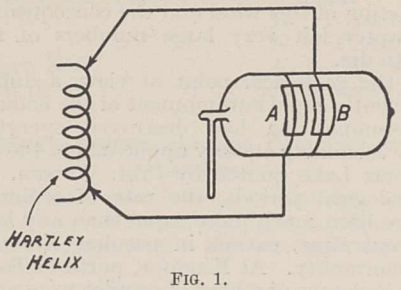

FIG. 1.

that the appearance of the striations is strongly suggestive of a sine curve. They were first obtained accidentally when a solenoidal coil was used with one half wound back on itself, so that a high potential existed between the adjacent initial and final turns. In the narrow region between these turns, of width about one centimetre, the striation pattern was observed when the coil carried an undamped high frequency current. It was afterwards found that, by means of the arrangement shown in Fig. 1, conditions

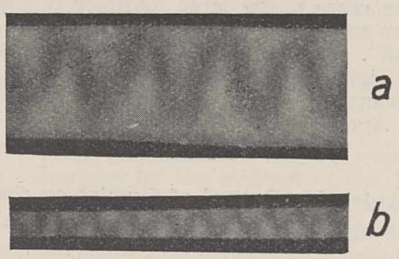

FIG. 2.

could be controlled so as to permit of a more careful, as well as a photographic, study.

To keep the striations steady and well-defined, a suitable distance between the electrodes is necessary. Frequently, the whole pattern has a rotational motion, the direction of which may be reversed sometimes simply by bringing the hand near the tube.

The length of the striations varies markedly with the wave-length. Thus, photograph *b* (Fig. 2) was taken with a wave-length of 65 m., and electrodes *A*, *B*, 0·2 cm. apart; photograph *a* (Fig. 2), enlarged to the same extent, with a wave-length of 175 m., and electrodes 1 cm. apart. With a wave-length of 33 mm., the pattern was too fine to be photographed.

Although the striations resemble so strongly a continuous sine curve, a careful examination shows that they are in reality more like two sets of interlocking teeth. It is hoped that the exact origin of these striations will be revealed by the more extended investigation now in progress.

KEITH A. MACKINNON.
JOHN K. ROBERTSON.

Queen's University,
Kingston, Ontario,
May 14.

Dragonflies in Folk-Lore.

IN a recent letter to NATURE (June 1, p. 837) Dr. R. J. Tillyard directs attention to a chapter on dragonflies in the late Mary Webb's novel "Precious Bane". He asks if the expressions "ether's mon" or "ether's nild" used in that chapter for the dragonfly are still in use in Great Britain.

The novel is set, according to the introduction, in north Shropshire—the Ellesmere district. Hence it is worthy of note, I think, that here over the border in North Wales the Welsh name for the dragonfly, which is in common use throughout the province, is 'gwas-y-neidr'—the adder's servant. The choice of the word 'gwas' (servant) appears to be particularly suited to the legend given in "Precious Bane" which reads "where the adder lay hid in the grass there above hovered the ether's mon as a warning". An interesting parallel of the use of 'gwas' in natural history is found in 'gwas-y-gog', the cuckoo's servant, which name is given to the hedge-sparrow owing to the belief that this bird follows the cuckoo and permits the latter to lay its egg in her nest.

I am indebted to Prof. Ifor Williams (of this College) for looking up the Welsh names for the dragonfly in the older dictionaries. He informs me that Pughe, 1832 (2nd ed.), gives 'gwas-y-neidr' and 'gwaell neidr' as terms used for the dragonfly. The latter literally means 'the adder's knitting needle'. I am not aware of the use of this term in North Wales at present, but it is interesting to note that Dr. Tillyard states he believes the dragonflies are still commonly called 'devil's darning-needles' in many parts of the United States of America.

W. MALDWYN DAVIES.

Department of Agricultural Zoology,
University College of North Wales,
Bangor.

NEW ENGLAND is a long way from England, but our use of "darning needle", when I was a boy (Westborough, Mass., about 1895), is about the same as Dr. Tillyard's (NATURE, June 1, p. 837).

The 'darning needles', 'devil's darning needles', or 'blue darners' were definitely the smaller Zygoptera (Agrions). The 'blue darners' were of course in general the males, but we were not very careful in our distinctions. Larger dragonflies (Anisoptera) had no special name—they had to go as darning needles, but we felt the name did not really belong to them.

I have noticed that friends from the middle west, if they say 'darning needle' at all, mean especially the large Anisoptera; but they are more apt to say 'snake feeders', a term that is entirely unknown in our section, but recalls the "ether's mon" of Dr. Tillyard's letter. There is of course no real adder over here, and the word 'adder' is always used of a harmless snake.

I wonder if the difference of usage is related to the different source of the first immigration in the two parts of the country. New England was peopled from England and by Puritans—my own town was incorporated in 1717, long before the Presbyterian and Methodist immigrations, and still has a large proportion of the old stock. But the middle west had a substratum of Scotch, Scotch-Irish, and other Methodists and Presbyterians, dominating the New England overflow of Puritan stock. No doubt they brought different words, from a different part of Britain.

WM. T. M. FORBES.

Ithaca, N.Y., U.S.A.,
June 19.

The Electromotive Behaviour of Single Zinc Crystals.

To NATURE of Jan. 12, 1929, p. 49, Paul A. Anderson communicated some measurements of his on the potentials of single crystals of zinc. The investigation of a possible change of the electrochemical potential with the changing density of zinc atoms on different planes of the crystal was also the aim of an experimental research commenced in October 1928 in the Physicochemical Laboratory of the University of Latvia, in Riga, and is now in progress. The results obtained here do not agree with those of Anderson in so far as no difference could be found in the potentials of different, artificially prepared planes of single crystals of zinc against a neutral zinc sulphate solution. It must be admitted, however, that pyramidal faces were not investigated.

Each experiment consisted of four measurements on four planes ((0001), $(10\bar{1}0)$, $(11\bar{2}0)$ and polycrystal), which had undergone exactly the same previous treatment. The four electrodes were submerged to the same depth in the same vessel and measured against a calomel electrode.

In all cases the potential varied with (*a*) composition of the electrolyte: saturation with hydrogen increased the potential towards the less noble potentials as compared with oxygen saturation, addition of minute traces of acid greatly decreased the potential; (*b*) previous treatment: mechanical hard treatment, etching with very dilute and dilute acids, anodic treatment. But at the same time the four different planes showed no systematic difference in potential between themselves. This seems to be due to the following reasons:

1. Mechanical treatment (rubbing with emery, polishing, filing) disintegrates the ideal crystallographic planes. The resulting structure is indefinite and shows no differences of potential.

2. Etching with dilute acids after mechanical treatment attacks the surface very unevenly and no definite plane results.

3. The plane of etching does not develop parallel to the original plane when the surface of the crystal is etched anodically or with more concentrated acids strongly enough to show the structure of the crystal. This is particularly marked for the pyramidal faces investigated by Anderson and is not true for the basis plane. The consequence will be that several crystallographic faces will be present and the potential of the least noble face will be obtained.

The same equality of potential on the three different crystallographic planes was obtained for single crystals of zinc-cadmium (up to 0·2 per cent cadmium) alloys in neutral solutions (cf. *Zeitschr. für anorg. und allgem. Chemie*, **180**, 1; 1929).

M. STRAUMANIS.

Laboratory of Physical Chemistry,
University of Latvia, Riga.

Preservation of Animal Remains.

IN a belated copy of NATURE, dated Jan. 12, which reached me a short while ago, I read with much interest a review of a recent work written by Prof. Weigelt. In that review, entitled the "Preservation of Animal Remains", Prof. Watson enumerates modes of death which are "likely to affect large numbers of individuals at the same time". To those given the following may perhaps be added.

Geological work on the eastern edge of the Ufipa Highlands, south-east of Lake Tanganyika and a few miles from the western fault line of the Rukwa Trough or Rift Valley, has brought me into conversation with others who have an intimate acquaintance with this country. A member of the Brotherhood of White Fathers, Père Pourvoyeur, recently informed me of the effect of a strong wind from the south-east on Lake Rukwa. As may be seen on any good map, the lake is topographically prolonged in a northerly direction as a very flat plain, obviously a continuation of the area now covered by water, and recently part of the lake bottom. As an eye-witness, Père Pourvoyeur described how a strong wind from the south-east forced the waters of the existing lake over the flats, carrying both fish ('Siluridés') and crocodiles with it. The cessation of this wind and the consequent retreat of the water left very large numbers of fish and reptiles to die.

From the geological point of view, a difficulty is the sufficiently rapid entombment of the bodies before total decomposition had destroyed everything, a difficulty seemingly equally applicable to the instance of Smithers Lake quoted by Prof. Watson. During some geological periods, the rate of sedimentation may have been much more rapid than any known at the present time, except in peculiar circumstances as an abnormality. At Kindope, north of Tendaguru Hill, the skeletons of a herd of reptiles were unearthed in a relatively small space by the German expedition which first worked that celebrated locality in Tanganyika Territory for Deinosaur remains. The enclosing silts are frequently false-bedded on a very small scale; the planes of lamination change direction three or four times in a few inches, suggesting the swirling action of a slowly moving quicksand. At Tendaguru also the occurrence of large isolated bones surrounded by fine-grained sands and silts implies, during the time of deposition, that the sediments had a consistency approaching that of cream. These would constitute cases where large numbers of individuals "have an exceptionally favourable chance of being preserved".

JOHN PARKINSON.

Ufipa Highlands,
Tanganyika Territory,
April 26.

Kinematographic Record of Sunrise on the Moon.

ON the night of May 17–18, 1929, between 1·5 h. and about 5·5 h. Greenwich civil time (18 d.) a moving picture was made here of the lunar crater Copernicus, showing changes in the shadows at sunrise. A Victor kinema camera, using amateur-size film (16 mm.), was employed, attached in the focal plane of the 23-inch refractor (30 feet focal length) of the Princeton University Observatory. A yellow Wratten filter No. 45 was inserted about 15 inches ahead of the film. Exposures were made every 6 seconds, approximately, for about 4 hours, on Agfa negative film. The duration of each exposure was about 3·8 seconds, controlled by the rotating camera shutter (sector opening 200°), which was driven by a belt from a light electric motor carried in the same aluminium frame.

More than 50 feet of film was obtained, with above 2000 successive pictures of a region around Copernicus, about 200 by 330 miles in size, the ring-plain being in the middle. Guiding was with a power of 700 and a special eyepiece, which received light from a cube prism just ahead of the film, the diagonal surface of which was lightly silvered to divert about half of the light.

The exposure was too short to show the faint illumination on the low-lying areas outside Copernicus at the exact terminator; but the retreat of the shadow of the 'eastern' ridge down the inner slope of the 'western' ridge is well depicted. The age of the moon was 9·0 d. on May 18 at 6 h. G.C.T. The guiding was only fair, but the positive made from the film makes a good show when projected. (It will be remembered that Jupiter has already been depicted in motion pictures by W. H. Wright.)

Further development of the apparatus is planned. The low illumination at the terminator offers the chief difficulty, because if the exposure is made long, the whole film is rather short when projected. Technically satisfactory pictures may be helpful to serious investigators of the detailed topography; but the vivid general interest possessed by moving pictures of the moon justifies the effort of securing them.

R. F. ARNOTT.
E. G. F. ARNOTT.
Princeton, N.J., A. L. BENNETT.
June 10. J. Q. STEWART.

Heisenberg's Indetermination Principle and the Quantum.

THE Heisenberg principle states that $\delta p \delta q \sim h$, where p and q are two canonical conjugates. Energy and time are such conjugates. For the quantum, $E = h\nu$ and we have

$$\delta(h\nu)\delta t \sim h \text{ or } \delta\nu\delta t \sim 1 \quad . \quad . \quad (1)$$

where t is the time the quantum has been travelling from its source. If x is the distance the quantum has travelled in time t, then $\delta t = \delta x/c$, where c is the velocity of light, so that

$$\delta\nu\delta x \sim c \text{ or } \delta\lambda\delta x \sim \lambda^2 \quad . \quad . \quad (2)$$

since $\delta\nu = c\delta\lambda/\lambda^2$, neglecting sign.

From the classical theory (Compton, "X-Rays and Electrons", p. 55) the amplitude of a radiating oscillator decreases according to $A = A_0\epsilon^{-kt}$ due to damping, where $k = (4\pi^2/3) \cdot (e^2/mc\lambda^2)$ and e is the charge on the electron. The effective length of a wave-train may be taken as the length for A to be reduced to A_0/e and is c/k. This length may be taken as the uncertainty δx of the position of the quantum, so that

$$\delta\lambda \sim k\lambda^2/c \text{ or } \delta\lambda \sim (4\pi^2/3) \cdot (e^2/mc^2). \quad . \quad (3)$$

I have previously calculated the width of a spectrum line due to damping by the method of the Fourier integral (*Phys. Rev.*, **19**, 64; 1922) and have obtained a width $\Delta\lambda$ between half values of the maximum intensity of

$$\Delta\lambda = (4\pi/3) \cdot (e^2/mc^2) \quad . \quad . \quad (4)$$

It is interesting to note that $\delta\lambda$ and $\Delta\lambda$ are of the same order, namely, 10^{-12} cm. Does the Heisenberg principle therefore imply that a spectrum line given out by, say, a mercury atom, has a width in addition to the width due to the Doppler and pressure effects? Can a single quantum itself have a frequency width? When mercury resonance radiation is absorbed in mercury vapour, it seems necessary to assume a width for a single quantum if any absorption at all is to occur.

G. E. M. JAUNCEY.
Washington University,
St. Louis, Mo., U.S.A., May 24.

Vibrational Quantum Analysis of Red Cyanogen Bands.

A STUDY of the red cyanogen bands shows that the band at $\nu 14430$ is not the true $O - O$ band of the system. Six new bands on the higher λ side have been photographed on neocyanine plates, from the spectrum of cyanogen as developed in active nitrogen (R.K.A.) and of the high current density arc (J.W.R.). These can be fitted in a simple manner in the existing n'/n'' table for the red cyanogen bands, by extending the n' progressions as under:

n'/n''.	0.	1.	2.	3.	4.
0	10937 (*a*)				
1	12697 (*a*)	10654 (*b*)			
2	14432	12393 (*a*)			
3	16143	14099	12086 (*a*)		
4		15788	13769	11782 (*a*)	
5			15430	13439	11480 (*a*)

Numbers denote ν of the most refrangible head.
(*a*) denotes *new* bands found in active nitrogen and in arc.
(*b*) found in arc only.

This arrangement does not invalidate the existing analysis completely, and appears to be satisfactory. It is not certain that the band at $\nu 10937$ is the $O - O$ band, which may be higher up in the infra-red, beyond the range of sensitivity of the photographic plates now available. ω_0'' and $\omega_0''x''$ retain their old values; ω_0' is uncertain, but $\omega_0'x'$ retains the old value. The vibrational equation deduced from the present experiments, assuming $\nu 10937$ to be the $O - O$ band, is:

$$\nu_{(\text{head})} = 10937 + (1782\,n' - 13{\cdot}5\,n'^2) - (2055\,n'' - 13{\cdot}3n''^2).$$

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The Raman Effect in Carbon Disulphide.

IN view of the interesting observations of Rasetti with carbon dioxide (NATURE, Feb. 9 1929), the Raman spectrum of which was found to contain no lines corresponding to any of the observed infra-red absorption bands, the results obtained in the analogous compound carbon disulphide may be noteworthy. The scattered spectrum of this liquid gives two prominent frequency shifts, 655 and 800, corresponding to 15·27 μ and 12·50 μ respectively. The infra-red absorption of the liquid was studied by Coblentz in the region 2 μ to 15 μ, and he gives the following values for the absorption bands—3·2 μ, 4·6 μ, 6·8 μ, 11·65 μ, and 13·4 μ. All these bands, except the first, are very strong, the one at 6·8 μ being the most prominent. It is significant that none of these bands are represented in the scattered spectrum.

The Raman line corresponding to the frequency shift 655, excited by 4358, is very strong in the spectrum and has an anti-Stokes' line the intensity of which is less than 1/50 of it. The value calculated for the intensity ratio between the negative and the positive lines according to the relation $e^{-h\nu/kT}$ comes out to be 1/20. Whether this discrepancy in the relative intensity has any connexion with the absence of the corresponding infra-red absorption remains to be determined.

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S. VENKATESWARAN.
210 Bowbazar Street,
Calcutta, May 23.

The Ozone in the Earth's Atmosphere.

By Dr. D. N. HARRISON.

THE first accurate measurements of the amount of ozone in the atmosphere were made by Fabry and Buisson at Marseilles in 1920, and their method has been modified and developed by Dr. G. M. B. Dobson and others,[1] so that ozone observations are now made regularly at least once a day at about half a dozen places in different parts of the world. The results obtained up to the present from these series of observations are the subject of this article.

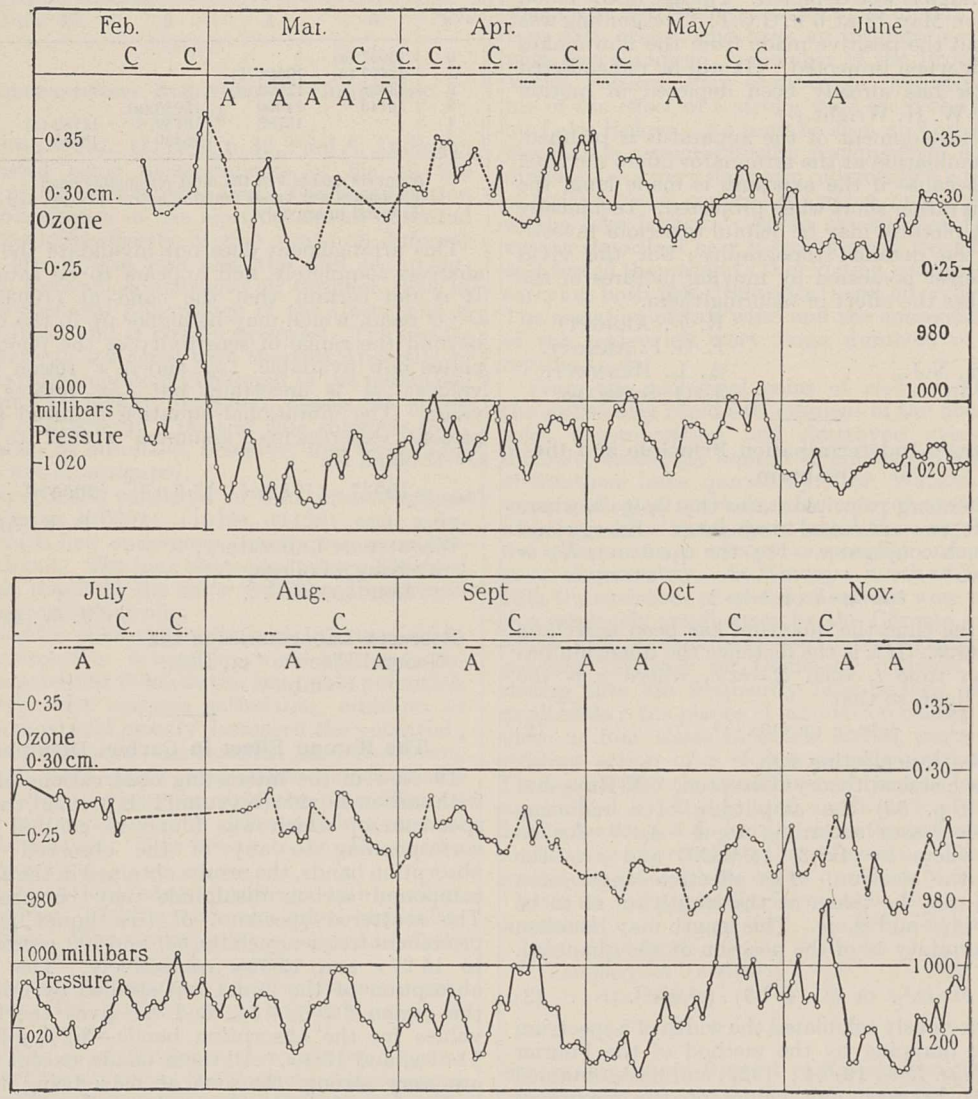

FIG. 1.

Ozone has an absorption spectrum consisting of bands in the infra-red, a weak band in the visible, and a very strong band in the ultra-violet, which cuts off the solar spectrum completely at about 2900 A. Its equilibrium temperature in sunlight is therefore higher than that of the other constituents of the atmosphere, which have no ultra-violet absorption. Moreover, atmospheric ozone was known to be confined to a region many kilometres above the earth's surface. Thus variations in the amount of ozone would be expected to affect the temperature of the upper atmosphere, and it was thought that in this way it might play an important part in the various changes which the atmosphere undergoes.

Ozone, as is well known, is a form of oxygen having three atoms in the molecule. It is formed from oxygen by the action of ultra-violet light of shorter wave-length than that which ozone itself absorbs. The spontaneous decomposition in the absence of a catalyst is extremely slow, but by absorbing ultra-violet radiation ozone is transformed into oxygen, so that in the absence of other factors the amounts of oxygen and ozone would

[1] *Proc. Roy. Soc.*, A, vol. 110 (1926), p. 660; vol. 114 (1927), p. 521; vol. 122 (1929), p. 456.

tend toward equilibrium, depending on the distribution of intensity in the solar spectrum. It was thought at one time that solar radiation was one of the main sources of atmospheric ozone, but this is probably not the case, for reasons which will be explained later.

METHOD OF MEASUREMENT.

Briefly, and without technical details, the method by which ozone is measured is as follows. The method is spectroscopic; since ozone absorbs ultra-violet light of certain wave-lengths, the intensity of this light reaching the earth from the sun depends on the amount of ozone in the atmosphere; the intensity of the light is measured photographically, and consequently the amount of ozone through which it has travelled can be found. This is expressed as the thickness of a layer of the pure gas at N.T.P.; it varies about a mean value of roughly 3 mm. in Europe. In actual fact, of course, the ozone is spread through an unknown depth of the atmosphere, and this method of expression merely gives the number of molecules per horizontal square centimetre. The accuracy of the measurements is such that the results can usefully be expressed to three significant figures; the unit is usually taken as 0·001 cm., so that 321 would mean that the amount of ozone was equal to that in a layer 0·321 cm. thick at N.T.P.

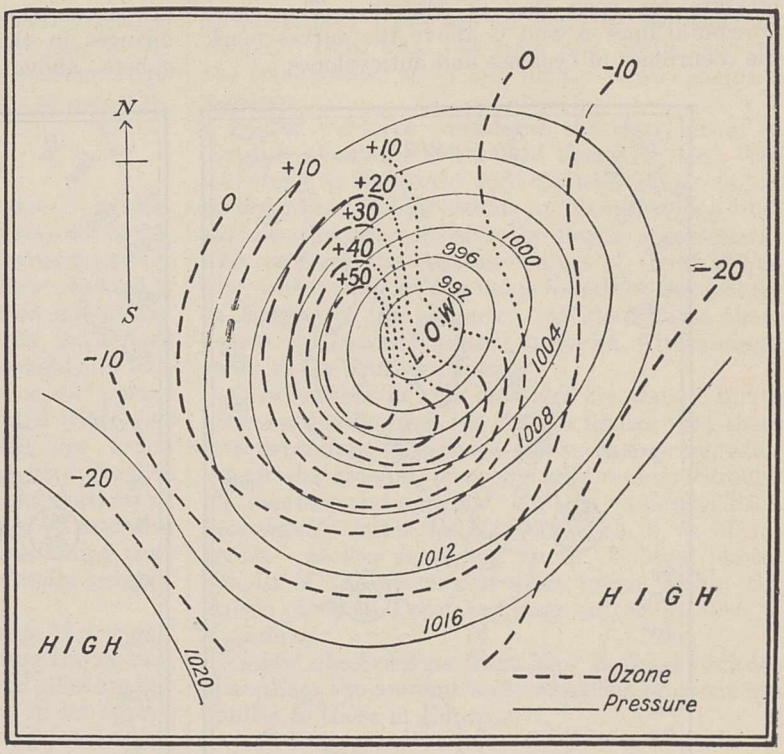

FIG. 2.

The height of the ozone layer can also be deduced. Several different workers agree in placing it at about 40-50 km.; this probably represents the 'centre of gravity' of the layer. The height appears to be greater when the amount of ozone is large than when it is small.

DIURNAL AND ANNUAL VARIATIONS.

It was discovered at Oxford in 1925: (1) that the amount of ozone can vary greatly from day to day, and indeed during one day; (2) that these variations have an inverse connexion with the barometric pressure; and (3) that there is a marked annual variation with a maximum of about 330 in April and a minimum of about 220 in October, taking a smooth curve through the year. Fig. 1[2] shows the ozone values for 1925, together with mean

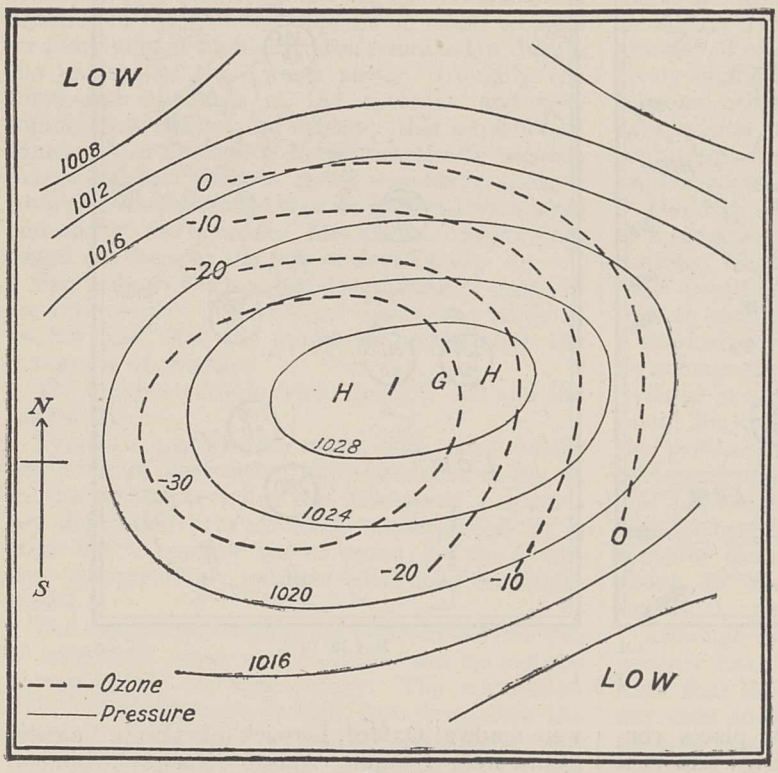

FIG. 3.

[2] The illustrations are reproduced by kind permission from the *Proceedings of the Royal Society*.

pressure for each day at Oxford. The short horizontal lines A and C above the curves mark the occurrence of cyclones and anticyclones.

are accompanied by definite and characteristic changes in the quantity of ozone in the atmosphere above any given place. Measurements

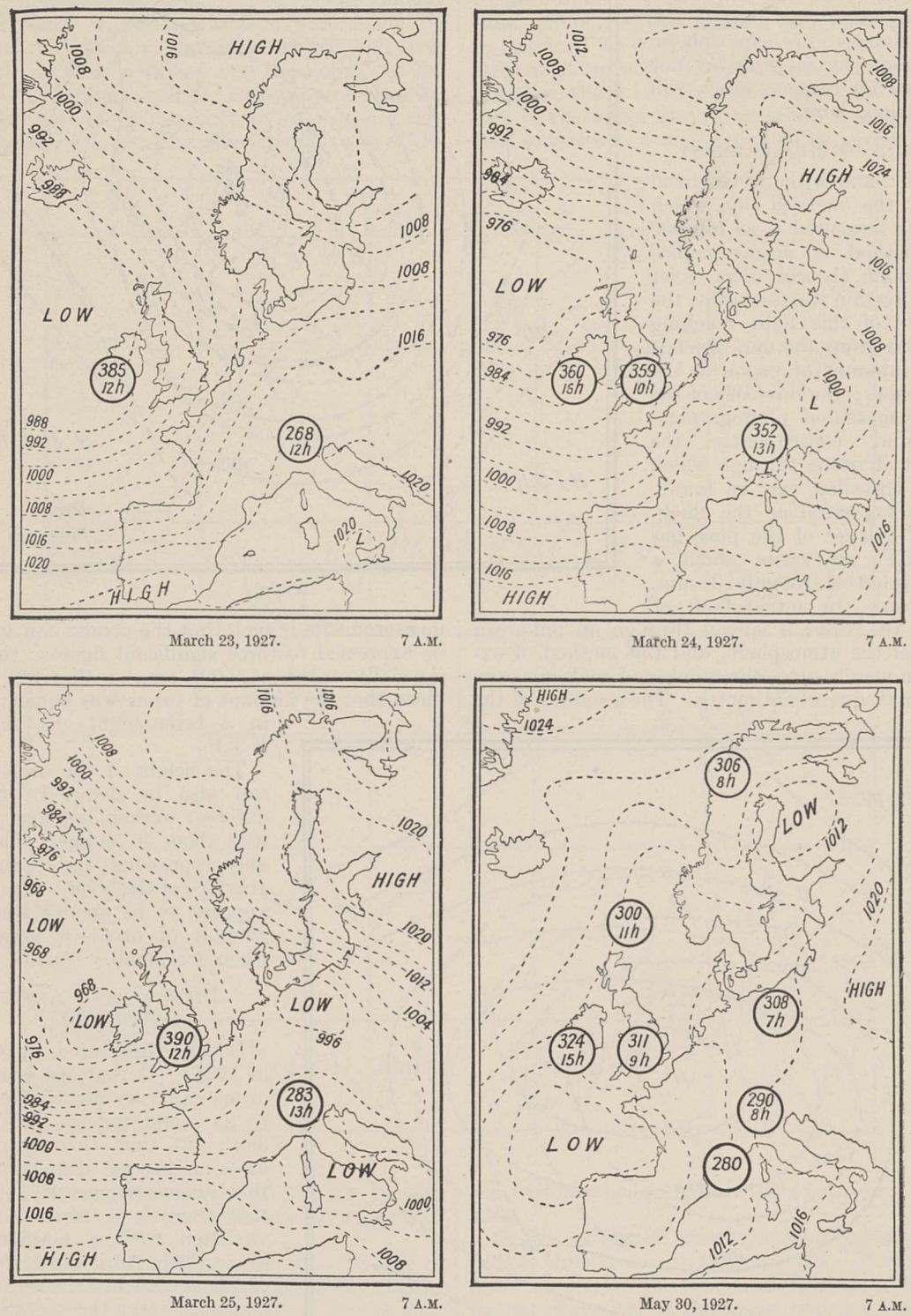

FIG. 4.

Subsequent observations at other places confirmed and amplified these conclusions, and it is now certain that the various sequences of weather were made at Oxford, Lerwick (Shetland), Valentia (south-west Ireland), Abisko (Norway), Lindenberg (near Berlin), Arosa (in the Alps), and Marseilles

during 1926 and 1927, with the view of discovering the distribution of ozone at different times, in the same sort of way as that in which weather maps are plotted by the aid of a network of reporting stations.

OZONE AND WEATHER.

The general conclusion so far reached is that there is a very close connexion between the ozone and the origin of the great air-currents the interplay of which gives us our 'weather'; the connexion is closest when the air considered is that not at the surface, but in the stratosphere (the isothermal region) which begins at a height of roughly 10 km. These currents are named by meteorologists 'polar' and 'tropical'; polar air is associated with high ozone values and tropical air with low ozone values. When studied in connexion with a weather map, the changes of ozone with the fluctuations of these air masses are most striking. There are difficulties, however, in the way of assuming that the varying quantities of ozone are actually brought by the air-currents.

Fig. 2 shows the average distribution of ozone in a cyclone. It was obtained by drawing the isobars for a typical or idealised cyclone, and plotting for each individual case the ozone value in its appropriate position; in order to eliminate the annual variation, the ozone values are expressed as differences from the mean for the time of year, so that the figure shows in units of 0·001 cm. the changes which, on the average, take place during the passage of a cyclone. (The figure should be imagined to move from left to right, that is, from west to east.) It will be seen that the ozone begins to fall at some distance in front of the depression, when tropical air is arriving at high altitudes, remains low during the passage of the 'warm sector' (roughly the south-east quadrant of the cyclone), and rises rapidly just behind the centre; this sequence of changes in a cyclone is found practically without exception, and even a small secondary (judged from the weather-map) may be followed by a large and abrupt rise of ozone. The highest ozone values found are those at the rear of depressions.

Fig. 3 shows the average distribution of ozone in an anticyclone; here we see that ozone tends to be low and that the minimum comes after the maximum of pressure.

The highest value hitherto found is 420 and the lowest 172.

Typical 7 A.M. weather maps, with ozone-values and hours of observation, are reproduced in Fig. 4. In the first three maps the passage of a secondary depression over Arosa is accompanied by a large but temporary rise of ozone; in the fourth map comparatively uniform conditions are illustrated.

The correlation co-efficients between the amount of ozone and upper air conditions are among the highest found in meteorology. The correlation with surface pressure is high, but those with the pressure at heights of 9-14 km. are much higher, and very high values are found for temperature in the troposphere and for the height of the base of the stratosphere; these are all negative, as would be expected from what has been said, while that for the temperature at 14 km. (in the stratosphere) is positive.

So far we have considered the distribution in Europe, about the latitude of Great Britain. We now turn to the world-wide distribution, so far as it is known. Observations at Montezuma (Chile) and at other places within the tropics give remarkably uniform and constant values of about 200 to 220, which is about the value found for tropical air in Europe in the summer. At Montezuma there seems to be a small annual variation, with a maximum in the southern spring.

Observations in high latitudes are scanty, but it seems probable from the Abisko figures that there is a maximum of perhaps 400 in the spring, after which the amount of ozone falls rapidly through the summer and autumn. In this connexion Prof. Rosseland's letter in NATURE, Feb. 9, is of interest. As was predicted by Dr. Dobson, photographs of the spectra of stars taken within the Arctic circle in December were cut off at 3000 A. by ozone.

A few observations from New Zealand indicate that there the amount and variations of ozone are similar to those in Europe.

ORIGIN OF OZONE IN THE ATMOSPHERE.

These results are of great interest from their bearing on the probable origin of atmospheric ozone. The ozone is at a minimum in the tropics; it is at a maximum in Arctic regions after the winter night, and decreases rapidly as the sunlight becomes stronger. Therefore we must conclude that the amount of ozone in equilibrium in sunlight is relatively small (perhaps about 2 mm.) and there must be some other source of supply. The rate of decomposition in sunlight must be slow, since observations near sunrise and sunset indicate no regular decrease during the day.

The origin may possibly be found in the aurora, or some associated phenomenon of which we know nothing. The amount of ozone is related to magnetic conditions in the sense that high ozone values tend to occur at times of magnetic disturbance, and a marked auroral display is always accompanied by a magnetic storm. Nevertheless, the aurora is situated at a height of 100-500 km., far above that found for the ozone layer. Further evidence of the presence of ozone at about 50 km. is given by temperatures found near this level. Dobson's and Lindemann's observations of meteors gave a high temperature above 55 km., and observations of sound-waves indicate a temperature at about 40 km. as high as that at the earth's surface.

Although no simple relation between ozone and weather has been found, the results here outlined show that the problem is full of interest; and in any case no one would expect, with such a complicated machine as the earth, its atmosphere, and the sun together form, to disentangle one complete thread of cause and effect.

Polyploids and Polyploidy.

By C. D. DARLINGTON.

WHEN a cell divides to produce two daughter cells having the same genetical properties as itself, the nucleus resolves itself into a definite number of structures, the chromosomes. These, splitting lengthwise, give rise to two identical groups which go to make the daughter nuclei. In this process, known as mitosis, it is evident that, with certain exceptions which need not be gone into here, the chromosomes into which the nucleus resolves itself are always identical in number and form with those which went to constitute it at the preceding division. The chromosome number is said to be constant. It follows that when, in the course of sexual reproduction, two germ-cells unite to form a zygote and their nuclei fuse, the new generation of cells thus established will show at mitosis a new chromosome outfit or 'complement', the sum of those of the two germ-cells. When these are identical the number will be simply doubled, and in these circumstances the number of chromosomes in the germ-cell is said to be 'haploid' and the double number of the zygote is said to be 'diploid' (see Fig. 1). Further, when the new zygote comes to produce germ cells, which by their union will reconstitute a diploid individual like itself, the zygote nuclei undergo a process of 'reduction', by which a new cell generation is produced having the haploid number of the gametes.

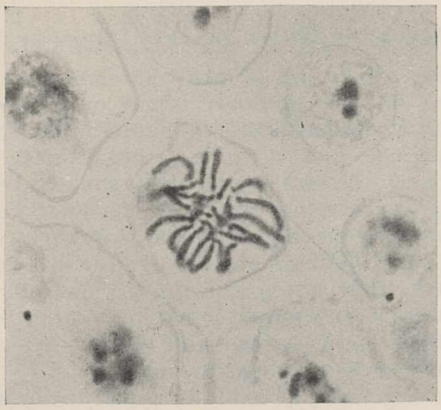

FIG. 1.—The diploid chromosome number (24) in a root tip of *Tulipa Clusiana*, a form from Tibet.

These three processes provide the mechanism that determines the Mendelian laws of inheritance, and so long as mitosis, fertilisation, and reduction follow a regular course, the Mendelian laws, with all the complications that are implicit in them, are obeyed. But all three processes are liable to error. In the first place, we frequently find body cells, both in plants and animals, the chromosome numbers of which are double those characteristic of the individual and its species. This type of 'doubling' probably follows the failure of two bodies of chromosomes to separate after mitosis, or the simultaneous division of two nuclei which have not been separated by a cell-wall after the preceding cell-division. In plants, owing to their unlimited growth, such 'doubled' cells sometimes produce germinal tissue, and a new tetraploid race, such as *Primula kewensis*, with four times the haploid chromosome number, is established. Doubling is so frequent in the formation of a callus in the tomato that we can be certain of obtaining a proportion of tetraploids amongst the adventitious shoots thrown up from the callused wound when the stem is cut off. In the normal course of development, doubling has been found to occur frequently in the embryo-sac nuclei of several plants belonging to the Liliaceæ. Usually the doubling occurs at the opposite end of the embryo sac from the egg-cell, but sometimes the egg-cell itself is affected, and in these cases fertilisation of the diploid female gamete will produce a new triploid individual.

In the second place, abnormalities in fertilisation occur which give rise to a different kind of change. Various stimuli may excite the development of the egg-cell without fertilisation. For example, when an interspecific cross, such as hexaploid *Solanum nigrum* by tetraploid *S. luteum*, is attempted, the stimulus of pollination sometimes excites the development of the egg-cell with the reduced (triploid) number, although the pollen-nucleus does not fuse with the egg-nucleus. Similarly, by the stimulus of changes of temperature, an egg-cell in *Datura* can be induced to develop. In these ways a haploid, or relatively haploid, individual arises having the hereditary material of a germ-cell and the outward form, on a reduced scale, of a diploid plant. Experimentally it has been found possible to induce the fusion of two male germ-cells with one female; in the formation of the endosperm we have virtually the reverse case of the fusion of two female germ-cells with one male. From both these unions a triploid cell generation is produced.

It is in the finely regulated processes of reduction, however, that irregularities most frequently occur, and these irregularities are of great importance in the production of polyploids. In considering reduction, two properties of the chromosomes should be particularly borne in mind. First, the material of which the chromosomes are made up has specific physiological properties, so that, to take a simple example, if one type of chromosome is represented in the organism three times instead of twice, constant physiological changes are produced. To take another example, if one of the chromosomes of a haploid gamete is lacking, the gamete is not usually viable. Secondly, where, as is usually the case, the diploid organism is the result of the union of two similar gametes, the chromosomes contributed by these gametes must correspond in pairs. They must be structurally and functionally homologous. When, therefore, we see pairs of chromosomes formed at reduction, it is a legitimate assumption that these are pairs of homologous

chromosomes and that they pair because they are like. Further, where pairing fails, it is perhaps natural to conclude that this failure is the result of lack of likeness or affinity. Exceptions to this rule we shall return to later. In the main it is true,

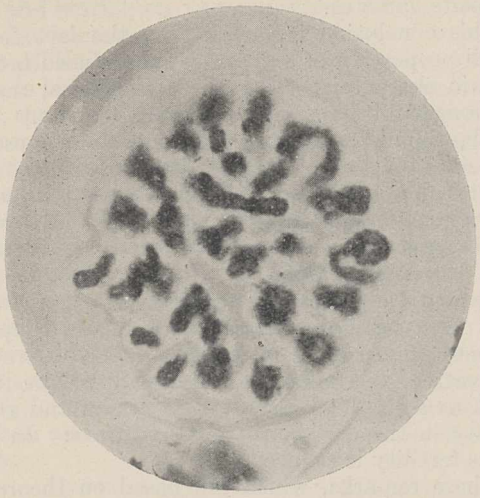

FIG. 2.—Pollen mother-cell division in a pentaploid form of *Tulipa Clusiana* (60 chromosomes) showing associations of various numbers of chromosomes, and some chromosomes unpaired.

and it is as a consequence largely of failure of pairing that irregularities in reduction arise in hybrids.

The simplest form that these irregularities can take is the failure of the two corresponding groups of chromosomes to separate, and the consequent formation of a single nucleus with the diploid number. This nucleus then divides to give two nuclei in which the number is similarly unreduced. Germ-cells have been shown to arise in this way in large numbers of plants, which are either of known hybrid origin (like *Raphanus-Brassica*) or believed on independent grounds to be hybrids (like species of *Hieracium*). In *Pygœra* hybrids, where the formation of diploid germ-cells, with complete failure of chromosome-pairing, was first observed, the nuclear phenomenon was shown to be correlated with the fact that the character differences completely fail to segregate. This is one of the discoveries on which the chromosome theory is based.

If the conditions of the origin of polyploids *before the fact* are almost universal, the conditions *after the fact* impose important limitations on their maintenance. These limitations are almost all bound up with the processes of sexual reproduction. Where the sexes are differentiated, doubling of the chromosome number may be associated with sterility on one side, as in *Pygœra* hybrids, and consequent failure of the tetraploid to perpetuate itself; or there may be a change in the method of reproduction, as in *Artemia* where a tetraploid is parthenogenetic, or *Empetrum* where a tetraploid is hermaphrodite, the diploid that probably corresponds being in each case unisexual.

In a different way the purely mechanical conditions of reduction greatly limit the success of those polyploids which reproduce sexually. The conditions under which the corresponding chromosomes separate regularly when present in pairs are not always equally satisfactory when more than two of each kind are present. For example, in a triploid, where there are three of a sort, the odd chromosomes, whether associated with the pairs or not, separate at random to the two daughter cells. Consequently the germ-cells produced have chromosome numbers varying between the haploid and the diploid number (see Fig. 3). In these new intermediate types the balance of the physiologically differentiated chromosomes is new, untried, and in most cases unsuccessful. Most triploids are therefore sterile so far as sexual reproduction is concerned. Triploidy is none the less common both in natural species and in cultivated plants, but a study of its incidence shows that in these established triploid forms sexual reproduction has lost its value. Triploids occur, for example, in plants with various kinds of natural vegetative propagation in *Hyacinthus*, *Tulipa*, *Iris*, *Rubus* (Fig. 4), *Canna*, and *Tradescantia*; with reproduction by grafting in *Prunus*; with apogamy in *Hieracium*; with partial parthenocarpy in the cultivated apples; and probably with both apogamy and parthenocarpy in cultivated *Citrus*. To such forms as these it is clear that ordinary seed fertility, so far from being an advantage, may actually become a hindrance.

The case of tetraploids is more complicated, both in regard to chromosome behaviour and to the fertility that largely depends on it. For the sake of simplicity, let us take two opposite types. From a haploid *Datura*, itself the result of the development of an unfertilised egg, diploid offspring have

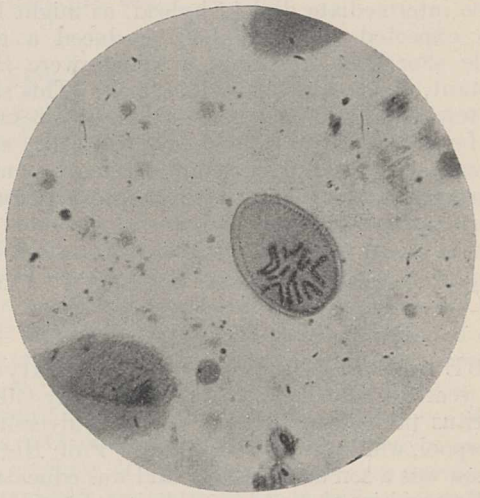

FIG. 3.—A pollen grain of a triploid hyacinth (somatic number, 24) showing 13 chromosomes; numbers between 8 and 16 have been found. Note the three chromosome types.

arisen by failure of reduction, and from these again tetraploids. In such tetraploids there are four identical representatives of each chromosome type, which usually associate to form quadrivalent bodies at reduction. These quadrivalents are, of course, capable of dividing into two and two, but seem to

be subject to irregularity in division, for gametes arise (as in tetraploid *Prunus cerasus* and *Tradescantia virginiana*) both with more and less than the normal gametic number, and the fertility of such tetraploids is consequently reduced.

We may mention parenthetically that, just as the functional gametes must contain two out of the four chromosomes of each type chosen at random, so the breeding results in tetraploid *Datura* and *Primula sinensis* have always agreed with the assumption that two Mendelian factors, chosen at random from four, pass to each gamete. This agreement, verifying prediction, is a substantial corroboration of the chromosome theory of heredity.

On the other hand, we have tetraploids arising as a result of doubling in hybrids. The result depends on what we may loosely call the 'degree of hybridity.' *Primula kewensis* is not an extreme example, and will serve to show the peculiarities

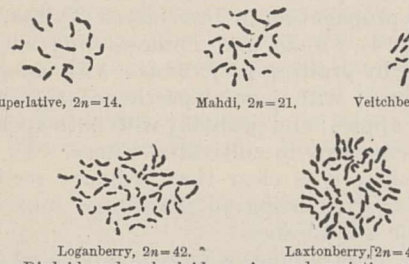

FIG. 4.—Diploid and polyploid species and varieties of *Rubus*. All the even multiples are fertile, although the tetraploid and hexaploid are known to be interspecific hybrids. The odd multiples are both sterile in a high degree.

associated with various degrees of hybridity. It is the result of a cross between *Primula floribunda* and by *P. verticillata*, which gave in the first instance a sterile intermediate diploid hybrid, as might have been expected. This diploid produced a giant fertile shoot the offspring of which were fairly constant, giant, and fertile like itself. This shoot was tetraploid and must have arisen as a result of the formation of tetraploid somatic cells, as in *Solanum*. In the diploid hybrid, the corresponding chromosomes of the two parental species paired at reduction; its sterility must therefore be assumed to be the result of failure of the new genetic combinations brought together in the gametes. In the tetraploid, however, pairs are usually formed as in the diploid, but the general absence of segregation means that identical mates must pair and pass to opposite gametes.

This conclusion is justified by the fact that a small proportion of segregates is produced bearing certain characters of the parental species, that is, no longer intermediate in every respect. In a similar small proportion of cases the chromosomes associate in fours, derived therefore from both species and capable of yielding gametes pure in the characters of one species carried by the chromosomes concerned. It follows that the constancy and relative fertility of the hybrid tetraploid depends on its degree of hybridity, for, in so far as the corresponding chromosomes of the opposite species are capable of pairing in the tetraploid derivative, dissimilar gametes will be produced, both as a result of genetic segregation and abnormality in the division of quadrivalents. In both cases fertility is reduced.

These remarks, which are based on theoretical considerations, are in agreement with all the available experimental evidence. Fertile diploids such as *Œnothera Lamarckiana*, *Datura Stramonium*, *Primula sinensis*, *Solanum Lycopersicum*, and *Campanula persicifolia* give less fertile tetraploids. Sterile diploids such as *Primula kewensis*, *Raphanus-Brassica*, and relatively diploid *Nicotiana* and *Solanum* hybrids give more fertile tetraploids.

It is therefore possible for a tetraploid arising from a hybrid diploid to have the mechanical properties of a fertile diploid. But it combines with these certain genetical peculiarities. Not only is it a hybrid, with such physiological advantages as hybridity may confer, but occasionally the corresponding chromosomes of the opposite diploid parents may pair. The tetraploid will then show the segregation of a hybrid, and may give rise to offspring with any workable combination of the characters of its two parents.

(*To be continued.*)

Obituary.

PROF. R. J. HARVEY-GIBSON.

THE death in Glasgow on June 3, at sixty-nine years of age, of Dr. Robert J. Harvey-Gibson, emeritus professor of botany in the University of Liverpool, will be widely regretted. Prof. Harvey-Gibson was a son of the manse and was educated in the Universities of Aberdeen, Edinburgh, and Strasbourg. He first held appointments as demonstrator in zoology and later in physiology in the University of Edinburgh. His association with the University of Liverpool goes back to the year 1883, in which his first appointment was that of demonstrator in biology in the old School of Medicine, which was later amalgamated with University College as the foundation of the present University. At the amalgamation, Harvey-Gibson was promoted to a lectureship in botany, which became in 1887 a subject in the new Faculty of Science. The institution and growth of a Department of Botany under his direction soon followed, and in 1889 a new laboratory was erected to meet the needs of the Department. The first assistant in the Department was Dr. A. J. Ewart, and when in 1894 Mr. Holbrook Gaskell made possible the foundation of a chair of botany, Harvey-Gibson became its first holder and worked arduously for the advancement of the Department and the acquisition of modern laboratories. At that time Dr. J. C. Willis was a student in the Department. In 1900 Mr. Hartley offered to build a new laboratory, and in 1902 the present Department was erected to the plans of

Prof. Harvey-Gibson, and was officially opened by Sir W. Thiselton-Dyer.

It may truly be said that Harvey-Gibson devoted himself to the construction and equipment of a department, and that in this he built largely for his successors. Yet he found time for investigation and writing on varied subjects, for he was of catholic interests, and for administration in many fields of University activity. His chief contributions to his subject are a series of papers on marine algæ, the Lycopods, and on questions of systematic anatomy, and he was the author of philosophical essays, an outline of the history of botany, and other works of a more general nature. He was keenly interested in the military training of undergraduates and was the founder of the Officers' Training Corps of his University. During the War he served as a colonel in the Territorial Army and took an active part in the work of the Red Cross Society.

Harvey-Gibson was a man of scholarly achievement, and although he had been in indifferent health for some years, he maintained a lively interest in all branches of his subject and in classical study.

MRS. THEODORE BENT.

THE death of Mrs. Theodore Bent on July 3, at the age of eighty-three years, has removed a striking personality for many years familiar in literary and scientific circles in London. She was the widow of Theodore Bent, whom she married in 1877. Of Irish extraction, she preserved to the end of her life some of the characteristics of her nationality, notably readiness in conversation and a sharpness in repartee.

Mrs. Bent accompanied her husband and gave him valuable assistance in his many journeys of archæological exploration. Their first important expedition was in the Aegean Islands in 1885–86 and 1886–87. In the latter year Bent was excavating in Thasos under the auspices of the Society for the Promotion of Hellenic Studies. Journeys to Asia Minor in 1888 and to the Bahrein Islands in the Persian Gulf in 1889 were followed by their best-known expedition in 1891, when they visited South Africa to study the ancient ruins at Zimbabwe in Mashonaland, then examined and measured systematically for the first time. The results of the expedition were embodied in "The Ruined Cities of Mashonaland" which appeared in 1892. Bent held the view that the builders of Zimbabwe were a northern race from Arabia, and for the rest of his life—he died in 1897—their expeditions had as their object to discover traces of such a race. They visited Abyssinia and the southern part of Arabia, of which they made a special study, visiting the almost unknown Hadramut country. Their last journey was through the Vafei and Fadhli countries in March 1897, Mrs. Bent giving an account of this journey to the Royal Geographical Society.

Mrs. Bent was an experienced photographer, as well as an accurate observer, as was shown by the book "Southern Arabia", published in 1900, which was written mainly by her with the aid of her husband's journals. One book which she wrote apart from her husband was "Anglo-Saxons from Palestine", published in 1900, in which she showed herself an adherent of the Anglo-Israelite theory.

WE regret to announce the following deaths:

Mr. A. B. Bruce, formerly of the Indian Civil Service and of the Ministry of Agriculture, on July 2.

Prof. L. T. Hobhouse, Martin White professor of sociology in the University of London, on June 21, aged sixty-four years.

News and Views.

AN honorary fellowship of the British Academy—a signal distinction—has been added to the many academic honours which have been conferred on that veteran scholar, Prof. A. H. Sayce. He has also been awarded the Huxley Memorial Medal of the Royal Anthropological Institute for 1929, and invited to deliver the Institute's Huxley Memorial Lecture in 1930. Prof. Sayce's long career—he is now in his eighty-fourth year, and has been a fellow of Queen's College, Oxford, since 1869—is a remarkable record of scholarship, both in the study and in the field. For to the long list of books and articles from his pen dealing with the archæology of the Near East, especially as related to Biblical archæology, must be added his work as an explorer and excavator in Asia Minor, Egypt, and other countries of the East which bear upon his special studies. His work in the decipherment of cuneiform and Hittite inscriptions will always be a monument to British scholarship in this branch of study. Yet notwithstanding the highly specialised character of his studies, his interests have always remained wide, as was shown by the "Reminiscences" published in 1923. It was probably a surprise to most of his readers to learn that he was nearly shot as a spy in the Franco-Prussian War of 1870.

THE Kelvin Medal Award Committee, consisting of the presidents of the leading British engineering institutions, after consideration of representations received from leading engineering bodies in all parts of the world, has awarded the Kelvin Medal for 1929 to M. André Blondel. The medal is awarded as a mark of distinction in engineering work and investigation of the kinds with which Lord Kelvin was especially identified. M. Blondel, as engineer of the Ponts et Chaussées since 1889 and for many years the chief engineer of the French lighthouse services, is distinguished by his work on signalling apparatus, both optical and electrical, and particularly for his investigations in connexion with electrical measuring apparatus and photometry. In 1913 he was elected a member of the Paris Academy of Sciences, and in 1923 was appointed Inspecteur Général des Ponts et Chaussées. M. Blondel is an honorary member of both the British and American Institutions of Electrical Engineers. This is the fourth triennial award

of the medal, which has in previous years been given to Dr. W. C. Unwin (Great Britain), Prof. Elihu Thomson (U.S.A.), and the Hon. Sir Charles Parsons (Great Britain).

THE new laboratory at the University of Sheffield for research on the cold-working of steel, opened on July 6, has been established in consequence of a generous gift from the Worshipful Company of Ironmongers of London, which made a grant of £800 a year for seven years to endow a fellowship and two scholarships in the cold-working of steel. To make this gift available, the firms connected with the cold-working industry have, through the Cutlers' Company of Hallamshire, presented the University with the necessary plant. The new laboratory will be attached to the metallurgical and engineering departments of the University, and will be controlled by the professors of those subjects assisted by a committee on which the Ironmongers' Company, the Cutlers' Company, and the industry will be represented as well as the University. The University is greatly indebted to Mr. Percy Lee, Master Cutler of last year, to whose initiative and energy the establishment of the laboratory is due.

THE mechanical equipment of the new laboratory includes a wire and bar drawing plant constructed by Messrs. George Crossley, Ltd., of Cleckheaton. Having a two-speed gear and variable speed motor, wire drawing speeds of from 28 to 360 feet a minute may be obtained, and wires can be drawn of all sizes up to $\frac{5}{8}$ in. diameter and rods up to 1 in. diameter. The heavy drawing block is fitted with a friction clutch drive and capstan type pull-in gear, which is also used for drawing steel bars, for which purpose a specially strong die stand is fitted at the end of the bench. The light wire block is fitted with the ordinary creeper drive, using spring shock-absorbing cushions. Capstan type pull-in gear is provided. The motor can develop 20 h.p. throughout its range of speed. The rolling mill plant has been constructed by Messrs. W. H. A. Robertson and Co., Ltd., of Bedford. It has hardened steel rolls of 10 in. diameter and 10 in. face, and is fitted with two-speed gear box and variable speed motor, giving a range of rolling speeds from 60 to 300 feet a minute. The motor is capable of developing from 50 h.p. at 570 r.p.m. to 120 h.p. at 1260 r.p.m. The lubrication is by Messrs. Robertson's patent 'Flood' system. Water cooling is provided for the rolls and roll bearings and for the oil in connexion with the lubrication system. An alternative set of rolls is fitted with 'Skefko' double roller bearings. The research laboratories of the Department are well provided with appliances for mechanical and physical testing of the cold-worked material, including a complete outfit for the study of deformation by the X-ray method.

THE *Bulletin* of the Physical Society for May contains abstracts of the papers communicated and the remarks made at the discussion on the teaching of geometrical optics held on April 26. Nearly thirty members took part, some engaged in teaching the subject in schools, others in university or technical colleges, and a few engaged in designing or constructing optical instruments. On the question of sign convention, there appears to be wide differences of opinion; some teachers take distances as positive when measured with the light stream, others positive against the stream; some make a converging lens have a positive, others a negative, focal length. The designers all appear to use the analytical geometry method, and in conformity with industry make the focal length of a converging lens positive. These sign conventions are the great stumbling-block in the way of pupils, one speaker stating that in a recent school examination 240 out of 244 candidates made mistakes of sign in a simple lens question.

THE vergence or convergence method of dealing with lens problems, which has been used in several German and at least one English book for thirty years or more and is free from many of the difficulties as to sign, was mentioned by one teacher only. The wave surface method introduced forty years ago was advocated by three teachers and by several speakers holding non-teaching posts, but was considered unsuitable by the majority of the school teachers. Many speakers stressed the necessity of bringing the pupil, whether in school or college, into contact with modern optical instruments. It must be very unsatisfactory to school teachers of the subject to find how frequently their pupils fail to understand the sign convention they use, and it is to be hoped that one result of the discussion will be the general adoption of some method which will produce better results than those brought before the meeting.

ON Monday, July 8, an interesting collection of exhibits was opened at the Science Museum, South Kensington, to illustrate the history of the famous Rainhill locomotive trials on the Liverpool and Manchester Railway, the centenary of which falls in October of this year. The three outstanding dates in the early development of the world's railway systems are Sept. 27, 1825, when the Stockton and Darlington Railway was opened; Oct. 6, 1829, when the competition between the *Rocket*, *Sans Pareil*, *Novelty*, and *Perseverance* began on the Liverpool and Manchester Railway; and Sept. 15, 1830, when that line was officially opened. The collection of engines and models in the locomotive section of the Museum is well known, but during the next four months additional exhibits, including portraits, models, drawings, and letters, will be shown, while the Museum authorities have constructed a full-scale model of Ericsson's *Novelty*, and Mr. Henry Ford is kindly lending the working copy of Stephenson's *Rocket* which he has had constructed for his Museum at Dearborn, Michigan, U.S.A. Railways came into use two hundred years ago; Trevithick made the first steam locomotive in 1804, Blenkinsop's engines were running in 1812, Hedley's *Puffing Billy* was built in 1813, and Stephenson's first engine in 1814. By 1829 about fifty locomotives had been made in England; two, which would not go, in Germany; and one, a mere model, in America. Even in 1829, however,

there was a difference of opinion about the merits of the locomotive, but the Rainhill trials settled the question once for all. The exhibition just opened should prove of great interest to teachers giving lessons on industrial development.

A FURTHER contribution to the history of the ship was made by Sir Westcott Abell in a paper read at Newcastle on July 2 to a joint meeting of the North-East Coast Institution of Engineers and Shipbuilders and the Institution of Engineers and Shipbuilders in Scotland, entitled "The Story of Safety at Sea". Dealing with his subject under the headings freeboard regulations, subdivision into watertight compartments, and life-saving appliances, he referred to the loading marks placed on the sides of vessels by the Venetian authorities so early as A.D. 1000, and an appendix gives a chronology of safety regulations. The modern history of the subject, however, begins with the action of the Committee of Lloyd's and the Liverpool Underwriters, who, about 1835, proposed rules governing free board. The important work of the Royal Commission of 1873 came through the action of Plimsoll, who took up the cause of sailors in unseaworthy ships, in the House of Commons. The various committees which have sat under the guidance of Sir Edward Reed, Sir Philip Watts, Sir Edward Harland, and Lord Charles Beresford have dealt with various aspects of the matter; the First International Conference on the Safety of Life at Sea was held in 1913, and the second met in April and May last. The latter was attended by representatives from fourteen maritime countries and four Dominions and Colonies, and regulations were agreed to for the subdivision and construction of ships as well as for life-saving appliances, navigation, and wireless. In some tabular matter accompanying his paper, Sir Westcott Abell states that the average number of vessels lost annually during 1905–14 was 44, while the average during 1920–27 was only 18.

THE only paper read at the recent summer meeting of the Institution of Mechanical Engineers, held at Manchester on June 24–28, was that by Mr. R. W. Bailey on "The Contribution of Manchester Researches to Mechanical Science." Beginning with a reference to the work of Dalton, Mr. Bailey reviewed at some length the epoch-making investigations of Joule on the mechanical equivalent of heat, and then passed on to the researches of Fairbairn, who was "a born engineer, possessing all the qualities necessary for the execution of large enterprises, and although, perhaps, of limited technical attainments, he appreciated and was able to employ them in others". Fairbairn's collaborators included Eaton Hodgkinson and the mathematician Thomas Tate. Hodgkinson's own work on cast iron is among the classics of engineering research. The concluding part of the paper was devoted to the work of Osborne Reynolds, who, like Dalton and Joule, "possessed the philosophic mind and a gift for demonstrating or investigating a phenomenon by simple and ingenious experiment". The full import of Reynolds's researches is only now adequately appreciated. Mr. Bailey also gave a sketch of the researches conducted in the mechanical engineering departments of the University of Manchester and of the Manchester Municipal College of Technology. The paper as it has been published is illustrated by photographs and drawings, and contains a bibliography which in itself affords ample evidence of the great value of the research work done in the district.

MR. E. C. SNELGROVE completes an interesting account of two important irrigation schemes in the Bombay Deccan in *Engineering* for June 21. The first is on the River Pravara and the second on the River Nira, both of which rise in the Western Ghats. The scheme on the Pravara River included the erection of the Bhandardara Dam for impounding water in Lake Arthur Hill, while that on the River Nira included the erection of the New Bhatgar Dam for storing water in Lake Whiting. The rainfall on the Ghats reaches as much as 250 in. per annum, but it is confined to the four monsoon months. The Bhatgar Dam, which took sixteen years to build, is by far the biggest masonry dam in the world, while the Bhandardara Dam is only exceeded in height by the Pacoima Arch Dam, California. The Bhandardara Dam is 1663 feet long, 278 feet high above the lowest foundation, and cost £560,000, while the storage capacity of Lake Arthur Hill is 10,086 million cubic feet. The Bhatgar Dam, replacing an older dam of the same name, is 5333 feet long, 190 feet high, and contains 21½ million cubic feet of masonry, or nearly 3½ million cubic feet more than the Assuan Dam; it cost £1,170,000. Mr. Snelgrove compares the cost of these three great dams, and says that 100 cubic feet of masonry in the Bhandardara Dam cost £4, 13*s.* 4*d.*, in the Bhatgar Dam £5, 10*s.*, and in the Assuan Dam £12, 17*s.* 4*d.* He also says that protecting the land by irrigation increases its value by 200 per cent, and that while charges for water have increased by less than 40 per cent, the value of crops has increased by about 85 per cent.

THE *Himalayan Journal*, of which the first number is dated April 1929, is a periodical that is to be published from time to time by the Himalayan Club. This club, designed to bring together all those interested in travel and exploration in the Himalaya, was suggested so long ago as 1866, but the actual foundation dates from 1927. The club exists "to encourage and assist Himalayan travel and exploration, and to extend knowledge of the Himalaya and adjoining mountain ranges through science, art, literature, and sport". At its start it amalgamated with the Mountain Club of India, the foundation of which was contemporaneous. The club hopes to prepare route- and guide-books as well as scientific monographs. It has found temporary accommodation in the office of the Survey of India at Simla. The *Himalayan Journal* is edited by Major K. Mason, and contains a dozen important articles illustrated with photographs and maps. They include articles by Mr. F. Ludlow on the Shyok Dam in 1928; by Major K. Mason on the Indus floods and the Shyok glaciers; and by Mr. Kingdon Ward on botanical exploration in the Mishmi Hills. News of various

expeditions are also given. The journal has started with a high standard of achievement which promises well for future issues.

IN *A.E.G. Progress* for May an interesting account is given of a floating Diesel-electric power station. This station was built specially to help in the construction of a lock on an inland waterway near Berlin. The station is of 500 horse-power, and work on the lock has been proceeding continuously for the last eighteen months. Any disturbance to the smooth working of the water pumps used for draining would be very serious and would involve a heavy loss. In colonial countries, new power stations are sometimes erected on building sites of a swampy nature. In this case the outlay for the machine foundations is very costly. As the probable demand also is difficult to estimate, it seems to us that a floating power station would be very useful. It could be anchored in a river or in a sheltered sea bay, and the electrical possibilities of the site could be explored in a year or two and the ideal site for an electric power station to serve the neighbourhood determined. The advantages of a Diesel-electric unit are that it can be started almost at once and is always ready for service. These units can also be erected on pontoons. With four cylinder engines the vibration is noticeable but is not objectionable.

THE non-magnetic ship *Carnegie* left Yokohama on June 24; she is due at San Francisco about July 29. The vessel was at Pago-Pago, American Samoa, on April 1–5, and at Apia, Western Samoa, on April 6–20. Passing close to Wake Island on May 11, the vessel arrived at Guam on May 20 and left for Yokohama on May 25. The oceanographic observations are constantly developing new bottom features; among these was the discovery of a new deep which was named "Fleming Deep" by Captain Ault, the maximum depth recorded being 8650 metres at lat. 23·8° N. and long. 144·1° E. While in Western Samoa and in Japan the magnetic standards of the Apia and Kakioka observatories were compared with those of the *Carnegie*. Celebrations of the twenty-fifth anniversary of the research activities of the Carnegie Institution of Washington are to be held on board the *Carnegie* in San Francisco Harbour on Aug. 26, 27, and 28, just before her departure late in August for Hawaii, Samoa, and New Zealand.

AT its annual business meeting, held at Worthing last week, the Museums Association elected Dr. F. A. Bather as an honorary member in recognition of his distinguished museum work and of his services to the Association as president, as editor, and in other ways during the forty years of its existence.

THE earthquake which was felt in Gloucestershire on Tuesday, July 2, was recorded at Kew Observatory as an extremely small disturbance, which commenced at 20 hr. 27 min. 32 sec. G.M.T., and lasted about 30 sec. Five considerable earthquakes were recorded at the Observatory during the three days July 5–7. Four of these had epicentres in the North Pacific. The fifth, which occurred on the morning of July 6, originated in the Atlantic Ocean off the coast of Brazil.

THE Newcomen Society will hold its summer meeting jointly with the Devonshire Association at Dartmouth on July 23–26 to commemorate the bicentenary of the death of Thomas Newcomen. During the meeting a small collection of Newcomeniana will be on view in the Mayor's Parlour at the Town Hall. Wreaths will be laid on the Newcomen Memorial on July 23, when Mr. L. St. L. Pendred, president of the Newcomen Society, will deliver a eulogy, and Dr. G. P. Bidder, president of the Devonshire Association, will give an address on the same evening. Eng.-Capt. E. C. Smith is to deliver a public lecture on "Thomas Newcomen: Two Hundred Years of Steam Power" on July 25, and various local excursions have also been arranged. The honorary secretary of the Newcomen Society is Mr. H. W. Dickinson, Science Museum, South Kensington, London, S.W.7.

IN our issue of June 15, p. 926, in a paragraph on "Chemical Apparatus", it was stated that Messrs. Griffin and Tatlock, Ltd., combine the former business of John J. Griffin and Sons, Ltd., and Baird and Tatlock, Ltd. While this statement is perfectly correct, we are asked to point out that Messrs. Baird and Tatlock (London), Ltd., are not concerned in this merger.

Two very useful catalogues of science books have just been issued by Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. They range respectively over the subjects of mathematics, physics, astronomy, and the history and method of science, and botany, zoology, agriculture, and geology, and will be of service for reference. They can be had free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A junior lecturer in applied mathematics in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (July 15). A visiting teacher of heat engines, at the L.C.C. School of Engineering and Navigation, High Street, Poplar, E. 14—Education Officer (T.1a), The County Hall, Westminster Bridge, S.E.1 (July 15). Two temporary junior engineering assistants and a temporary architectural assistant—The Chief Engineer, Metropolitan Water Board, 173 Rosebery Avenue, E.C.1 (July 15). An assistant lecturer in pathology at the Welsh National School of Medicine—The Secretary, University College, Cardiff (July 15). A senior lecturer in chemistry at the Bournemouth Municipal College—The Director of Education, Town Hall, Bournemouth (July 16). A science master, with special qualifications in agricultural science, under the Magherafelt Regional Education Committee, Co. Londonderry—The Principal and Executive Officer, Technical School, Magherafelt, Londonderry (July 16). A taxidermist and preparator of specimens in the Auckland (New

Zealand) Institute and Museum—The High Commissioner for New Zealand, 415 Strand, W.C.2 (July 20). Assistant civil engineers in Civil Engineer-in-Chief's Department, Admiralty, and H.M. Naval Establishments at home and abroad—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (July 20). An assistant lecturer in zoology—The Registrar, University College of North Wales, Bangor (July 20). A junior physicist at the Building Research Station, Garston, nr. Watford—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (July 20). A demonstrator in zoology at the Royal College of Science—The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (July 23). A student probationer (zoologist or physiologist)—The Director, Marine Biological Laboratory, Plymouth (July 25). A curator of radium at the General Hospital, Birmingham—The House Governor, General Hospital, Birmingham (July 25). A lecturer in geology at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (July 27). An assistant chemist (woman) for the Air Ministry, Kidbrooke—The Secretary (I.G.), Air Ministry, W.C.2. A physico-chemist at the Indian Lac Research Institute, for research work in the problems connected with harvesting, storage, manufacturing, and packing lac and shellac—"India", care of Messrs. Richardson and Co., 26 King Street, St. James's, London, S.W.1. A visiting lecturer in engineering science and a full-time chemistry master at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A full-time teacher of general engineering subjects at the Acton Technical Institute—Mr. J. E. Smart, Municipal Offices, Acton, W.3. A part-time instructor in mechanical engineering at the Watford Technical School—The Principal, Technical School, Watford. Pathologists in Nigeria on the West African Medical Staff—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1. An assistant experimental officer for design duties at the Government experimental establishment, Biggin Hill, Kent—The Secretary, R.E. Board, 14 Grosvenor Gardens, S.W.1. An expert in animal husbandry, and a director of the Agricultural Research Institute, Pusa, India—The Under-Secretary of State, Economic and Overseas Department, India Office, Whitehall, S.W.1. Two junior assistants, one in physics and one in chemistry, under the British Boot, Shoe, and Allied Trades Research Association—The Director of Research of the Association, 19 Bedford Square, W.C.1. A biologist at the Rothamsted Experimental Station for research work in general microbiology—The Secretary, Rothamsted Experimental Station, Harpenden.

Our Astronomical Column.

New Minor Planet.—A planet, the provisional designation of which is 1929*KA*, was recently discovered at Heidelberg; it had the unusually rapid motion of 27′ northwards per diem. Dr. G. Stracke gives an ephemeris in *Beobachtungs-Zirkular*, No. 23; its magnitude is now 13·3 and is slowly diminishing. He states that the rapid motion arises from a combination of great eccentricity and high inclination, the planet being now near perihelion. Its position on July 16 is R.A. $16^h\ 32^m{\cdot}0$; N. Decl. 5° 3′. It is then nearly stationary in R.A. and is moving north 5′ daily.

Solar Activity.—Observations of sunspots and faculæ for the first half of 1929 show that the sun's activity is definitely declining towards minimum, which may be expected in about four years' time. As another indication of the progress of the 11-yr. solar cycle, it may be noted that the shape of the corona seen during the total eclipse of May 9 last was of intermediate type. Although the sun's activity is lessening, occasional large sunspots may be expected. In the preceding cycle, for example, the most extensive stream of spots seen for nearly half a century occurred in 1920, three years after the maximum. A couple of large spots have recently been seen together on the disc, nearly on the same meridian but on opposite sides of the sun's equator. Both were visible to the naked eye for a few days. Particulars of these spots are given in the following table in continuation of that given in NATURE of Mar. 16, p. 425:

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area on June 24.
5	June 18–30	June 24·0	9° S.	1/1350
6	June 18–30	June 24·5	13° N.	1/2000

(Areas express proportion of hemisphere covered.)

Catalogue of the Comparison Stars for Eros.—It is now only a year and a half before the very near approach of Eros to the earth in January 1931. Prof. Kopff prepared a list of stars suitable for use as comparison stars on this occasion; many observatories have co-operated in observing them. Prof. P. Stroobant, Director of the Uccle Observatory, is one of the first to publish results. In Tome 2, Fascicule 2, of the *Annals* of the Observatory, he publishes the positions of about 400 stars, lying between north declinations 19° and 48°; these are the stars needed for the earlier portion of the apparition; Eros goes later into south declination, and the observation of the southern stars is more difficult for northern observatories. The magnitudes of the stars observed at Uccle range from 7·0 to 9·6. Some were observed eight times; a few were observed once only, but by co-operation of observatories good positions should be available.

Russian Society for the Study of the Universe.—The report for 1928 just issued by this Society gives details of remarkable activities shown in various branches of astronomical research. The number of members was 604, and 29 meetings took place. As an example of the work of the observing sections, it may be mentioned that 23 observers pursued solar inquiries and sent in 1789 drawings of groups and spots. Variable stars attracted 20 members, who obtained 7600 observations. The meteoric field had 30 observers, who gathered 17,200 records. The results obtained in the various departments appear to be of excellent character and extensive in amount. Fifteen volumes have been published by the Society, and the last one issued comprised 390 pages. Branches of the Society have been formed in the provinces, and these have already proved very successful in their work, as being of considerable assistance to the parent organisation at Leningrad. The marked increase in the number of members and subjects under investigation gives promise of the accomplishment of much useful research in various fields of astronomy.

Research Items.

Anatomy of Seals.—The structure of seals has been the subject of various memoirs, but none has been so thoroughgoing as A. Brazier Howell's account of the comparative anatomy of the eared and earless seals (*Proc. U.S. Nat. Mus.*, vol. 73, art. 15, 1928). The investigation is based upon *Phoca hispida* as representing the earless and *Zalophus californianus* the eared seals, but comparative references to the work of other anatomists are included. A few general results only can be mentioned. In spite of the efforts which have been made to link eared and earless seals with land mammals of the bear and otter tribes, Howell regards the evidence to be so indefinite as to preclude any reasoned conclusion as to ancestry. The methods of swimming now employed by the two groups of seals are fundamentally different, but many of the characters common to both may be largely due to convergence, although on the whole the earless seals exhibit in such characters a somewhat greater divergence from fissiped conditions than the eared. On the other hand, there are characters, such as the telescoping of the skull, the cartilaginous extensions of the digits, and the flatter phalanges, which suggest that *Zalophus* may have travelled further from the typical terrestrial carnivore. In both groups there are hints of structures in the limbs which suggest that a certain amount of retrogressive evolution may have taken place, *Phoca* at one period having perhaps made more use of its fore limbs, *Zalophus* of its hind limbs. But this suggestion requires more evidence and is put forward tentatively.

'Knothead' Carp.—Mr. David H. Thompson has investigated the causes of deformed carp in the Illinois River (State of Illinois Department of Registration and Education, Division of the Natural History Survey, *Bulletin*, vol. 17, art. 8, 1928). The carp of the Illinois River are of considerable importance commercially and the 'knothead' malformation is well known. The fish have bulging opercles, narrowed skull, and sunken cheeks, besides other irregularities, are pronouncedly sluggish in habit, and smaller than the normal form. Investigation of the gills showed a reduction of lamellæ and an altogether less effectual breathing apparatus than is shown in the ordinary healthy fish. No parasites were present nor other infection, but the flesh was very soft. It was found that these deformed individuals inhabit those parts of the river which are polluted largely by sewage with a consequent reduction of green algæ, and that there is apparently a direct relation between this reduction of algæ, containing vitamin D, and the malformed fish. It seems probable that the malformation is due to some external influence which has interfered with the developmental processes or the metabolism of the fish and has altered their growth form. The author concludes from his researches that the 'knotheadedness' is a disease similar to rickets in the higher vertebrates, due to lack of vitamin D. Other fishes of the area are not affected, probably because they are less tolerant of pollution than the carp and feed in the cleaner backwaters. Interesting radiograms are given of the heads of the normal and 'knothead' carp.

Development of a Hexactinellid Sponge.—Y. Okada describes (*Jour. Fac. Sci. Imp. Univ. Tokyo*, vol. 2, 1928) the development of a hexactinellid sponge, *Farrea Sollasii*. Material was obtained by monthly dredgings at about 150 fm. in the Sagami Sea. The author considers that the breeding period extends throughout the year. The oocyte is at first scarcely distinguishable from an archæocyte, but later becomes larger and lies in the outer trabecular layer of the sponge. After fertilisation it appears to migrate into the inner side of the trabecular layer and takes up its position near the wall of a flagellated chamber, where it undergoes its early development. The first two cleavages at least are total and equal. The blastula is planula-like, at first nearly spherical but later oval. The youngest embryo found in the trabecular layer consists of an outer layer of closely packed cells and a central mass of jelly-like substance containing numerous amœboid cells which have wandered in from the outer layer. Six stauractin spicules are present. In a later stage with twelve spicules, flagellated chambers appear in the central mass—each chamber is due to the amœboid cells having become rounded and arranged round a central cavity. Coincident with the formation of flagellated chambers an invagination appears on the surface of the young sponge—probably the commencement of the communication between the chambers and the exterior. The collars and flagellæ probably develop after the embryos are set free. The development of the spicules is described. The six rays of the hexactin do not grow in a single cell as in other siliceous sponges but from a syncytial scleroblast mass. The nuclei of this mass are more than six and bear no definite relation to the rays. The hexactines originate as such.

***Echinococcus* in New South Wales.**—Ian Clunies Ross records (*Sydney University Reprints, Series* I, Agric. and Vet. Sci., 1927) the results of an investigation into the occurrence and distribution of *Echinococcus granulosus* (*Taenia echinococcus*) in New South Wales. Of 18 cattle examined, six were infected with hydatids (two in the liver and four in the lungs); of 123 sheep 41 were infected (liver 12 times and lungs 33 times). Of twenty-three dogs examined at the slaughter yards in four country districts, seven were infected with the worm, but more than one hundred dogs from the city and suburbs of Sydney were examined and no infestations were observed. The records of four district hospitals chiefly between 1911 and 1924 show that out of about 19,000 patients 71 were infected with hydatids. In a south coast district there were ten persons infected with hydatids in a total of 1370 in-patients at the local hospitals. In man, cases of hydatid in the liver greatly outnumber those in which the lungs are affected.

Hawaiian Non-Marine Mollusca.—The molluscan fauna of Hawaii has been studied for many years, but the literature is very scattered. Mr. E. L. Caum has, therefore, rendered very real service in compiling a "Check List of Hawaiian Land and Fresh Water Mollusca" (*Bernice P. Bishop Mus. Bull.*, 56). This list is systematically arranged with abbreviated references to sources for which a key is supplied at the end, and also an alphabetical list of all the names from orders to species, exclusive of synonymous generic names. It is a most valuable piece of bibliographical work, and more such are wanted.

Removal of Chlorosis in Fruit Trees.—The phenomenon of chlorosis (or scarcity of chlorophyll) is not uncommon on calcareous soils, and it is generally recognised that it is usually due either to scarcity of available iron or to immobility of this metal in the plants. In commercial practice it is not always easy to remedy the condition. This is most often done by spraying with iron salts, and more than half the pineapple crop in Hawaii has to be treated in this way.

T. Wallace (*Jour. Pomology and Hort. Sci.*, 7, 251-260), continuing his investigations on chlorosis of fruit trees, now finds that much more certain improvements can be produced by growing cover crops over the roots of the affected trees. Any danger of nitrogen starvation can be removed by suitable fertilisers.

Non-Dehiscence of Stamens in Punjab-American Cottons.—This phenomenon, which was observed by Trevor Trought, the Cotton Research Botanist at Lyallpur, and is described in the *Memoirs* of the Department of Agriculture in India, Bot. Ser., vol. 17, No. 1, 1928, may prove of general importance, as under these conditions the flowers are not fertilised, and are shed after a few days. With American cotton in the Punjab at certain times of the year the anther of every stamen fails to open. In this preliminary paper the cause for this failure to dehisce is left open, but the author is evidently inclined to attribute it to a failure of the pollen grains to swell up to their normal size at maturity. Incidentally, he gives reasons for thinking that the text-book mechanism of dehiscence through the hygroscopic qualities of the wall of the fibrous layer does not account for the normal dehiscence of the anthers in cotton.

A Haploid Tomato.—In the last few years, haploid mutations or plants with a single set of chromosomes have occurred in the experiments of several different investigators. A haploid *Datura* arose in 1922 among the offspring of certain plants which had been subjected to cold, by Blakeslee. Other cases have been described since in tobacco (*Nicotiana tabacum*), wheat (*Triticum compactum*), *Solanum ringrum*, and *Crepis capillaris*. These have usually occurred in the F_1 generation of a species-cross involving more or less sterility. A haploid tomato mutant has recently been described by Lindstrom (*Jour. of Heredity*, vol. 20, No. 1). It appeared in the F_2 of a variety cross in which there was complete fertility. It was dwarf, with shorter, thinner stem, much smaller leaves and flowers, and almost completely sterile, since its twelve chromosomes had no mates. In the pollen mother cells there is no attempt at pairing of the chromosomes, and they separate in various irregular ways. In the root tips, occasional cells had the diploid number. Cuttings made from the original plant through six generations of cuttings numbering more than 300 plants have shown no fertility and no reversion to the diploid number of chromosomes. It may be significant that, of the six haploid mutants now known, all but two belong to the family of the Solanaceæ.

Annual Periodicity of Earthquakes.—In a paper published in the recent number of the *Bulletin* of the Seismological Society of America (vol. 18, pp. 246-266; 1928), Dr. C. Davison considers the annual periodicity of earthquakes in relation to geographical conditions and the intensity of the shocks. It is shown that, throughout the vast continental areas of both hemispheres, the maximum epoch of the annual period in earthquakes of semi-destructive or less intensity falls during the mid-winter months. These great areas are, however, fringed by certain insular and peninsular regions in parts of which the maximum epoch is reversed. On the other hand, the annual periodicity of great destructive earthquakes in either hemisphere is independent of geographical conditions. The maximum epoch occurs in the summer months, whether the regions are continental, peninsular or insular.

Miocene of Northern Colombia.—The marine Miocene strata of northern Colombia, now described by F. M. Anderson (*Proc. Calif. Acad. Sci.*, Ser. 4, vol. 18) extend eastwards from the Gulf of Urabá along the Colombian coast to the Sierra Nevada de Santa Marta and are found again near Rio Hacha, whence they extend southwards into the valley of the Rio Cesar. The author briefly describes the several subdivisions and considers that they correspond fairly well on the whole with those of Santo Domingo. Of the fossil contents, 170 species of Mollusca and three Foraminifera are enumerated, almost without regard to any scheme of taxonomy. Thirty-seven new species and one new name are included and figured on sixteen very good plates.

Post-Tertiary Marine Mollusca of Oahu.—Limestone formations fringe the shore line of the Hawaiian island of Oahu above tide mark and extend for miles inland. From a study of their fossil contents, J. M. Ostergaard considers that their age is not greater than the Pleistocene (*Bernice P. Bishop Mus. Bull.*, 51). Details of the twenty-two collecting stations are given and their positions shown on a text map, with a table of the fossil occurrences at them. Eighty-two species and subspecies of mollusca were determined, of which three are presumably extinct. These last, as well as some forms living elsewhere than at Hawaii, are fully described and figured. The author discusses certain problems concerning the distribution of Indo-Pacific forms and concludes, in view of the fact that many species now found thriving best in the warmer Indo-Pacific are represented in Hawaii by fossils only, and others by species on the border of extinction, that when the limestone was forming Hawaii had a higher ocean temperature.

Oil-fields of Burma.—Dr. L. D. Stamp has been indefatigable in his efforts to make known more widely the oil geology of Burma, which, it must be admitted, since the well-known publications of Sir Ernest Pascoe, has been somewhat of a closed book to all save those concerned with actual developments. Two years ago Dr. Stamp dealt with the conditions governing the occurrence of oil in this territory; this was followed last year by his paper on the connexion between structural features and commercial oil deposits, in which Burma also figured prominently; and now we have a paper on the actual oil-fields themselves, read to the Institution of Petroleum Technologists on April 9. It is creditable to the author that he has been able to deal with his data in such a way that there is comparatively little overlap between the three papers, though one wonders why he did not present this last subject as a natural continuation of the first, as most of the facts must have been available to him at that time. However, this discussion of the chief oil-fields and their geology is timely and will be useful to students and others who have long felt that some authoritative account of this important oil-producing region of the British Empire should be available, particularly as the official volume referred to was published so long ago as 1912. The account of the oil-fields is not only technical, but also economic, and in every case an interesting summary of developments by the varied interests concerned is given. The author expresses the opinion that, while existing fields in Burma have prospects of good reserves and long life, there are small hopes of extensive new fields.

Ozone in the Atmosphere.—In *Smithsonian Miscellaneous Collections*, vol. 81, No. 11, 1929, F. E. Fowle discusses measurements of the ozone content of the earth's atmosphere made at the Smithsonian solar radiation observatories. Cabannes and Dufay showed in 1926 that the published coefficients of

atmospheric transmission obtained by Smithsonian observers revealed ozone absorption in the Chappuis band (4500-6500 A.) in the visible spectrum, in remarkable agreement with the characteristics of this band as measured by Colange in the laboratory. Fowle has applied this method to the original observations, in more detail than was possible with the published data alone. He is thus able to examine the amount and variation of ozone at the Smithsonian stations, using data totally independent of those on which the work of Fabry, Dobson and their collaborators is based, since the latter refers to the Hartley band (2300-3100 A.). For Table Mountain results from both methods are available; they agree in the mean values, and the variations found in the two ways are closely correlated, but those obtained by Fowle's reductions are the greater. Further, Fowle finds a distinct correlation between ozone content and the annual mean sunspot number for the northern stations, though not for Montezuma in Chile; Dobson found very little connexion of this kind. Fowle raises the question whether the ozone absorbing in these two bands may be in different molecular states, produced by different agencies and possibly situated in separate layers of the atmosphere.

Infra-Red Spectra.—The first two papers by Dr. E. K. Rideal and his collaborators in a projected series on infra-red spectra appear in the June issue of the *Proceedings of the Royal Society*. In the first, by C. P. Snow and A. M. Taylor, a grating spectrometer is described, and the particular points to which attention had to be directed in its construction are set out. The chief of these are efficiency between 2 μ and 6 μ, dispersion and resolution sufficient to effect fine structure analysis of the order of one wave-number, and adaptability for absolute measurements of absorption. In the second, by F. I. G. Rawlins, E. K. Rideal, and C. P. Snow, an account is given of the results obtained in the investigation of the 5·3 μ band of nitric oxide with this instrument. The spectrum includes a Q branch, as would be anticipated from the gyroscopic nature of the molecule NO, which is of the odd-electron type, and has also the expected steady change in intensities in bands of low rotational quantum number. There is, in addition, close agreement between the magnitudes of the molecular constants as deduced from this part of the spectrum, and those obtained from the electronic band-spectra, the two values given for the moment of inertia of the normal molecule, for example, being $1{\cdot}64 \times 10^{-39}$ gm. cm.^{2} and $1{\cdot}63 \times 10^{-39}$ gm. cm.^{2} respectively. Work is now in progress on the 4·7 μ band of carbon monoxide, and has already shown, contrary to a previous statement, that this does possess a fine structure.

Scattering of Electrons.—A paper by N. F. Mott in the June number of the *Proceedings of the Royal Society*, on the scattering of fast electrons by atomic nuclei, contains some interesting remarks on the physical significance of some of the quantities that enter into the equations of the new mechanics. The special problem considered is the existence of a spin axis in an electron. When the electron is part of an atom, it evidently cannot be dealt with individually. When it is free, on the other hand, the 'uncertainty principle' shows that the two obvious methods of testing for whether or not it has magnetic moment, namely, by the use of a magnetometer, or by the setting up of a Stern-Gerlach deflection apparatus, must also fail. There are, nevertheless, two constants in the mathematical expression for an electron which might be taken to define an axis, and the question becomes one of finding if these can appear in the solution of any experimental problem involving an electron in such a way as to be recognisable. Mr. Mott finds that this can be answered in the affirmative; when an initially unpolarised beam—that is, one in which the supposed axes are orientated at random—is scattered from two targets in succession, its intensity will be asymmetrical about the direction in which it falls on the second target, and this should be detectable experimentally. The actual formula which is derived for single scattering does not agree very well with the experimental results of Chadwick and Mercier, but it is possible that the discrepancy is due to the neglect of the radiative forces upon an accelerated electron.

Synthesis of an Isomeride of Thyroxine.—Since the constitution of thyroxine was elucidated in 1926, a number of its derivatives have been prepared and their physiological activity examined. The *Journal of the Chemical Society* for May contains an account of the preparation by Harington and McCartney of the preparation of $\beta\beta$-di(3 : 5-di-iodo-4-hydroxyphenyl)-α-aminopropionic acid

$$[(OH.C_6H_2I_2)_2CH.CH(NH_2).CO_2H],$$

which is isomeric with thyroxine. This substance differs from thyroxine in that the benzene rings are connected by a carbon instead of an oxygen linkage, but it retains the characteristic *o*-di-iodophenolic grouping. The new compound does not appear to show any physiological activity of the type exhibited by thyroxine.

Dissolution of Silver in Water.—According to a paper in Collection I., No. 3, of *Czechoslovak Chemical Communications*, Křepelka and Toul have found that pure silver dissolves slightly in distilled water and passes into solution in the form of silver ions. The greatest concentration of silver found by nephelometric measurements was 0·037 mgm. in 1000 c.c., and this amount was reached after about 21 days; further contact of the metal with water did not increase the concentration above this figure. When the surface of the metal had been reduced with hydrogen and the water freed from dissolved gases, the silver did not dissolve in sufficient quantity to be detected. It is concluded that the dissolution is due to a surface film of oxide or adsorbed oxygen, or to oxygen dissolved in the water. When the measurements were made using glass vessels, the amount of silver dissolved was about 0·003 mgm. more than when silver apparatus was employed. This difference is probably caused by alkalis from the glass.

A Transformation of Austenite into Martensite.—A paper by Dartrey Lewis, of more than usual interest, was presented at the recent meeting of the Iron and Steel Institute. A 0·8 per cent carbon steel may be quenched in a molten salt-bath at 232° C. to an austenite which is stable for at least five minutes. On subsequent cooling to room temperatures, the austenite is converted into martensite, the final hardness of which is practically independent of the rate of this cooling. Such a two-stage hardening should have commercial application in the treatment of steel since the quenching can be placed under full control and the rate at which the martensite is formed varied. Such treatment should be of value in the avoidance of quenching cracks and distortion. Further, the possibility is opened up of conducting forming operations at this temperature whilst the steel is still ductile, and then allowing the parts to harden on cooling in air.

Annual Conference of the Museums Association.

THE fortieth annual conference of the Museums Association, held at Worthing on July 1–5, was in many respects the most successful in the history of that body. The success was due to many favouring circumstances. The Royal Commission on National Museums and the Miers Report on Provincial Museums had awakened the interest of a wider public; hints from the Commission that the national establishments might be helped to give more practical shape to their acknowledged sympathy with the local museums, as well as the bodily presence of two Carnegie Trustees with their secretary, roused the hopes of curators; the nearness to London enabled many busy people to attend and contribute papers; and, above all, the choice of Sir Henry Miers for president promised a practical address and a fruitful discussion.

A main object of the Association is to promote co-operation between museums of every kind. Sir Henry Miers took that as the subject of his address, and speakers had been chosen to approach it from various sides. Sir Henry has in mind a museum service for the whole country, parallel to the library service that has cast a net which now gathers in even small villages. As driving force for such a scheme he sees only the Museums Association. With small means the Association has already done much, but voluntary labour, manifesting its results only in the annual conference, the *Museums Journal*, and a few circulating collections, is no longer enough. A central office and a whole-time secretary are urgently needed, and to provide these more museums should come in. There is too much individualism and competition, too little co-operation and mutual aid between museums; the larger museums do not realise how much they stand to gain by helping their weaker brethren. Sir Henry indicated many openings for co-operation, among them the guidance of archæological excavation, the interchange of loan exhibits, and the training of curators.

In the ensuing discussion, Dr. Cyril Fox extended the idea of co-operation to the overseas members, and showed how ethnographical material stored in our museums might now be of more use if returned to the Dominions whence it came long ago; he suggested a central clearing-house for archæological objects. The Earl of Crawford, comparing museums, picture-galleries, and libraries, pointed out that the public appreciation of museums called for greater mental effort; the three classes should be put on a level, since each is necessary for intellectual progress. Mr. A. J. K. Esdaile urged the need of a central office for arranging exchanges and exhibitions. Mr. Tate Regan thought that junior members of museum staffs should be welcomed to the Association at a smaller subscription but without the *Journal*. Dr. F. A. Bather replied that this would not help the juniors so long as their superiors did not encourage them to attend the Conference. As for a central clearing-house, the best course would be for each department of the national museums to receive and distribute its own class of material, but much could be done directly if use were made of the *Journal*. Other speakers advocated the extension of regional federations under the auspices of the Association.

The discussion was revived later by Dr. Hay Murray's suggestion that every large museum should adopt a small museum, and was carried further by Mr. Lawrence Haward's account of the scheme of loans initiated by the late C. Rutherston's bequest to the Manchester Art Gallery, by Major Longden's informative paper on exhibitions of foreign art, and by a most vigorous address from Dr. G. H. Locke, public librarian of Toronto, on co-operation between libraries and museums. Mr. Eric Maclagan here arrived to explain the kind of help the Victoria and Albert Museum could give to provincial museums, and reopened the discussion on training.

Most of the remaining papers dealt with the educational work of museums. Mr. Harold L. Madison, curator of education at the Cleveland (Ohio) Museum of Natural History, gave a thoughtful and instructive address on the work of his museum in connexion with schools. Miss Bertha Hindshaw related the efforts of the Ancoats Museum, Manchester, to get hold of the 'young visitor' from that poor district. Sir William Furse explained how he had managed to get the numerous small-scale panoramas which add so greatly to the attraction of the Imperial Institute Galleries. Mr. C. A. Siepmann, of the British Broadcasting Corporation, made a suggestive speech on the relations between broadcasting and museums, and this also provoked an animated discussion.

The more technical papers included a demonstration by Mr. W. E. Mayes of making wax models of plants, and notes by Mr. J. Ritchie on the preservation of ancient tempera paintings and on celluloid mounts for insects and herbarium specimens.

After so much time given to papers, the delegates enjoyed a visit to Tarring Cottages and Cissbury Camp, the latter admirably elucidated by Mr. T. Sheppard, and a whole-day excursion to Arundel Castle, Goodwood House, Chichester, Bignor Roman Villa (explained by Mr. S. E. Winbolt), and Petworth House. The remarkably smooth working of the excursions, as of all the other arrangements, was due to the organising capacity of the local secretary, Miss Marian Frost, of the Worthing Museum, aided by the ladies of her staff.

Biology of Norwegian Lakes.

T. BRAARUD, B. Föyn, and H. H. Gran, in a recent paper entitled "Biologische Untersuchungen in einigen Seen des östlichen Norwegens August–September 1927" (Norske Videnskaps-Akademi i Oslo, I. Mathem. Naturvid. Klasse 1928, No. 2), report on several lakes in the east of Norway with regard to the plankton and its environment. The work was carried on in a similar way, but for a longer period, in the Hurdals-See in 1926, and the results published in this same publication (1927). In the Hurdals-See the temperature, oxygen content, hydrogen ion concentration, and distribution of the plankton were investigated at different depths from May to October, the preserved plankton centrifuged and estimated quantitatively side by side with living net-plankton estimated qualitatively, the result showing that most of the species were in largest numbers in summer with a maximum in August–September. Only *Dinobryon sertularia* formed a maximum in June.

The other lakes, and also the Hurdals-See again, were worked in August and September 1927 with the same methods and apparatus. The plankton of the Hurdals-See was poorer than in 1926, probably because of the very wet summer.

Amongst the nine lakes in question, the Haugatjern was distinctive in having large masses of plankton

made up of few species occupying the opaque upper layers, a strong oxygen deficit in the depths and below six metres, and definite differences in the hydrogen ion concentration between the upper and deeper layers. Such conditions can only be explained by a strong food stream from land. The plankton production of the Haugatjern is as much as 100 to 1000 times greater per surface unit than any of the other lakes. These lakes are different from one another in several ways, and the amount of plankton varies much in the different lakes. The renewing of the plankton food on which the plankton production depends comes either from the upper layers, by supply from land, or from the depths by vertical circulation. In those lakes where the flowing water in summer must always be comparatively poor in nourishment, the circulation of the food-stuffs for plankton production is more important than the supply from outside. In shallow lakes in summer a daily vertical circulation is possible by the warming of the bottom by radiation, and otherwise in spring and autumn layers are quickly mixed so that maxima are formed of quick-growing planktonic species.

Such distinct maxima at special times of year are to be expected, especially in shallow lakes. In the deeper lakes the circulation is slower and seasonal maxima not so distinct. Thus the differences in the richness of the plankton in those lakes, other than the Haugatjern, can probably be explained best by the fact that the relative richness in the shallower lakes is conditional on a quick circulation of the food-stuffs present.

The species which take part in the mass production are few. They include Cyanophyceæ, Chlorophyceæ, Flagellata, Dinoflagellata, and Diatomaceæ. The diatoms, especially *Asterionella gracillima* and Cyanophyceæ (*Anabæna flos aquæ* and *Cœlosphærium Nægelianum*), are very quick-growing. Of the dinoflagellates, *Ceratium hirundinella* is universally present, reproducing in masses in the Haugatjern.

Agricultural Afghanistan.[1]

THE Institute of Applied Botany (Leningrad) sent an expedition to Afghanistan in 1924, consisting of the director of the Institute, Prof. N. I. Vavilov, the engineer-agronomist, D. D. Bukinich, and the agronomist, V. N. Lebedev. The principal purposes of the expedition were: (1) To investigate and collect plants cultivated in the country; (2) to ascertain the regularities in the distribution of crops and their varieties over the slopes of the Hindu Kush; (3) to investigate the technique of local agriculture, the irrigation in particular; (4) to gather information as to the agricultural resources, especially as regards cotton-growing.

The expedition travelled about 6000 km., covering the whole territory of agricultural Afghanistan. The authors divide Afghanistan into six climatic regions: (1) Mountain regions with cold and temperate climate and well-marked differences between the seasons. (*a*) High mountain regions 2400 m. above sea-level, with 7-9 months of winter. This is the region of spring cereals, chiefly of irrigated crops. The highest altitudes are characterised by a dry desert climate. (*b*) Regions of temperate climate situated between 1300 m. and 2400 m. above sea-level. This region is chiefly characterised by irrigated winter wheat, and irrigated cultivation generally. (2) The lowland regions below 900 m. (*c*) Desert regions with small amount of rainfall (less than 250 mm.), very hot summers and cold winters. (*d*) The region of steppes and foot-hills. The summer is hot, with average temperature above 25° for the warmest month. This is a region of non-irrigated crops. (*e*) The lowland of Yalalabad with subtropical, comparatively moist climate. (3) The median zone from 900 m. to 1300 m. (*f*) Desert regions with very small amounts of rainfall and cold winters.

The soils of Afghanistan may be divided into four groups: (1) Heavy loams peculiar to swampy river valleys, chiefly in rice-growing regions; (2) medium loams of the slopes; (3) loess-like loams of the foot-hills; (4) the 'irrigation' soils of the oases.

A characteristic feature of Afghanistan is the co-existence of extremely primitive forms of husbandry with rather intensive forms of farming in the oases, which may be observed in the valley of Hari-Rud, especially near Herat. Agriculture of the valley is characterised by extraordinary diversity of crops. The methods of irrigation are thoroughly worked out, cereals are harvested twice a year, and manuring is extensively practised.

The most isolated and unexplored region of Afghanistan is Kafiristan. High up in the thickets of mountain forests, the population practises a sedentary type of agriculture. Fearing the hostility of neighbours, the agricultural population of Kafiristan lives on inaccessible heights. Mills are found everywhere; the plough—where possible. In places some excellently cultivated terraces of crops may be observed. Every foot of soil is utilised.

The study of Afghanistan by the expedition has established the dependence of water sources on meteorological conditions. This is naturally unfavourable to agriculture, which is adapted to the rainfall; thus the increase of acreage under winter crops depends on the rainfall in autumn.

Three principal types of irrigation were observed: (1) Source irrigation, (2) kiarese irrigation, and (3) river irrigation. The acreage of irrigated lands in Afghanistan is estimated by the authors as approximately half a million hectares, that of cultivated lands as one and a half million hectares, and the area of 'bohara' as approximately 500,000 hectares. The most wide-spread method of irrigation is with running water. Three peculiarities are noted in the native methods of irrigation: the primitive construction of the main water-carrying canals, and the good condition of small irrigation networks, and the elaborate implements used in preparing fields for irrigation.

The first place in cultivation in Afghanistan is taken by wheat, the second by barley, the third by rice. Then follow the Leguminosæ, and the next place is occupied by cotton. A considerable acreage is under alfalfa and *Trifolium resupinatum*.

The Hindu Kush dividing Afghanistan determines the general progress of agriculture from the low periphery to the main mountain range, and distinctly shows the regularities in the vertical distribution of the crops over the mountain zones. The authors give a table of the extreme elevation reached by different plants of Afghanistan under conditions of cultivation: hull-less barley, 3400 m.-3000 m.; 2500 m.-3000 m., hulled barley, peas, spring rye, *Ervum Ervilia*. This is, on the whole, the zone of spring cereals and of grain Leguminosæ. At 1500 m.-2000 m., the majority of cultivated plants appear. This is the zone of maximum diversity of crops and varieties. Grapes may be regarded as the determining plant of the zone. 1000 m.-1500 m. is the principal zone of cotton, rice,

[1] Supplement 33rd to the Bulletin of Applied Botany, of Genetics, and Plant-Breeding. Agricultural Afghanistan. (Composed on the Basis of the Data and Materials of the Expedition of the Institute of Applied Botany to Afghanistan.) By Prof. N. I. Vavilov and D. D. Bukinich. Pp. iii+610+xxxii+28 plates. (Leningrad.) In Russian, with summary in English.

Cucurbitaceæ. Below 1000 m. subtropical crops thrive: sugar-cane, oranges, the date palm.

The study of the separate crops is discussed in great detail in eight special chapters. The investigation of varietal diversity of cultivated plants has shown that Afghanistan and adjacent countries, especially the North-Western Provinces of India, is one of the most important primary world agricultural centres, where the varieties of numerous plants have originated. This is objectively proved by varietal diversity of a series of crop plants and by the coincidence of the area of the varietal diversity of many most important European crops. For example, as regards the diversity of club wheats and soft wheats generally, Afghanistan occupies the first place in the world. Though the varietal diversity of cultivated barley is poor, *Hordeum spontaneum* grows abundantly in northern Afghanistan, while eastern Afghanistan, and the adjacent regions of north-western India, are the world centre where the maximum of characteristics of the most important Leguminosæ are found. The region is probably the centre of origin of these crops. Many endemic forms have been found. In regard to flax, Afghanistan undoubtedly borders on one of the principal centres where the forms of this crop have originated. Hemp in south-eastern Afghanistan represents the pro-genital type of *Cannabis indica* Lam. A series of oleiferous Cruciferæ have evidently independently become cultivated field crops of Afghanistan and adjacent countries. Northern Afghanistan is the realm of wild melon, with all transitions to the cultivated type, and there is no doubt that Afghanistan is a part of the primary area in which cultivated melon has originated. The extraordinary wealth of varieties of carrots, turnips, and radishes show that Afghanistan is the primary world centre of these crops. The same may be observed with regard to other less important crops, such as spinach.

The botanico-geographical facts definitely direct attention to the south-eastern part of Afghanistan and regions towards the Punjab. It is in this region that the complex of genes of many European-Asiatic crops have been found. Here, and in the adjacent districts, a series of crops have originated, a fact proved by the presence of all stages of evolution. The above-mentioned region includes the Punjab. It is to this small part of India that we turn for the solution of the genesis of the above cultivated plants and not to the rest of India, which has no bearing on the majority of these crops. In regard to climate, relief, and crops, the North-Western Provinces form one undivided whole with Afghanistan. The remaining part of India differs sharply from Afghanistan in climate and soil.

At the end of the book the authors give a detailed description of the route travelled by the expedition, with the indication of distances, the character of landscape, short agronomical notes on the region, the description of the road, and altitudinal data. Good maps are given illustrating geographical, orographical, geological, vegetational, and agricultural divisions of Afghanistan. Most of the photographs in the book are very interesting, but poorly reproduced.

University and Educational Intelligence.

LONDON.—Sir Gregory Foster has been elected vice-chancellor for the year 1929–30.

The following doctorates have been conferred:—*D.Sc. in Biochemistry:* Mr. H. J. Channon, an internal student of University College, for a thesis entitled "The Unsaponifiable Fraction of Liver Oils"; *D.Sc. in Statistics:* Miss E. M. Newbold, an internal student of University College, for a thesis entitled "Practical Applications of the Statistics of Repeated Events, particularly to Industrial Accidents"; *D.Sc. in Anthropology:* Mr. W. J. Perry, University reader in cultural anthropology, for a thesis entitled "The Children of the Sun".

A SHORT account is given in *La Nature* for June 1 of the inauguration and development during the past hundred years of the well-known École Centrale des Arts et Manufactures of Paris, the principal technical institution in France for training students for private industrial works. Founded by the four savants, Théodore Olivier, a mathematician, Eugène Péclet, a physicist, Phillippe Benoit, a mechanician, and the famous chemist J. B. Dumas, with whom was associated an administrator, Alphonse Lavallée, the school was authorised by the Minister of Public Instruction on Dec. 23, 1828, and its first session opened on Nov. 20, 1829, with 145 students. Its early career was threatened at first by the political upheaval of 1830 and then by the cholera epidemic of 1832, but it gradually grew in importance and in 1862 became a recognised government establishment. Housed at first in the old Hôtel de Juigné, it now occupies a fine block of buildings in the quadrilateral formed by the streets named after Condé, Montgolfier, Berthoud, and Vaucanson, just behind the Conservatoire National des Arts et Métiers. When Lavallée retired from the directorship, the well-known French engineer August Perdonnet succeeded him, while to-day the destinies of the school are controlled by M. Léon Guillet. During the War, between four and five thousand old students of the School served as officers in the French army, while the handsome memorial gateway at the School is to the memory of some five hundred of them who fell on the field of battle.

A FURTHER stage in the development of one of the oldest technical colleges in Great Britain was marked by appropriate ceremony on June 13, when the recently completed extension of the Wigan and District Mining and Technical College was opened by Viscount Chelmsford. The College dates back to 1857, when it began as the Wigan Mining and Mechanical School, which occupied a single room in the Mechanics' Institute and boasted 50 students. It was in 1903 that the present College buildings were opened, and in 1919 a temporary annexe was erected: this was in use until 1921, when the allocation of £32,000, together with £5000 for equipment, by the Miners' Welfare Fund, allowed the erection of the present permanent extension in its place. At the opening ceremony, the chair was taken by the chairman of the governing body, Mr. J. T. Gee, and, after Viscount Chelmsford's address, he, Mr. A. M. Lamb, vice-chairman of the governing body, and Mr. G. H. Winstanley, were presented with the honorary diploma of the College in mining. Speeches were made by Mr. J. T. Browne, president of the Lancashire and Cheshire Coal Association, Mr. J. McGurk, president of the Lancashire and Cheshire Miners' Federation, the Mayor of Wigan (Councillor P. Murphy), and Mr. P. E. Meadon, Lancashire County Director of Education. The work of the College, under Principal J. F. S. Ross, falls into four main categories: full-time courses of university or equivalent standard, full-time junior schools (technical and commercial), part-time day courses, and evening courses in a great range of subjects. The College, which stands on an island-site, has now about 110 rooms, which include nearly 30 laboratories, 9 workshops, 5 drawing offices, and many lecture- and class-rooms.

Calendar of Patent Records.

July 14, 1730.—On July 14, 1730, a patent was granted to Captain Robert Hamblin, a shipowner of Lynn, for "a new method for distinguishing of lights, whereby one light erected for the guidance of shipping may be perfectly known from another, and consequently every ship's crew be informed what coast they are off". The invention was, however, held to be an infringement of the powers of Trinity House, and the patent was revoked. Hamblin also financed the first light-ship, which was established at the Nore in 1732 by David Avery, and again brought him into conflict with Trinity House. The Admiralty agreed, however, that tolls might be levied although the ship itself should become the property of Trinity House.

July 14, 1808.—The bobbin-lace machine, the foundation of a large industry, was invented by John Heathcoat, whose first patent for the invention was sealed on July 14, 1808. The first factory was set up by Heathcoat at Loughborough, but this was attacked and the machinery destroyed by the Luddites in 1816, and the manufacture was transferred to Tiverton, where the firm is still operating.

July 15, 1846.—An early example of the 'pedrail' system of locomotion is shown in the specification of Edmund Leahy's English patent, which was enrolled on July 15, 1846. The invention is described as for the purpose of easing the motion and reducing the friction of wheels of carriages while passing over irregular surfaces, and consists in the "adaptation of a series of short rails to the wheels, which rails are linked together in a manner resembling an endless chain, arranged on rollers round the peripheries of the wheels".

July 15, 1869.—Margarine was the invention of the French chemist, Hippolyte Mège, and was patented in France on July 15, 1869, and in England the same year. The manufacture received a great impetus during the Franco-Prussian war, and was rapidly developed.

July 16, 1867.—One of the earliest systems of reinforced concrete was due to Joseph Monier, a gardener of Paris, who was the first to make extensive use of reinforced concrete and was mainly responsible for its general adoption. His French patent was granted on July 16, 1867, and the new method of construction was firmly established by the German firm of Freytag und Heidschuch, which purchased the German and Austrian rights.

July 17, 1790.—The English patent granted to Thomas Saint, a cabinetmaker of London, on July 17, 1790, contains the earliest description of a sewing machine. The machine, which is for sewing leather for boots and shoes, makes a chain-stitch, and has a perpendicular action, automatic feed for the material, and an eye-pointed needle.

July 18, 1783.—John Broadwood's piano patent, which is dated July 18, 1783, revolutionised the construction of the early square piano and represents an important step in the history of the instrument. Broadwood placed the tuning pins at the back of the case instead of as usual at the right-hand side, and added dampers and pedals. The construction was copied by all the leading makers, including those of Germany.

July 18, 1833.—On July 18, 1833, a patent was granted to Francis Maceroni for his steam-carriage, which had a multi-tubular boiler with fan-draught behind the carriage, and a horizontal two-cylinder engine below the body. A carriage was built in 1833 and ran between Edgware and Paddington for some time, attaining an average speed of 10 miles an hour. Carriages were also sent to Paris and Brussels, where they were received favourably.

Societies and Academies.

LONDON.

Geological Society, May 29.—**K. S. Sandford**: The Pliocene and Pleistocene deposits of Wadi Qena and of the Nile Valley between Luxor and Assiut (Qau). Wadi Qena is a broad and deep dry valley which joins the Nile from the north at Qena, about 40 miles north of Luxor. The oldest beds visible within the walls of the valley system are of Pliocene age, deposited in a gulf of the Mediterranean. This had been cut by river erosion during the elevation of the Egyptian plateaux in Miocene and (in the south) partly in Oligocene times, and it was then flooded to a height of at least 550 feet above present sea-level. A non-fossiliferous series of strata was deposited in it. Great thicknesses of travertine are locally present in the series. Re-elevation carried the flooded valley system back to fluviatile conditions in Plio-Pleistocene times, accompanied by the irruption of enormous quantities of detritus from the Red Sea Hills. In Pleistocene times an ordered succession of river terraces was laid down in the Nile valley and in all the major wadis. Thereafter (in Upper Palæolithic times) desert conditions began to assert themselves, and the Nile alone survived. At about the same time the Nile carved a deep channel and re-excavated the deeper parts of the Pliocene-filled Miocene gorge. The process of filling this up still continues.

Mineralogical Society, June 11.—**E. J. Wayland** and **L. J. Spencer**: Bismutotantalite, a new mineral from Uganda. This was found in a pegmatite vein at Gamba Hill, about 35 miles north-west of Entebbe. The large rough crystals, weighing up to a kilogram or more, are orthorhombic with a habit and axial ratios similar to those of columbite. Analyses made by Mr. W. O. R. Wynn at the Imperial Institute give the formula $Bi_2O_3.Ta_2O_5$, analogous to stibiotantalite ($Sb_2O_3.Ta_2O_5$).—**L. Hawkes**: On a partially fused quartz-felspar rock and on glomero-granular texture. In a partially melted granite, fusion began at the quartz-felspar contacts. It is suggested that the temperature was raised above the eutectic point but not to the melting-point of any of the constituent minerals, and that a granite of quartz-orthoclase-albite eutectic composition will melt completely in the dry state below 950° C. Coarse-grained granites may exhibit a segregation of quartz and felspar, revealed in section by monomineralic areas of several grains in anhedral intergrowth. The name 'glomero-granular' is proposed for this texture, which may result from the normal undisturbed crystallisation of the magma.—**P. Marshall**: The occurrence of a mineral hitherto unrecognised in the phonolites of Dunedin, New Zealand. A mineral with low birefringence and low refractive index, hitherto taken to be either nepheline or sodalite, is distinct from these and nearer microsommite or davyne. It is usually allotriomorphic but also occurs as very small (0·15 mm.) hexagonal prisms. Analyses of hydrochloric acid solution of phonolites containing this mineral to the exclusion of other soluble silicates, indicate that it is a sodium aluminosilicate loosely combined with sodium chloride. The mineral stains dark violet when treated with silver nitrate. The name proposed for the mineral is ameletite.—**G. T. Prior**: The meteoric stone of Lake Brown, Western Australia. The stone, weighing when found 4·75 kgm., has been known since 1919. Chemical analysis and microscopic examination prove it to be an intermediate hypersthene-chondrite of Baroti type.—**I. de Finály** and **Sándor Koch**: Fülöppite, a new Hungarian mineral of the plagionite-

semseyite group. This was found at Nagybánya, Hungary [=Baia Mare, Rumania] as small monoclinic crystals of the plagionite habit. Analysis shows it to be an acid member of the group with the formula $2PbS.3Sb_2S_3$. Associated with it is an acicular (probably orthorhombic) lead-antimony mineral with the composition $3PbS.4Sb_2S_3$, which is compared with the Bolivian keeleyite.

Optical Society, June 13.—**W. M. Hampton**: The beam given by dioptric apparatus. The light in the axial direction given by a lighthouse lens using a white source can only be white if the source is greater than a certain limiting size. For such sources a simple expression is deduced for the axial beam candle-power for revolving lenses. A graphical method is given for computing the candle-power of smaller sources. The effect of the dispersion of the glass of the lens on the maximum distance at which satisfactory candle-power readings can be made is considered. A general solution is obtained for the intensity of light of any colour in any direction and at any distance when using fixed lenses.

Royal Meteorological Society, June 19.—**F. J. W. Whipple**: Potential gradient and atmospheric pollution; the influence of 'summer time'. The Kew Observatory records for periods before and after 1916 have been compared. There are normally two oscillations of potential gradient in the 24 hours; the early morning minimum and the forenoon maximum were both advanced when 'summer time' came in, whereas the second oscillation of the day was reduced in amplitude.—**A. J. Bamford**: Vertical air-currents as measured by pilot balloons. The results of the last seven years' pilot balloon observations at Colombo show that in the first half kilometre the average rate of ascent is considerably faster than the theoretical rate given by the Dines formula, while in the next half kilometre it is appreciably less than this value. This can be reconciled with a general atmospheric movement that is, on the whole, upwards in these layers, by accepting the idea that tropical convection occurs in the form of large rolling whirls of at least a kilometre in diameter, the effect of such whirls being to displace balloons from the ascending side towards the descending side after they pass the level of the centre. The next part of the paper deals with cases where the simple whirl system is complicated by monsoonal and other circulations, and the last part deals with observations up to ten kilometres.—**George Slater**: Studies on the Rhone glacier, 1927: the relationship between the average air-temperature and the rate of melting of the surface of the glacier. Work in Spitzbergen suggested the following formula: If M = thickness (in feet) of ice melted per month (30 days) and t = average monthly temperature (° F.), $M = (t - 32)/2$. This gives 0·2 inches of ice melted per day for each degree (F.) above zero under normal atmospheric conditions, wind and rain producing deviations from the normal. The relationship was confirmed by observations on the Rhône Glacier in 1927 over a period of twenty days. The average temperatures (July 26 to Aug. 15) used were: Maximum 50·6° F., minimum 34·5° F., noon 43·79° F., giving a daily average of 8·8° F. above 32° F. Assuming the rate of 0·2 inches of ice melted per day for each degree, the total amount melted would be 35·2 inches, which is confirmed by actual measurement.

PARIS.

Academy of Sciences, June 3.—**Ch. Achard and M. Enachesco**: Chloride elimination in acute diseases and its relations with the acid-base equilibrium.—**Georges Claude**: The utilisation of thermal energy. Directing attention to a suggestion published by d'Arsonval in 1881 for the utilisation of the energy of hot springs with sulphur dioxide as the working fluid.—**E. Bataillon**: The physiological condition of male and female stereomitoses in the immature eggs of Anoura.—**Achille Le Bel** was elected a free Academician in the place of the late Marshal Foch.—**André Blondel**: A new method for the laboratory study of the beams of optical apparatus.—**J. Neyman**: A method of verification of hypotheses.—**V. Fock and D. Iwanenko**: Linear quantic geometry and parallel displacement.—**N. Cioranesco**: The method of Riemann for systems of equations of the second order.—**Jacques Chokhate**: The summation of certain series of integrable functions. Application to orthogonal functions.—**Paul Lévy**: The influence of the arguments of the coefficients on the growth of integral functions.—**J. Haag**: The elastic suspension of pendulums.—**Emile Belot**: The forms and evolution of the terrestrial mass before its spheroidal condensation.—**Thadée Banachiewicz**: The correction of orbits with the aid of co-ordinates referred to the plane of the movement.—**E. Prévot**: The determination of the international zero of altitudes, taking into account the law of variation of the mean annual level of the sea.—**Alex. Véronnet**: The electronic theory of the ether and electromagnetism.—**Henri Chaumat**: An electrostatic machine giving continuous current.—**Daure**: The comparative study of the Raman spectra of some hydrogen compounds. From the comparison of the Raman spectra of more than forty compounds, all in the liquid state, it is concluded that although it is not possible to interpret the Raman spectra of all compounds by their molecular constitution, it is possible in the limited field of hydrogen compounds alone empirically to connect certain lines with particular linkages in the molecule.—**Bourguel**: A relation between the boiling point and the molecular structure of cis-trans ethylenic saturated and acetylenic acids. The boiling points of acids containing from four to nine atoms of carbon, saturated, cis and trans ethylenic and acetylenic acids are given both in tabular and graphical form. Certain regularities appear in the latter and these are summarised.—**F. Bourion and Ch. Tuttle**: The cryoscopic determination of the molecular equilibria of resorcinol in aqueous solutions of sodium chloride.—**Maurice Fallot**: The magnetisation coefficient and structure of gelatine solutions. The curve showing the coefficient of magnetisation as a function of the concentration consists of two straight lines, with a sharp angular point at 0·8 per cent of gelatine. This concentration was also found by Marinesco to correspond to a sudden change in the dielectric constant. These results confirm the view (Smith) that gelatine can exist in two molecular forms in solution.—**Maurice François**: The action of gaseous ammonia on mercuric bromide and chloride.—**Ch. Courtot and J. Pierron**: Contribution to the study of the α-ethylenic chlorides and alcohols.—**A. Mavrodin**: The action of organomagnesium derivatives on ethyl ethylcyanacetate.—**L. Berthois**: The heavy minerals of the eruptive and crystallophyllian rocks of Brittany. Detailed study of occurrence and morphology of the zircons and tourmalines. A study of these in a disintegrated rock may give useful indications as to the nature of the mother rock (granites, granulites, gneiss or mica schists).—**Marcel Casteras**: The western termination of the Massif of Arize and the structure of the secondary deposits of the neighbourhood of Saint-Girons (Ariège).—**Auguste Chevalier**: An ancestral form of the cultivated *Arachis*.—**Paul Genaud**: The exchanges of ions between yeast cells and solutions of ammonium chloride.

From the experimental data given it is concluded that the law of mass action is capable of accounting for the equilibria between a living cell and the solution in which it is placed.—E. Blanchard and J. Chaussin: The influence of a complete manure on the osmotic pressure in some agricultural plants. The special action of potash manures. The more rapid development of certain plants (oats, beetroot) under the action of manures coincides with a greater osmotic pressure in the interior medium, and the potash manures (sylvinite and potassium chloride) play a special part in this effect.—Maurice Parat: The active chondriome of the animal cell and the phenomena of pachynesis.—Raymond-Hamet: Some pharmacological properties of the alkaloid of *Banisteria Caapi*.

CAPE TOWN.

Royal Society of South Africa, Mar. 20.—James Moir: Colour and chemical constitution (26). (*a*) Pigments of yellow flowers, (*b*) addenda to previous parts. The first portion deals with flavone and its derivatives the yellow flower-pigments: a miscellaneous part follows dealing with (*a*) 'loading'-phenomena, (*b*) analogues of the quinoline-cyanine dyes, and some interesting little-known colour phenomena.—Sir Thomas Muir: Note on the Lagrangian of a special unit determinant.—S. H. Haughton: Notes on the Karroo Reptilia from Madagascar. Redescriptions of material in the Paris Museum. All the genera fall within the order Eosuchia, which is redefined; and two main lines of descent from *Youngina* within the order are indicated.—K. H. Barnard: A study of the genus *Colophon* (Coleoptera). The genus is essentially a mountain form, living on the summits of the peaks, and is flightless. Only two species were known, one of which has never been rediscovered since its description in 1855. Five new species have now been discovered.—S. Schonland: The South African species of *Rhus*, L. There is comparatively little diversity in the flowers of our *Rhus*. Inflorescences and fruits yield distinctive characters in many cases, but on the whole one has to rely on vegetative organs, which, however, vary often on the same plant within wide limits. The plant is usually unisexual, and male and female plants are sometimes different. Further, coppice shoots often show distinctive features. Interspecific hybridisation is not uncommon.—F. E. Fritsch and Florence Rich: Contributions to our knowledge of the freshwater Algæ of Africa. (8.) Bacillariales (Diatoms) from Griqualand West. In point of actual abundance, Diatoms form an important part of the algal flora of Griqualand West, but the actual number of species present is small. The total number here recorded is 72, of which 5 are new, while 4 new varieties are described. There are 25 new records for South Africa.

CRACOW.

Polish Academy of Science and Art, Mar. 8.—W. Swietoslawski, Z. Blaszkowska, and E. Jozefowicz: The boiling-point method of determination of the constant of chemical equilibrium.—W. Swietoslawski and J. G. Zawidzki: The application of reduced equations in chemical kinetics.—L. Marchlewski and J. Meyer: The absorption of ultra-violet rays by certain organic substances. The substances under examination included derivatives of furfurane, and isomeric bisubstituted benzene derivatives.—J. Wasowicz: The limits of perpetual snow in the Cordilleras of Alaska and Canada.

April 8.—C. Fuja: The formation and development of the stems and roots on the isolated cotyledons of *Cucurbita*, *Cucumis*, and *Lupinus*.—S. Maziarski: The striated ramified muscular cells in the liver of spiders.—J. Wiszniewski: Two new species of rotifers: *Pedalia intermedia* and *Paradicranophorus limosus*.—M. Gieysztor: Contributions to the knowledge of some species of Rhabdoceles belonging to the genera *Dalyellia*, *Castradella*, *Castrada*.—S. Wisniewski: The genus *Archigetes*: its anatomy, histogenesis, and biology.—W. Szafer: The flora of Poland.

May 6.—T. Wazewski: The change of the variable in simple integrals.—Ladislas Natanson: Certain properties of groups of waves.—Nalini N. Bosc: Fourier's series subjected to a quantic condition.—Satyendra Ray: (1) The regressive wave. (2) The generalisation of the virial of Clausius. If the pressure of the gas is not uniform but varies in the neighbourhood of the vessel walls according to a fixed law, the equation of the virial still holds good.—L. Kwiecinski and L. Marchlewski: The absorption of ultra-violet rays by benzene.—L. Marchlewski and B. Skarzynski: The absorption of ultra-violet light by certain hormones and by some analogous substances.—R. Malachowski: The constitution of anhydrotricarballylic acid.—F. Poznanski: The reactions of nitrous acid and of the diazo compounds on the substances contained in plants.

GENEVA.

Society of Physics and Natural History, April 18.—Sw. and Th. Posternak: The configuration of inactive inosite. By controlled oxidation of inosite with alkaline permanganate, the authors have obtained allomucic acid. This result, taken in conjunction with the optical properties of certain natural inositophosphoric esters previously described by the authors and by Anderson, leads to the selection for inactive inosite of that one of the seven stereochemical formulæ predicted by the theory which shows five hydroxyl groups on the same side of the plane of the ring, the sixth being found on the opposite side. The formation of ribosophosphoric acid of the nucleotides at the expense of the monophosphate of inosite, by the opening of the ring, becomes probable. This throws some light on the obscure question of the physiological rôle of inosite.

May 2.—L. Duparc: The geology of the lower Congo (left bank of the Niari). The author has prospected a region situated to the west of Mindouli. Two formations were found: the limestone schist at the base, supporting, sometimes discordant, red grits (Kundelungu). Two systems of orthogonal folds, east-north-east and north-north-west, were verified, the crossing of which gave rise to formation of domes.—M. Gysin: Some optical properties of mucic acid. The author has successfully applied Fedorow's method and the usual petrographic methods to crystals of mucic acid of very small dimensions ($60 \times 15 \times 10$ microns). He has proved a very strong double refraction $n_g - n_p = 0{\cdot}33$ and an angle for the optic axes $2V = -75°$.

May 16.—L. Duparc, P. Wenger, and Ch. Cimerman: The combination of nitrogen with manganese. The authors have studied the part played by the five following factors on the course of the reaction: the composition and origin of the manganese, temperature, duration of the reaction, pressure, catalyst. For the last two the results are new: the nitrogen fixed increases with the pressure and lithium nitride used as the catalyst increases the fixation of the nitrogen and accelerates the dissociation.—A. Jayet: The presence of old glacial and interglacial formations in the northern part of the Canton of Geneva. The author has found a typical base moraine covered by stratified clays. The latter in turn support a recent moraine. The old moraine has never been distinguished in visible outcrop except by excavation. Up to the present, only two moraines have been proved in the

basin of Lake Geneva.—**R. Wavre**: The second approximation in the investigation of the free surface of the planets. The author continues the study of the form of the exterior surface of stars in rotation by the method indicated in an earlier note. He makes a more extended investigation in which the terms of the second order are not neglected and gives the results of very lengthy calculations, giving the Newtonian potential on the polar axis and the flattening of the equipotential surfaces.

ROME.

Royal National Academy of the Lincei, April 7.—**G. Giorgi** and **A. Cabras**: Relativistic questions on the proofs of the earth's rotation. Nordmann has recently stated that, in the light of modern physics, it is as legitimate to regard the stellar universe as rotating daily round the earth as to consider that the earth revolves about its axis. The author discusses this question and concludes that the earth is endowed with rotation with respect to local inertial axes. Of Galileo's proofs, those of generic character deduced from considerations of symmetry in the distribution of velocity throughout the whole of the stars are really valid, as well as the specific proof derived from the fall of weights from a tower. To these are to be added Foucault's proof, gyroscopic proofs, Michelson and Gale's experiment, and, though less directly, those depending on centrifugal force.—**Q. Majorana**: Photoelectric thallium cells. Rolla and Mazza's claim to priority as regards these cells is disputed. The discovery of such cells is due to Case (1920), but an exact and detailed process for preparing them was first published by Majorana and Todesco (1928).—**L. Cambi** and **A. Clerici**: Reactions between ferrous compounds and nitric oxide. The results of experiments on the interaction of iron nitrosulphate and alkali hydroxide indicate that the decomposition of this complex proceeds according to the schemes: $2[>Fe\,.\,NO] \rightarrow 2[Fe'''] + N_2O$ (1) or $2Fe''' + \frac{1}{2}N_2 + NO$ (2) or $2Fe'' + 2NO$ (3). Decomposition (1) occurs quantitatively in an alkaline medium and only as a secondary reaction in presence of acid; in neutral solution in presence of $Ag^{\cdot}$ the same reaction corresponds with the formation of silver hyponitrite. The scissions (2) and (3) take place in acid media, the former predominating, as is shown by the fact that the ratio between the numbers of nitrogen atoms as N_2 and as NO tends towards unity, whilst the ferrous iron undergoes progressive reduction. Reactions analogous to the above are observed in the action of NO on ferrous carbonate, bicarbonate, and phosphate.—**G. Cimmino**: Extension of Picone's identity to the more general ordinary linear differential equation.—**Pia Nalli**: Parallelism and geodetic coordinates.—**E. Bortolotti**: Congruence stars and absolute parallelism: geometrical bases of a recent theory of Einstein.—**G. Mammana**: Decomposition of homogeneous linear differential expressions into symbolic factors of the first order.—**M. Picone**: Addition to the note: Demonstration of a theorem of analysis used in plane physics.—**L. Toscano**: Dual formulæ of Newton.—**L. Onofri**: Series of powers which assume the circumference of convergence as a singular line.—**G. Natta** and **L. Passerini**: Spinels of the type $Me_2''Me^{IV}O_4$. Results are given of the examination by means of X-rays and by the powder method of magnesium and cobaltous orthostannates, Mg_2SnO_4, and Co_2SnO_4, prepared by calcining the products obtained by precipitating with alkali hydroxides solutions containing one molecule of stannic chloride and two molecules of magnesium or cobaltous chloride. Cobaltous orthostannate crystallises in the cubic system, and the unit cell, containing eight molecules, has the side $8{\cdot}605 \pm 0{\cdot}005$ A. and the volume $637{\cdot}16 \times 10^{-24}$ c.c.; the röntgenographic density is 6·307, the experimental value being 6·108. The magnesium salt is isomorphous with the cobaltous compound, the cell having the side $8{\cdot}580 \pm 0{\cdot}007$ A., and the volume being $631{\cdot}63 \times 10^{-24}$ c.c.; the röntgenographic density is 4·864, and the experimental density 4·738. Calculation of the structure factor shows that the space structure of these compounds belongs to the type 8*f*, 16*c*, 32*b* (space group O_h^7) and corresponds with that of the spinels. For the parameter *u* defining the position of the oxygen a value approximating to 1/8 is found.—**V. Caglioti**: Polyhalides (1). Chloroiodic acid, $HICl_4$, $4H_2O$. This acid may be obtained by adding finely divided iodine to concentrated hydrochloric acid and passing chlorine through the liquid until the iodine dissolves completely. The deep orange-red solution thus formed is converted almost entirely into crystals of chloro-iodic acid when immersed in ice.—**G. Malquori**: The systems $Al(NO_3)_3 - Fe(NO_3)_3 - H_2O$ and $KNO_3 - Fe(NO_3)_3 - H_2O$ at 0° and 40°. Neither at 0° nor at 40° does nonahydrated ferric nitrate form additive compounds or mixed crystals with either potassium nitrate or nonahydrated aluminium nitrate.—**A. Occhialini**: Length of the lines in the spectrum of a spark in relation to the concentration of the element. Experiments on various nickel and lead-tin alloys show that observation of the length of the spectral lines of the spark furnishes a rapid means for the quantitative analysis of alloys.

Official Publications Received.

BRITISH.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1928. Pp. 32+2 plates. (Jamaica: Government Printing Office, Port-of-Spain.)

Colony and Protectorate of Kenya: The British East African Meteorological Service. Memoirs, 1: Note on the Inauguration of a Joint Meteorological Service for British East African Territories. Under the Direction of A. Walter. Pp. 5. (Nairobi: Government Printer.)

Imperial Agricultural Research Conference, 1927. Abstracts of Papers on Agricultural Research in the United Kingdom, published during the Year October 1927 to September 1928. Pp. 115. (London: Ministry of Agriculture and Fisheries.) 1*s.* net.

Southern Rhodesia. Geological Survey Bulletin, No. 12: The Geology of the Shabani Mineral Belt, Belingwe District. By F. E. Keep. Pp. v+193+18 plates. (Salisbury, S.R.)

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Gardens, Whitehill, near Matjesfontein), for the Year ending 31st December 1928. Pp. 29. (Kirstenbosch.)

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1928. Pp. 10. (Cape of Good Hope.)

The Quarterly Journal of the Geological Society. Vol. 85, Part 2, No. 338, June 20th. Pp. xlix-cxxviii+109-222. (London: Longmans, Green and Co., Ltd.) 7*s.* 6*d.*

Scientific and Industrial Research Council of Alberta. Report No. 18: The Bituminous Sands of Alberta. By K. A. Clark. Part 3: Utilization. Pp. vi+33. (Edmonton, Alba.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1929. Pp. xii+58. (Aberdeen.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1928. Part 1. With Report of the Geological Survey Board and Report of the Director. Pp. iv+99. (London: H.M. Stationery Office.) 2*s.* net.

Mines Department. Report on an Investigation at the Mines Department Testing Station, Sheffield, of the Safety of Miners' Electric Cap Lamps when the Battery is Short-circuited. By Capt. C. B. Platt and G. A. Cutler. Pp. 7. (London: H.M. Stationery Office.) 2*d.* net.

Proceedings of the Royal Society. Series A, Vol. 124, No. A795, July 1. Pp. 477-723+x. (London: Harrison and Sons, Ltd.) 8*s.*

City of Norwich. The Report of the Castle Museum Committee to the Council, 1928. Pp. 30. (Norwich.)

The Research Scheme of the Institute of Brewing. Memorandum, 1929. Pp. 20. (London.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1927. Pp. 147. (London: H.M. Stationery Office.) 5*s.* net.

Trinidad and Tobago. Minutes and Proceedings of the Froghopper Investigation Committee. Part 15. Pp. 223-289. (Trinidad: Government Printing Office, Port-of-Spain.)

FOREIGN.

Comptes rendus de la quatrième séance de la Commission Géodésique Baltique, réunie à Berlin du 24 au 28 Septembre 1928. Redigés par le Secrétaire-général Ilmari Bonsdorff. Pp. iii+164. (Helsinki.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 81. New Light on the Collection of North American Plants by Peter Kahn. By H. O. Juel and John W. Harshberger. Pp. 297-303. Agalinis and Allies in North America, II. By Francis W. Pennell. Pp. 111-249. Pseudohyaline American Land Snails. By H. Burrington Baker. Pp. 251-266. Leeches from Borneo with Descriptions of New Species. By J. Percy Moore. Pp. 267-295. (Philadelphia.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 23, Part 3: Arbeiten aus dem Institut für Gerberei-Wissenschaft, Mitteilung 4. Von Prof. Dr. G. Grasser und Dr. H. Nakanishi. Pp. 87-125. (Tokyo: Maruzen Co., Ltd.)

University of Illinois Engineering Experiment Station. Bulletin No. 191: Rolling Tests of Plates. By Prof. Wilbur M. Wilson. Pp. 60. (Urbana, Ill.) 30 cents.

University of California Publications in American Archaeology and Ethnology. Vol. 26: Aboriginal Society in Southern California. By William Duncan Strong. Pp. x+358. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 4.50 dollars.

Methods and Problems of Medical Education. (Twelfth Series.) Pp. v+466. (New York: The Rockefeller Foundation.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 57: Scientific Report of the North-Western Area Committee for 1926-27 (Rapport Atlantique, Secteur Nord-ouest, 1926-27.) By Prof. Johs. Schmidt. Pp. 73+28+11+134. (Copenhague: Andr. Fred. Høst et fils.) 10.00 kr.

Ministry of Finance. Calendar for the Year 1929. Pp. vii+373. (Cairo: Government Press.) 5 P.T.

Bulletin of the National Research Council. No. 68: Transactions of the American Geophysical Union, Ninth Annual Meeting, April 26 and 27, 1928, Washington, D.C. Pp. 103. (Washington, D.C.: National Academy of Sciences.)

Smithsonian Institution: United States National Museum. Bulletin 146: Life Histories of North American Shore Birds, Order Limicolae (Part 2). By Arthur Cleveland Bent. Pp. ix+412+66 plates. (Washington, D.C.: Government Printing Office.) 1 dollar.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 2, No. 5. R.P. No. 60: Continuous Spectrum X rays from Thin Targets, by Warren W. Nicholas; R.P. No. 61: A Multiple-Strand Test for Yarns, by Charles W. Schoffstall and H. A. Hamm; R.P. No. 62: Thermal Expansion of Tantalum, by Peter Hidnert; R.P. No. 63: Sound proofing of Airplane Cabins, by W. L. Chrisler and W. F. Snyder; R.P. No. 64: Prism Refractometry and certain Goniometrical Requirements for Precision, by L. W. Tilton; R.P. No. 65: A new Determination of the Melting Point of Palladium, by C. O. Fairchild, W. H. Hoover and M. F. Peters; R.P. No. 66: A new Seismometer equipped for Electromagnetic Damping and Electromagnetic and Optical Magnification (Theory, General Design and Preliminary Results), by Frank Wenner. Pp. 837-999. (Washington, D.C.: Government Printing Office.)

World Weather Records. Errata collected by Dr. Felix Exner, Dr. G. C. Simpson, Sir Gilbert Walker, H. Helm Clayton, Robert G. Mossman. Assembled and arranged for Publication by H. Helm Clayton. (Publication 3019.) To accompany Smithsonian Miscellaneous Collections, Vol. 79 (whole volume). Pp. iii+28. (Washington, D.C.: Smithsonian Institution.)

Classified List of Smithsonian Publications available for Distribution, May 20, 1929. Compiled by Helen Munroe. (Publication 3020.) Pp. iv+29. (Washington, D.C.: Smithsonian Institution.)

Memorie del R. Ufficio Centrale di Meteorologia e Geofisica, Roma. Serie 3, Vol. 2: Misure magnetiche in Oltregiuba e Somalia nel 1926. Memoria di L. Pallazzo. Pp. 63+4 tav. (Roma.)

Havsforskningsinstitutets Skrift. No. 49: Die thalassologische Terminfahrt im Jahre 1927. Von S. E. Stenij. Pp. 20. 20 Fmk. No. 50: Översikt av Isarna Vintern 1916–17. Referat: Übersicht der Eisverhältnisse im Winter 1916–17 an den Küsten Finnlands. Av E. Palmén. Pp. 43. 20 Fmk. No. 51: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1926. Herausgegeben von Gunnar Granquist. Pp. 44. 25 Fmk. No. 52: Päivittäisiä Vedenkorkeusarvoja 1925, dagliga Vattenståndsuppgifter 1925. Referat: Tägliche Wasserstandsangaben 1925. Av Henrik Renquist. Pp. 44. 20 Fmk. No. 53: Die *pH*-Bestimmung des Meerwassers; Studien über Eigenschaften und Gebrauch einiger hierfür geeigneten Farbenindikatoren. Von Kurt Buch. Pp. 30. 25 Fmk. No. 54: Havsforskningsinstitutets värksamhet under år 1927. Av Rolf Witting. Pp. 18. 10 Fmk. No. 55: Översikt av Isarna Vintern 1926–27. Referat: Übersicht der Eisverhältnisse im Winter 1926–27 an den Küsten Finnlands. Av Gunnar Granquist. Pp. 52. 20 Fmk. No. 56: Översikt av Isarna Vintern 1927–28. Referat: Übersicht der Eisverhältnisse im Winter 1927–28 an den Küsten Finnlands. Av Gunnar Granquist. Pp. 56. 20 Fmk. No. 57: Översikt av Isarna Vintern 1918–19. Referat: Übersicht der Eisverhältnisse im Winter 1918–19 an den Küsten Finnlands. Av E. Palmén. Pp. 35. 15 Fmk. No. 59: Beobachtungen von Strom und Wind an den Leuchtschiffen in den Jahren 1926 und 1927. Von E. Palmén. Pp. 22. 20 Fmk. No. 60: Beobachtungen im Ladoga-See in den Jahren 1898–1903. Herausgegeben von Rolf Witting. Pp. 34. 25 Fmk. (Helsinki.)

The Peking Society of Natural History. Bulletin, Vol. 3, Part 3: A Canton Sponge, by N. Gist Gee; Chinese Crickets, by Y. C. Hsü; Peking Diatoms, by B. W. Skvortzow. Pp. 48+3 plates. (Peking.) 1 dollar.

Smithsonian Miscellaneous Collections. Vol. 81, No. 13: Descriptions of Four New Forms of Birds from Hispaniola. By Alexander Wetmore. (Publication 3021.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the United States National Museum. Vol. 75, Art. 9: Recent Foraminifera from off Juan Fernandez Islands. By Joseph A. Cushman and R. T. D. Wickenden. (No. 2780.) Pp. 16+6 plates. (Washington, D.C.: Government Printing Office.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Special Bulletin No. 187: What makes some Farms Pay; a Business Analysis of 114 Farms in Eaton County, Michigan. By E. B. Hill and F. T. Riddell. Pp. 26. Special Bulletin No. 191: Barley for Michigan Farms. By H. C. Rather, E. E. Down, H. M. Brown and F. H. Clark. Pp. 28. Technical Bulletin No. 97: Studies on the Overwintering and Modes of Infection of the Fire Blight Organism. By E. C. Tullis. Pp. 32. (East Lansing, Mich.)

Det Kgl. Danske Videnskabernes Selskab: Mathematisk-fysiske Meddelelser. Bind 8, No. 10: On the Lichtenberg Figures. Part 3: The Positive Figures. By Prof. P. O. Pedersen. Pp. 137+28 plates. 10.00 kr. Bind 9, No. 5: Wireless Echoes of Long Delay. By Prof. P. O. Pedersen. Pp. 48. 2.40 kr. (København: Andr. Fred. Høst and Son.)

Department of Commerce: Bureau of Standards. Miscellaneous Publication, No. 92: Code for Protection against Lightning. Approved April 4, 1929, by the American Standards Association. Pp. xiii+114+2 plates. (Washington, D.C.: Government Printing Office.) 25 cents.

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 18, Article 2: Fall and Winter Stoneflies, or Plecoptera, of Illinois. By Theodore H. Frison. Pp. 341-409. (Urbana, Ill.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský sous le patronage de la Regia Societas Scientiarum Bohemica. Année 1, No. 6, Juin. Pp. 315-367. (Prague.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 102. Mededeelingen en Verhandelingen, 31: Über die Ausbreitung des Schalles bei der Versuchssprengung in Oldebroek am 28 Oktober 1922. Von Dr. E. van Everdingen. Pp. 69+3 Tafeln. 1.10 fl. No. 104a, Supplement. Oceanographische en Meteorologische Waarnemingen in den Indischen Oceaan, Maart, April, Mei (1856–1912). Tabellen. Waarnemingen Noord van 0° (1856–1923). Pp. iii+36. 1.25 fl. (Amsterdam: Seyffardt's Boekhandel.)

Svenska Hydrografisk-Biologiska Kommissionens Fyrskeppsundersökning år 1928. Pp. 43. (Göteborg: Elanders Boktryckeri A.-B.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 190: On Tea Catechin isolated from Green Tea. By Michiyo Tsujimura. Pp. 253-261+plates 26-27. 30 sen. No. 191: Sur la lampe à cadmium de type nouveau. Par Hantaro Nagaoka et Yoshikatsu Sugiura. Pp. 263-270. 20 sen. Supplement, No. 10: The Radioactive Constituents of Hokutolites and other Minerals in Japan. By Jun Yoshimura. Pp. 47-52. 10 sen. (Tōkyō: Iwanami Shoten.)

United States Department of Agriculture. Technical Bulletin No. 90: Life History of the Codling Moth in Northern Georgia. By E. R. Van Leeuwen. Pp. 95. (Washington, D.C.: Government Printing Office.) 20 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 82: Bee-Keeping in Palestine and Egypt Compared, June 1927. By J. E. M. Mellor. Pp. ii+17+13 plates. 5 P.T. Bulletin No. 88: Note sur la peste bovine en Égypte. Par Dr. Ibrahim Fahmi Salem. Pp. 56. 5 P.T. (Cairo: Government Press.)

Catalogue.

Catalogue of Fine Chemical Products for Laboratory Use: including Organic and Inorganic Chemicals, Analytical Reagents, Standard Stains, Indicators. (July.) Pp. 130. (London: The British Drug Houses, Ltd.)

Diary of Societies.

MONDAY, JULY 15.

EGYPT EXPLORATION SOCIETY (at Royal Society), at 5.—Dr. H. Frankfort: The Winter's Work of the Society (Lecture).

TUESDAY, JULY 16.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section).—Visit to the Works of Messrs. J. S. Fry and Sons, Ltd., at Somerdale, near Bristol.

WEDNESDAY, JULY 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates' and Students' Section), at 2.30.—Visit to Seghill Colliery.

PUBLIC LECTURE.

TUESDAY, JULY 16.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Sir Thomas Lewis: Observations Relating to the Mechanism of Raynaud's Disease (Victor Horsley Memorial Lecture).

CONFERENCES.

JULY 12 TO 14.

MIND ASSOCIATION (Annual Meeting) (jointly with Aristotelian Society) (at University College, Nottingham).

Friday, July 12, at 8 P.M.—Prof. F. Granger: Probability and Paradox.

Saturday, July 13, at 10 A.M.—Prof. G. E. Moore and H. W. B. Joseph: Indirect Knowledge.

At 2.—Prof. J. Laird, C. E. M. Joad, and Miss L. S. Stebbing: The Present Position of Realism.

At 8 P.M.—J. D. Mabbott, H. H. Price, and G. Ryle: Negation.

Sunday, July 14, at 2.—Prof. G. Dawes Hicks, Prof. B. Edgell, and Prof. G. C. Field: Immediate Experience.

At 8 P.M.—Address.

JULY 13 TO 20.

ROYAL SANITARY INSTITUTE (at Sheffield).

In Sections devoted to Preventive Medicine, Architecture and Engineering, Maternity and Child Welfare (including School Hygiene), Hygiene of Food, Hygiene in Industry, Veterinary Hygiene, Representatives of Sanitary Authorities, National Health Insurance Services, Medical Officers of Health, Engineers and Surveyors, Sanitary Inspectors, Health Visitors (including Personal and Domestic Hygiene).

JULY 23 TO 26.

BRITISH MEDICAL ASSOCIATION (at Manchester).