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The Future of the British Patent Office.

IN the issue of NATURE for February 7 of the present year, we dwelt at some length upon the qualifications which were called for in the head of the British Patent Office, and concluded that the responsibilities of the Office were such that the staff should be presided over by a man eminent in science. The interest which our remarks aroused, combined with the passing of time when a new official in the ordinary course of events will be appointed, lead us again to refer to the same subject and to emphasise the importance of the position occupied by a Comptroller-General of Patents and the desirability for the post to be allotted to one in whom discoverers, inventors, scientific workers, manufacturers, and lawyers would have confidence.

As we have already pointed out in our former article, the duties of a Comptroller are multifarious. Apart from those in which science, industry, and law occupy so great a part, there are many duties referable to clerical management which, very properly, may be assigned to a subordinate. With these duties, however, we are not here concerned. We desire rather to consider some special aspects which we trust will be present in the minds of those who in due course will be called upon to select the individual best fitted to perform the functions inherent in one of the important offices in the State.

Under the Patent Law Amendment Act of 1852, down to January 1884, the granting of patents was in the hands of the Commissioners of Patents, among whom were the Lord Chancellor and the Master of the Rolls. During that period, therefore, the department was almost entirely of a legal character and only remotely associated with the manufacturing classes. When the Patents Act of 1884 came into operation—now superseded by other Acts—the Patent Office was created and its functions transferred to the Board of Trade, in the control of which the Office has continued to the present day. At the same time, in 1884, a body of examiners was created, composed of persons who, by their training, were qualified in the various branches of industry and science in which they had had experience. By a further section of the Patents Act a Comptroller-General was appointed head of the Patent Office.

Since January 1884 three Comptrollers have successively held office. Without in any way attempting to depreciate the great abilities which have been shown by these Comptrollers in their respective spheres, we may say that none has held high position at the Bar, or has been in close touch with the manufacturing interests of the community, or has been distinguished in scientific circles. Each appears to have been content to be strictly "official." Some may perhaps see in this the truly distinctive British policy of "muddling

through," a policy which, however successful in the past, is not necessarily bound to serve in the future. But a policy such as this is by no means compulsory; on the want of a suitable candidate being known, there would be found many whose qualifications are of the highest who would be willing to undertake the responsibilities of the post, provided the remuneration offered was commensurate with the duties to be assumed and approached the salary obtainable outside the Civil Service.

It is only fair to remark, however, that the policy since 1883 has resulted in some substantial gain, and that a definite amount of progress has been secured. Thus mention has been made in previous articles of the setting up of a system of a limited search for "novelty" and a publication of abstracts of all specifications. Minor alterations in the law have also brought about the changes which the public has demanded, while the payment of fees, many of which are on a low scale, has been facilitated. But, speaking generally, the Board of Trade has been content to follow some distance behind public opinion and has resisted changes until agreement had been arrived at on all sides. One is almost tempted to say that the pouring into the national revenue of profits from the Patent Office of annual sums exceeding 70,000*l.* has had a soporific effect upon the Board of Trade, with the result that stagnation rather than progress has resulted. Now, within a measurable distance of time, the Board will have to appoint a new chief of the Patent Office, and thereby to settle for a considerable period the silent but certain trend of affairs in a department where the interests of all classes of the community meet on a common level.

The same problem which is involved in the selection of the chief of the Patent Office has also presented itself to the Government of the United States of America. It would be well, therefore, to consider for a moment the way in which that problem has there been attacked. In the United States, as in Britain, administration of the Patent Office involves mixed questions of law, science, and technics; and it appears to be the present policy of the U.S. Office, in the first place, not to promote any examiner to the position of Primary Examiner unless he has studied law and become a member of the Bar, it being premised that an examiner before entering the Office has passed a severe examination in science and industry. The Commissioner of Patents is chosen from among the patent lawyers or, in some instances, by the promotion of Assistant Commissioners of Patents who have risen through all the grades in the Office. It is, however, generally understood that neither the Patent Bar nor the industrial interests would tolerate the appointment of a Commissioner who had had neither a scientific education nor extensive experience as a patent lawyer. Custom and public sentiment in the United States demand that a Commissioner of Patents shall have had large experience in the practice of patent law and either a scientific education or extensive dealing with scientific questions.

Powerful advocacy for a thoroughly efficient Patent Office is to be found in the speech of the Prime Minister when reviewing the nation's position in the debate upon the unemployment question in June last. Mr. Stanley Baldwin said on that occasion that—

"No one will assert that British Industry can be saved by science alone, but it is none the less true that until scientific methods and scientific men can take their place in industry, and an equal place with the administrator and the financier, British trade will never be strong enough or resilient enough to meet the shocks that it is bound to meet as the years go by; to meet the sudden and unexpected changes which will always arise in international trade."

As the *Times* commentator expressed it: "Mr. Baldwin, as a business man himself, knows that there are thousands of people among us who already work up to the limit of their capacity and their strength. But he thinks that many employers by using their brains could add another ten per cent. to the efficiency of their several industries, and he touched briefly on some of the lines on which our conservative methods and practice might be improved."

It is an aim of the patent system to stimulate and assist employers in securing this increase of ten per cent. efficiency. The head of the Patent Office, with the qualifications which we have expressed, might be expected to make his influence felt not only within the narrow limits of his department but also in other regions far removed from bureaucratic control. The cry throughout the country is for increased production. To the discoverer and inventor we must look for a cutting adrift from old contrivances and for the best means and the most expeditious ways of bringing into being those necessities upon which our welfare as individuals and as a nation so much depends. Stimulation to industry and to invention is demanded if the position which the country held in the nineteenth century is to be recovered. A Comptroller-General high in scientific, engineering, and other technological societies, in touch with industrial concerns, and acquainted with the special needs of the various classes of persons to whom the industrial use of inventions is of paramount importance, would know best how to make the Patent Office play an effective part in the furtherance of the general advance.

We have set out in some detail the main qualifications which we think are desirable in a Comptroller of the Patent Office. That there are many in whom these qualifications may be found we have no doubt. There

are some even in the Civil Service who, not having surrendered themselves to the cramping conditions of their environment, could adequately fill the post. It is fairly certain, however, that a greater choice lies to hand outside the ranks of the Service; for, in general, it is more probable that the ideal man has already come to the front in situations where foresight, intelligence, and business capacity, unfettered by artificial restriction and official timidity, have been essential to success.

When such a man has been discovered, we may consider for the moment how his services are to be obtained. What are the inducements for him to leave his present position and to submit to the ruling of the permanent officials under whom the Patent Office is administered? At the end of a quiet and successful domestic career in the Civil Service there awaits the holder of an important position the companionage of an illustrious order with a possible knighthood. In extreme instances a Civil Servant becomes ennobled. In these respects, however, service under the Crown does not differ materially, or for the better, from commercial service. What then are the pecuniary advantages? Apart from security of tenure of office, which of course is a valuable asset, the salary attaching to the Comptrollership is altogether inadequate to attract the class of man who is so eminently desirable. The salary of the Comptroller of Patents is 1500*l.* per annum. To this there must be added a bonus calculated according to the published scale, say a sum of 200*l.*, which makes 1700*l.* in all. It may be said frankly and once for all that for such a sum the man who has given proofs of his ability in other walks of life to conduct the business of the Patent Office upon fitting lines is not to be found. The sum must be increased if the proper man is to be attracted to the post.

The Board of Trade, in conjunction with the Treasury, have the matter in their hands, for it is extremely unlikely that Parliament, which has the final control of salaries, would reject an increase which is shown to be necessary for securing the services of the right man. This selection is not merely a domestic matter which alone concerns officials in the Civil Service; it is one that affects industrialists, whether employers or employed. The issues are serious. Are we content to jog along as of old, making a minimum of progress even if stagnation is not present? Or are we to see assistance rendered in every department of industry, assistance in bringing forward the backward inventor, assistance towards the perfecting of the inventors' schemes and the securing of their best practical forms for immediate use by the public? It is therefore for the Board of Trade at the proper time to show that it is alive to the potentialities that await its selection of the head of the Patent Office.

The World's Scientific Periodicals.

A World List of Scientific Periodicals Published in the Years 1900–1921. Pp. xii+499. (London: Oxford University Press, 1925.) Two volumes, 3*l.* 10*s.* net (in cloth) or 3*l.* 3*s.* net (in paper).

THE "World List of Scientific Periodicals" had its origin in a letter written in 1920 by Sir Sidney F. Harmer, Director of the Natural History Departments of the British Museum, to Dr. P. Chalmers Mitchell. Sir Sidney Harmer asked that the Conjoint Board of Scientific Societies might consider the possibility of preparing a list of the chief scientific periodicals with an indication of the libraries in which these might be consulted. Dr. Chalmers Mitchell at once declared himself a warm advocate of the idea. Indeed, as secretary of the Zoological Society, and an enthusiastic supporter of the "Zoological Record," he had already taken some steps toward the inclusion in the "Record" of some indication of the libraries where the periodicals indexed could be found. Before the War, the Council of the Zoological Society had granted a small sum of money to compile a list of periodicals containing zoological articles, with indication of the libraries in London which had these periodicals on their shelves. This compilation had not been completed when war broke out.

The effort then made showed that the task of drawing up a list to show where each periodical could be consulted was a formidable one. While some periodicals are taken by several libraries, others are only to be found in one or two libraries, and many are not taken by any library in Great Britain. Even when a periodical is subscribed for, it is sometimes found that the series on the shelves is incomplete.

The Executive Committee of the Conjoint Board of Scientific Societies at once adopted Sir Sidney Harmer's suggestion in principle, provided that it should cover all branches of science. A Committee was appointed consisting of Sir Sidney Harmer, Mr. F. W. Clifford, Sir Richard Gregory, Dr. P. Chalmers Mitchell, Dr. A. W. Pollard, and Prof. W. W. Watts. The Committee decided that scientific periodicals in existence from January 1, 1900, should form the list, that the libraries to be indicated as taking in these periodicals should be those in London, Oxford, Cambridge, Edinburgh, Dublin, and Aberystwyth, and that, whenever possible, at least one library in the United Kingdom should be indicated for each title.

The objects of the list were declared to be:

(1) To supply a list of current scientific periodicals as nearly as possible complete.

(2) To indicate, where possible, at least one library where each periodical is taken.

(3) To form a basis for co-operation between libraries, so that both the number of duplicates and the list of periodicals not taken in at any centre may be reduced.

(4) To enable any library to use the list for its own purposes, by placing a mark against the title of each periodical it possesses, or by cutting up the pages to prepare a Card Catalogue. The list is accordingly printed only on one side of the paper, so as to make cutting up practical or to afford space for additions and annotations.

The Trustees of the British Museum not only recognised the importance of the enterprise as an aid to scientific research and as a means of increasing the usefulness of the libraries of Great Britain and Ireland, but also, on the recommendation of Dr. Pollard, then Keeper of Printed Books at the British Museum, supported by Sir Frederic Kenyon, Director and Principal Librarian of the Museum, they allowed the compilation of the list to be undertaken by the staff of the Museum as part of their official duties.

It soon became apparent that the magnitude of the work undertaken was such that the cost of preparation and publication could not be covered by subscriptions and sales. At this point, Sir Robert Hadfield and Mr. Robert Mond gave provisional guarantees to enable the work to proceed. The Trustees of the Carnegie United Kingdom Trust then guaranteed the sum of 1000*l.* towards the cost of production, on the condition that the number of centres with important libraries to be dealt with in the list should be greatly increased. This change in the original plan considerably increased the cost of preparation. Early in 1923 the Conjoint Board of Scientific Societies came to an end, but before its dissolution it entrusted "The World List" to Sir Arthur Schuster, Mr. Robert Mond, and Dr. P. Chalmers Mitchell, who undertook to form a company limited by guarantee to complete, own, and conduct the World List. Such a company was duly incorporated with a council of management consisting of Dr. P. Chalmers Mitchell (chairman), Sir Arthur Schuster, and Mr. Robert Mond. Miss Joan B. Procter became secretary. The original Committee was appointed as Advisory Committee, so that, except for the formal change in ownership and responsibility, there was no break in the control.

The actual compilation has been carried out, under the direction of Dr. A. W. Pollard, by Mr. W. A. Smith and Mr. L. A. Sheppard. Mr. Leonard Wharton has helped with the Slavonic entries. The periodicals catalogued are not only those in British libraries, but also all those concerning which information could be obtained from any part of the world.

Very special thanks are due to the Trustees of the British Museum and to the Keeper of Printed Books for allowing this work to be done by members of the staff of the Museum. It should, however, be mentioned that Dr. Pollard points out that it is only in very exceptional circumstances that any library can undertake to catalogue books not contained within its walls. He therefore suggests that there is a real need for a small "flying squad" of trained cataloguers and bibliographers who would help to make the wealth of books in English libraries available for students.

The actual list now published contains the titles of 24,128 periodicals. This is really a remarkable figure, when it is remembered that the number of periodicals indexed by the International Catalogue of Scientific Literature is only about 9000. In arranging the titles inessential words are disregarded and words regarded as unnecessary are cut out. The care with which these abbreviations have been made is, on the whole, judicious, but it is surely a mistake to change plurals into singulars in all the large headings. The title of the *Comptes rendus* is given as "Compte rendu hebdomadaire des séances de l'Académie des sciences, Paris."

This change from plural to singular is made in order that the periodicals beginning *Compte rendu* may be classified together with those beginning *Comptes rendus*. There are no less than ninety journals beginning with these two words either in the singular or in the plural, and the compilers evidently disliked having one list of journals beginning *Compte rendu* followed by another list beginning *Comptes rendus*. The "World List of Scientific Periodicals" will for a long time be the standard work to which authors will refer when anxious to quote the exact title of a journal. In these circumstances it is desirable that the titles given should be quite accurate in the list, and that any difficulties in classification should be overcome by laying down some general rules such as "In fixing the alphabetical order of the titles indexed, the plural 's' is disregarded." This would be on a par with the plan adopted in Watts's "Dictionary of Chemistry," where the prefixes "bi-," "tri-," etc., are disregarded so that bicarbonates and carbonates may come together.

The volume now published contains a numbered list of scientific periodicals. The scope of the term "scientific" is that laid down in the International Catalogue of Scientific Literature. The present volume does not give indications of the libraries in which the periodicals may be found. A second volume, to be issued shortly, will contain a list of numbers corresponding to the numbers allotted to the titles in this volume, followed by a standard abbreviation of the title and reference letters indicating the libraries filing each periodical.

An exceedingly valuable addendum to the list is a catalogue of international congresses. It is most

necessary that scientific workers should know how to get access to the accounts of papers read and discussions held at these congresses and conferences. Hitherto, there has been nothing approaching a complete list of these publications, still less any indication as to where they can be consulted. Mr. Gomme, of the Patent Office Library, has given much personal attention to the preparation of this catalogue of proceedings at international congresses. All who are interested in the advance of scientific knowledge will be grateful to him for the care he has given to this section.

Our thanks are due to all those who have ungrudgingly given time and thought to the successful working out of this great undertaking, and to those who gave financial assistance when the project seemed likely to fail from lack of funds to carry it on. Dr. P. Chalmers Mitchell, who signs the preface, has evidently been the driving force ready at all times to meet and overcome difficulties as they arose. The task has been great, but those who undertook it have resolutely set themselves to accomplish it and have brought it to a successful issue.

Jungle-Folk of India.

The Birhors: a Little-known Jungle Tribe of Chota Nagpur. By Rai Bahadur Sarat Chandra Roy. Pp. viii + 608 + 36 plates. (Ranchi: *Man in India* Office, 1925.) 10 rupees; 15*s*.

THE Birhors dwell in the jungles which fringe the eastern margin of the great central 2000 ft. plateau of Chota Nagpur, in the Province of Bihar and Orissa. Like so many other primitive communities, they seem doomed to perish under the impact of modern life; between 1911 and 1921 their number fell by more than 30 per cent. (from 2340 to 1510). Mr. Roy's monograph is a timely record of a dying race.

Some of the Birhors are "settled," and eke out a livelihood by burning patches of jungle and raising a scanty crop of maize and beans. But their normal mode of life, to which even settled Birhors often revert, is nomadic; the fauna and flora of the jungle supply them with food and with the *chōp* fibre (*Bauhinia scandens*) which they make into rope and barter for such clothing, condiments, etc., as they cannot produce themselves. The Birhors eat almost anything; whether they ever ate their ancestors, as commonly alleged, is an open question; the case against them is not yet proved.

Racially the Birhors resemble the more virile Mundas and Oraons of Chota Nagpur. Their language is a dialect of that Austric family which straggles round half the globe, from Madagascar to Easter Island. Their social organisation, as elsewhere in India, is based on clan exogamy, but in the economy of daily life the kin-group yields precedence to the clan-group, or *tāndā*, a word applied also to the encampments of Lambadi (Banjari) gipsies who were once the carriers of peninsular India and the Punjab. The *tāndā* consists of from 3 to 10 families, belonging to various clans, associated together for subsistence. Each *tāndā* has its captain (*nāyā*), its magician (*māti*), and its messenger (*diguār*), its own spirits (*sāngi bhūt*), and its own hunting expeditions. Mr. Roy explains in detail their hunting ritual and the partition of the spoil. Once a year several *tāndās* unite in a "regional hunt"; otherwise inter-*tāndā* relations are limited to wedding festivities and adjudication on infractions of tribal law.

The clan system, as usual, regulates matrimony. Mr. Roy names thirty-seven clans, and the list is not exhaustive. Most of the clan names are "totemistic," but some connote localities and some clans bear the names of alien castes and tribes, which indicate some infusion of alien blood. Each clan has its peculiar traditions, observances, and cults, and several clans are admittedly of hybrid origin. Broken folk cannot afford to be exclusive.

Lads and lasses are schooled by the familiar "dormitory" discipline of primitive culture. The dormitories are not exactly shrines of purity—boys will be boys,—but schoolboy etiquette insists that a lad should stick to his own sweetheart and not poach. With marriage comes respectability. Of marriage there are ten forms, nine of them informal and gallant, the tenth only is "regular," heavily laden with the elaborate negotiation and formalism in which India delights.

Mr. Roy's appraisement of Birhor religion is kindly and sound. He rightly discriminates between "personal" gods and spirits propitiated with prayers and sacrifices, and impersonal "powers, forces, or energies" controlled by spell or threat or other "magical" device. Religion to the Birhor is not all gloom and terror. Singbōngā, the supreme being, is benign enough, but, like other superior personalities, somewhat aloof. Then there are hosts of clan spirits, *tāndā*-spirits, family spirits (mostly ancestral), tutelary spirits, etc., whose censorship of moral lapses must exercise a salutary influence on social life. Mr. Roy's outline is clear and concise, and he neatly sums up the *summum bonum* of Birhor existence: "the power to control and direct the *impersonal* energies and powers and the stray *personal* powers—and secure the goodwill of the more important *personalised* powers or spirits."

In Birhor belief a man has two souls, one male, one female. When he dreams, the male soul quits the body, the female soul remains in charge, and the body

sleeps. But if the male soul lingers, its mate goes out to search for it, and the body dies; temporarily, perhaps, for the spirit-doctor (*māti*) is requisitioned and does what he can to call back the truant souls and restore life.

The Birhors are by no means untouched by Hindu influences, markedly so in the few religious festivals celebrated by certain clans, and in folk-tales of which Mr. Roy gives numerous examples. The Birhor version of the Rāmāyana is of special interest.

Students of Indian anthropology are deeply indebted to Mr. Roy for the light he has thrown on the past and present culture of the Chota Nagpur plateau. In the Bihar and Orissa Research Society's Journal he has opened up new ground in the archæology of his area. His monographs on the Mundas and Oraons are classics. "The Birhors" is yet another first-rate study, a study not merely of an obscure tribe but also of the workings of that mysterious complex of thought and feeling which go to make up human culture. The volume is handy in size and easily read, in spite of the numerous misprints inseparable from Indian typography. The plates are well chosen, but not too well printed. Mr. Roy is never a theoriser or a partisan; his diction is simple and precise, his inspiration comes straight from the hearts of the humble folk he has made his friends.

F. J. RICHARDS.

Research at High Temperatures.

Fours électriques et chimie. Publié sous la direction de Prof. P. Lebeau, avec la collaboration de C. Bedel, Prof. A. Damiens, P. Fleury, Prof. P. Jolibois, Dr. M. Picon, Prof. G. Ribaud, Dr. H. Weiss. (Fondation Edmond de Rothschild pour le développement de la recherche scientifique.) Pp. xii+585. (Paris: Les Presses universitaires de France, 1924.) n.p.

THE Committee of the Fondation Edmond de Rothschild has caused this book to be written as a preliminary step in the planning of investigations with electric furnaces, to extend scientific knowledge and industrial applications. It forms a review of electric furnace constructions and their applications and succeeds in covering the ground fairly thoroughly. Recognising that advances in chemistry and physics are frequently closely associated with the invention or development of new apparatus, an attempt is made to describe various types of electric furnace and to associate with the several forms a summary of the main researches already carried out by their aid.

Such a compilation has both its advantages and its dangers. Bibliographical surveys, or *documentation* as the French so aptly describe them, undoubtedly save the investigator a lot of tedious work; and literary searching is not only wasteful of the time, but actually detrimental to the originality of the more able scientific worker.

On the other hand, there is a real risk that too much attention will be paid to the acquisition of replicas of the apparatus of the earlier workers, without due regard to the more important part which the inspiration and skill of these investigators played in its design and use. The history of the scientific application of electric furnaces itself provides an excellent example of the power of the able experimenter to override all limitations in apparatus and equipment. The late Henri Moissan is even to-day unsurpassed in the richness of his discoveries in this field, and yet he had, for almost the whole period during which he was engaged in these researches, only the most simple equipment, and the only supply of electric current in his laboratory was that which he could provide from primary batteries; the electric furnace work being carefully prepared beforehand but executed on occasional pilgrimages to a central supply station, several miles away from the laboratory.

Whereas the work of Moissan was concerned chiefly with the primary survey of the subject and the production of metals and new compounds, hitherto outside the practical scope of ordinary methods of heating, later applications have called for apparatus of greater precision. The need for close control of the working temperatures, as in the determination of such physical constants as the boiling points of the metals; for heating *in vacuo* to prevent the oxidation or the carburisation of metals; or for high pressure to attain measurable yields of some of the products of high temperature chemical reactions, has in each case led to the design of much more complicated apparatus. The description of this apparatus is fully dealt with in this book in seven chapters devoted respectively to electric furnaces of the following types: (1) metallic resistance, (2) carbon resistance, (3) vacuum, (4) high pressure, (5) induction and high frequency, (6) arc, (7) spark and gas discharge; whilst an eighth chapter summarises the methods of pyrometry.

With a subject that covers such a wide borderland of physics, chemistry, and electrical engineering, it is not surprising for a reviewer to be able to find a few omissions—such as all mention of the electric furnace production of silica glass—but the survey on the whole is remarkably complete and superior to what is generally provided by French scientific books; and it can be strongly recommended to English workers who have need of a reference book on the subject. The Fondation Edmond de Rothschild (see NATURE, 1921, vol. 107, p. 563) is one of the largest French endowments for

physico-chemical research, and the further development of this branch of its activities, which will apparently consist in supporting work to supplement existing knowledge in this field, will be awaited with much interest. R. S. H.

Lakes.

Les lacs, leur mode de formation, leurs eaux, leur destin : éléments d'hydro-géologie. Par Léon W. Collet. Pp. xii + 320 + 28 planches. (Paris : Gaston Doin, 1925.) 35 francs.

THE limnologist is fortunate in having at his disposal two such excellent works of recent date as Prof. Halbfass's "Grundzüge einer vergleichenden Seenkunde" and Prof. Collet's "Les lacs." Though the subject is the same, there is room for both. The mode of treatment is very different and there is little overlapping between the two. Prof. Halbfass's book is the more general. Prof. Collet's deals chiefly, though by no means solely, with the lakes of Switzerland and the Alps, and some of these it describes in considerable detail. Prof. Collet was formerly Director of the Swiss Hydrographical Service, and the accounts that he gives of the observations made by himself or under his direction form a valuable feature of his book. He also took part in Sir John Murray's survey of the Scottish lochs.

Prof. Collet's book is divided into three sections: the formation of lake-basins, the water of lakes, and the destiny of lakes. Under the last heading he includes not only the filling of lakes by deposition but also the utilisation of their waters. The first section occupies about a hundred pages. Owing to the somewhat sceptical attitude adopted by some writers in England, the English geologist will probably be most interested in the lakes attributed to glacial erosion and to solution. Prof. Collet himself has no doubt about the erosive powers of glaciers, and like Penck and Brückner believes that most of the lakes of the Alpine borders are due to overdeepening where the glaciers debouched upon the plains. Lake Geneva, however, has had a more complex history, which has not yet been fully worked out; and only the upper basin is due to this cause. In connexion with this question of overdeepening he gives an interesting photograph of the left bank of Lake Ritom. It shows glacial striations rising steeply from the water, the direction of the rise being towards the outlet. It proves, he thinks, and it certainly suggests, that the glacier itself rose towards the barrier at the lower end of the lake. Perhaps, however, even this will not convince the confirmed sceptic, for it is still possible that the greater part of the ice in the lake-hollow may have been stagnant and only the upper layers moving.

No geologist denies the efficiency of water as a solvent agent; and in Cheshire, depressions of the surface due to the solution, natural or artificial, of the salt beneath, are too common to leave any doubt as to their cause. But it is not so clear in England that any lake-basins have been formed by direct solution of the rock that occupied the hollow. Hollows have been produced in this way in our limestone districts, but they do not usually hold water, for there is generally an underground escape. In the Karst, however, and in the Limestone Alps, the conditions are more favourable, and Prof. Collet describes several examples. In some there is no visible outlet, in others a part of the water escapes superficially and a part underground. By means of experiments with fluorescin, Prof. Collet has shown that in several cases the subterranean outflow is not in the direction that the surface topography would lead us to expect.

The section on the water of lakes occupies 85 pages and deals with the influence of the regime of the affluents, the temperature, the chemical composition, and the colour. One of the most interesting parts of this section is the account of Lake Ritom. For stable equilibrium the water must increase in density downwards. Consequently in temperate regions, when there is no disturbance due to wind or other causes, the temperature of the water in summer decreases downwards; in winter, if the surface water is below 4° C., the temperature increases downwards. Lake Ritom sometimes shows a layer of cold water lying between warmer water above and below. The condition is due to differences of salinity. The upper twelve and a half metres—the measurements were made before the level of the lake was artificially altered—consists of oxygenated water with a low percentage of salts. From thirteen metres downwards the water is highly saline and contains sulphuretted hydrogen. There is a transition layer of about half a metre in thickness. The lower water is almost stagnant and has a temperature of about 6° C., varying little with the depth or with the season. The fresher water is never so cold as to become heavier than the salt water beneath, and consequently the convection currents in the former do not extend into the latter. The upper layer, in fact, behaves as if the salt water formed the floor of the lake and the temperature at this false floor is often less than 6° C.

The salts in the lower water are derived from the dolomitic and gypsum-bearing Triassic rocks of the region, not by direct solution of the walls of the hollow but from underground sources. Since the water is nearly stagnant the supply is doubtless very slow—it must, in fact, be so slow that it is balanced by diffusion into the upper layer. This upper layer consists of the

water from the visible affluents of the lake, which are all only slightly mineralised, and the fresher water flows over the saline layer and escapes by the river Foos.

The third section, consisting of rather more than a hundred and twenty pages, is the most important from the practical point of view, and should be consulted by engineers who have to do with the construction of reservoirs for any purpose. All lakes tend to be filled up in time by the deposits brought into them by streams and rivers, and the same is true of reservoirs. In a country like Switzerland the process is often much more rapid than in England. The original artificial lake of Perolles was filled in fourteen years, and the rate of deposition in other cases is equally high. This is one of the matters investigated by the Hydrographic Survey, and though the rate must vary greatly in different cases, the figures which Prof. Collet gives are of great value. They are, in fact, almost the only figures available which are more than guesses.

Sufficient has been said to show the interest of the volume. Prof. Collet writes very clearly and the book is admirably produced and illustrated. There are 63 maps and diagrams and 28 plates of photographs. Apparently the paper on which the text is printed is heavily loaded, for though the book is not bulky it is inconveniently heavy. This is the only fault that can be found with it. P. L.

Our Bookshelf.

The Social and Political Systems of Central Polynesia. By Robert W. Williamson. Vol. 1. Pp. xxix + 438 + 6 maps. Vol. 2. Pp. v + 496. Vol. 3. Pp. v + 487. (Cambridge: At the University Press, 1924.) 75*s*. net.

THE amount of labour involved in the writing of this book has been, literally, enormous. The bibliography of books covers eleven closely printed pages, and to these must be added innumerable articles in the scientific journals of which the titles alone occupy nearly a page. Yet the Sandwich Islands and New Zealand are not included, and except for an opening chapter on origin and migrations, no subject outside what is strictly social or political is discussed. Even such matters as the functions of the chiefs in relation to ritual observances are postponed, with other topics connected with religious ceremonies and customs, for future consideration in another work.

Within the limits that Mr. Williamson has set himself, his treatment has been thorough. The difficulties arising out of the often unsatisfactory, and sometimes contradictory, character of the evidence—evidence collected at widely separated periods of time, by individuals of very different powers of observation and of varying capacity for precision of statement—have been squarely faced and usually resolved into a coherent account. Mr. Williamson's examination of local and social grouping may be taken as a very fair sample both of the difficulties and of the results of his meticulously careful method of analysis. Limitations of space forbid any critical examination of conclusions which are based upon a mass of detail drawn from so extensive a field; but it may be mentioned that Mr. Williamson finds that the fundamental factor in the social and political system of Polynesia was the recognition of the office of the head of the group, taking this term as applicable to functions ranging from those of the chief of the most extensive area under one authority to the head of a family group. Mr. Williamson is to be congratulated on the successful accomplishment of a heavy task by which he has earned the gratitude of all students of ethnology.

Automotive Electricity: a Text and Reference Work on the Construction, Operation, Characteristics and Maintenance of Automotive Ignition, Starting, Lighting and Storage Battery Equipment. By Earl L. Consoliver. Pp. xv + 665. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1925.) 20*s*. net.

ELECTRICITY plays a most important part in the equipment of a modern motor-car. In addition to igniting the fuel charges within the engine cylinders, it starts the engine and illuminates the road for night driving. It also operates the horn and other signal devices, and in many cases it operates electric gear shifts, hand-warmers, cigar-lighters, and carburettor heating devices. It plays an equally important part in connexion with motor-boats and aeroplanes. There is a demand, therefore, for a book which will give a clear and trustworthy account of the ignition requirements, the starting and generating equipment, and the management of storage batteries.

The volume under notice, whilst disclaiming to be an encyclopædia, does touch pretty thoroughly on all these subjects. Naturally American practice is most fully considered, but most of the advice given is directly applicable to all makes of car. The title led us to expect that vehicles driven exclusively by batteries would be described and that their limitations would be considered. This branch of the subject, although an important one—more especially in the United States—is not considered. Many useful hints can be picked up from this book. The author has had considerable experience in instructing those who have to look after motor-cars; he gives the minimum of theory and lays stress on those points which are important in practical running.

Practical Advice to Inventors and Patentees: Inventions and How to Patent Them. By C. M. Linley. Pp. vi + 126. (London: Sir Isaac Pitman and Sons, Ltd., 1925.) 3*s*. 6*d*. net.

THIS thoroughly practical little book can be strongly recommended to inventors who wish to know how to exploit their ingenuity commercially, for its author appears to have learned the ropes in the hard school of experience. The principles of patent law and practice are set forth clearly in non-technical language and the exposition of these is sound, although the following points might be noted for future editions: a British patent cannot be invalidated by publication in a prior British specification more than fifty years old (pp. 47, 48), while it can be invalidated by publication in a foreign specification taken by the Patent Office library, whether or not there has been additional publication

in a periodical (p. 45); and p. 44 would be improved by the addition of a paragraph on the gentle art of phrasing disclaimers.

It is, however, when he comes to more practical topics that the author is at his best: he shows a keen insight into human nature and much ripe wisdom when he explains how to attract a capitalist, how to deal with infringers, how to combine discipline with fair play when inferior workmen become inventive, and how to perform a good many other difficult but profitable feats which are not mentioned in text-books of patent law. His anecdotes relating to the history of inventions also make good reading. The book is written in a conversational style and is all the more readable on that account, but it would be the better for a thorough revision of its syntax, which is in places slipshod.

Methods in Plant Histology. By Prof. Charles J. Chamberlain. Fourth revised edition. Pp. xi + 349. (Chicago: University of Chicago Press; London: Cambridge University Press, 1924.) 3.25 dollars.

SINCE the first edition of this book appeared in 1901 it has become a well-known manual of laboratory methods. Its usefulness may be judged from the succession of editions of continually increasing size. The present edition is largely re-written—a task necessitated in part by the stimulus to improvement in technique resulting from previous editions. There are additional hints on details of method throughout the book, and these are especially valuable in the field of cytological technique, where success—like genius—depends upon an infinite capacity for taking pains.

The Venetian turpentine method for mounting algæ has been made more specific and could doubtless be more widely used with advantage, as the staining results are brilliant when good preparations are obtained. A short chapter is added on the cellulose acetate method of softening woods for sectioning—a method developed by Dr. Kernot and Mrs. Williamson, which softens the hardest woods without destroying details of structure.

The standardisation of American stains, on which a scientific commission has been at work since the War, has led to a great improvement in dyes, which now often surpass the old Grübler stains, and incidentally has led to alterations in the directions for staining given in this book. Among the micro-chemical tests we are surprised to find no mention of aniline hydrochloride, which is such a useful laboratory reagent for lignified tissues. R. R. G.

An Outline of Automatic Telephony. By William Aitken. Pp. 143. (London: Ernest Benn, Ltd., 1925.) 5*s.* net.

SINCE the introduction of automatic working, telephony is becoming more and more a highly specialised science. To the outsider the problem appears to be one of the greatest complexity. Any telephone in an area has to be connected in a few seconds with any other telephone in that area so that two persons can converse clearly and uninterruptedly for a given period. As a mistake in dialling is always possible, the caller must be able to break down the connexion at any instant. The cables between any two switching stages may be in use or faults may develop in them. Signals therefore have to be given to the caller to indicate abnormal conditions. Further, supervisory signals have to be sent to the attendants and the sensitive pieces of apparatus have to be protected by suitable devices. Service has sometimes to be free, but generally it is either metered or obtained by "coin in the slot." As all these variations have to be done automatically and with the minimum risk of error, the difficulties that arise are unending, and telephone engineers are to be congratulated on having developed working systems. Mr. Aitken gives a good technical description of the various types of systems in use, particular stress being laid on the Strowger Director System, which is the one being installed in London. The system he adopts of describing the "circuits" is original and easily intelligible.

Sulphuric Acid Concentration. By P. Parrish and F. C. Snelling. (Chemical Engineering Library, Second Series.) Vol. 1: By Hot Gases. Pp. 141. Vol. 2: In Heated Vessels. Pp. 147. (London: Ernest Benn, Ltd., 1924.) 6*s.* net each.

THE chief merit of these two small volumes is that they are written by practical men who possess a ripe and successful experience of sulphuric acid manufacture. For this reason they will be read and studied with profit by the works' chemist and engineer, whilst the fact that they contain a considerable amount of information which is not found in ordinary text-books will make them appeal to the teacher and student in technical institutions. From the educational point of view, however, they have one drawback, namely, defective composition: there is scarcely a statement in them which could not be put into clearer and terser English; but even this could be turned to good purpose by a capable teacher.

The accounts of the Kessler and Gaillard methods of concentration in the first volume, and of cascade systems in the second, are particularly useful, and, like the rest of the subject-matter, quite up-to-date from the point of view of British practice. Two chapters are devoted to constructional materials, and one to transport and storage. In the final chapter on possible developments, the view is expressed that in the future "chamber" acid (70-80 per cent.) and oleum will be produced simultaneously in one plant, and rectified acid (96-98 per cent.) will be obtained by mixing them on the spot.

The Wandering Scholar. By David G. Hogarth. Pp. v + 274. (London: Oxford University Press, 1925.) 8*s.* 6*d.* net.

THIS book is neither a reissue nor a new edition, but in part is both. It is a combination of two books, "The Wandering Scholar" and "The Accidents of an Antiquary's Life," one published in 1896 and the other in 1910. Of the first, two chapters and some paragraphs are omitted; of the second, the introductory chapter. The account of the Anatolian Turk under the old Hamedian regime, a piece of description and psychological analysis of remarkable penetration and insight, is retained. Those, if any, who are unacquainted with these delightful sketches of travel and archæological exploration in Asia Minor, Greece, and Egypt, with their humour and their sympathetic appreciation of the people of each country, will be grateful for their reissue in the convenient form of a single volume.

Letters to the Editor.

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

The Isotopic Composition and the Atomic Weight of Chlorine in Meteorites.

THE most accurate determinations of the atomic weight of chlorine indicate that on earth this element consists of $76{\cdot}6_5$ per cent. of chlorine of isotopic number 1 (atomic weight = 35) and of $23{\cdot}3_5$ per cent. of isotopic number 3 (atomic weight = 37). It is of interest to determine the composition of this element in meteorites, and this has been done by the present writers, with the result that meteoritic chlorine has been found to have exactly the above isotopic composition. Within the limits of error of extremely accurate work, the atomic weight of meteoritic chlorine is found to be the same as that of this element as found on earth.

Presumably the material of meteorites has not been mixed with that on earth within the last few billion years. Thus, if during this period there has been any disintegration or formation of atoms of chlorine, it has either (1) not affected at all the relative amounts of the two isotopes, or (2) the relative amounts have been affected to exactly the same extent in both locations. The additional possibility that the coincidence is accidental seems to be ruled out by the similar results of Baxter for the atomic weight of meteoritic nickel. Have the materials involved ever been mixed with sufficient thoroughness to explain these results? According to Harkins (J. Am. Chem. Soc., 39, 856 (1917); *Phil. Mag.*, 42, 332 (1921)) the atoms of the lighter isotope are more stable, and a large part, if not all, of the exhibited constancy of isotopic composition of elements is due to the net effect of the different types of atomic stability.

The average of the best results for the atomic weight of terrestrial chlorine is 35·467. The five results obtained by us on highly purified meteoritic chlorine are 35·466, 35·468, 35·469, 35·469, 35·465, with an average of $35{\cdot}467_4$. The method used for the determination of the atomic weight consisted in weighing about two grams of extremely pure silver in a quartz flask, dissolving in nitric acid, and in finally adding hydrogen chloride obtained from a meteorite in sufficient excess to convert the silver completely to silver chloride. The water and acids were evaporated and the silver chloride fused, the last fusion being carried out in an atmosphere of chlorine. The balance used gave a deflexion of half a millimetre on the scale for a hundredth of a milligram. The methods used throughout were similar to those used by Richards and his associates, with the exception that the smaller amount of material available made it essential to use a balance of the highest sensitivity compatible with the requisite stability and constancy.

Chlorine from wernerite, from apatite, and from purified commercial hydrochloric acid gave results which were identical with those on the meteorite, within the limits of error of the work.

In calculating the percentages of the isotopes as given in the first paragraph, use was made of the Whole Number Rule of Harkins and Wilson (J. Am. Chem. Soc., 37, 1367-1421 (1915)) and the assumption was made that the atomic weights of the separate isotopes are exactly whole numbers. While any deviations from these whole numbers affect the percentages given, it is obvious that they do not affect the identity of composition of meteoritic and terrestrial chlorine as exhibited by the identity in the atomic weights of the mixtures from the two sources.

WILLIAM D. HARKINS.
S. B. STONE.

University of Chicago,
August 11.

Coastal Errors in Radio Direction-Finding.

FOR many years now it has been the experience of those dealing with wireless direction-finders that when the path of the waves being received lies approximately parallel to the coast, an error in apparent bearing is obtained which may or may not be constant. It is probably correct to state that the error is always such as to indicate that the waves in crossing from sea to land experience a deviation in a direction towards the normal to the coast-line at a point of transit. This is consistent with the generally accepted assumption that the velocity of waves over sea-water is greater than the velocity over land, due to the lower conductivity of the latter. The magnitude of the possible error which may occur appears to be usually of the order of 3° to 5°, although greater errors up to about 10° are apparently sometimes experienced.

While a fixed transmitting station should, in the absence of night variations, give a constant bearing even including any coastal refraction effects, a little consideration of the case will show that several stations at different distances on the same great circle from the D.F. stations will give different errors. It is thus evidently impracticable to apply a correction to the observed bearing of a ship at a D.F. station without assuming a knowledge of its true bearing and distance, and it is becoming the practice of those in charge of shore D.F. stations to supply information as to the arcs over which the bearings supplied may be considered to be reliable.

In the experimental direction-finding work conducted by me during the last four years, errors have been measured in certain cases which appear to support the above experience. At one D.F. station situated on the east coast of England, the only cases in which consistent errors of more than 1·3° were obtained in daylight, were found to be those for which the direction of transmission was within 20° of the coast-line. On the wave-lengths of 450 and 600 metres employed in the majority of these particular observations, this coastal error was of the order of 3° to 4·3° for some of the transmissions. In one instance, in which the wave-length was systematically increased from 500 to 2600 metres, the corresponding error decreased from 3·2° to 1·4°. On higher wave-lengths the possible coastal error observed in this and all other cases was less than 1°. In every instance the error was such as to indicate a bending of the waves towards the normal to the coast-line, in passing from the sea to the land side of the boundary.

From Zenneck's analysis (J. A. Zenneck, *Ann. der Phys.*, 1907, vol. 23, pp. 846-866) of the case of a plane wave travelling over the plane boundary of a semi-conducting ground and non-conducting air, it can be shown that the velocity of wireless waves in a horizontal direction is greater over land than over sea. Hence the effective refractive index, which is the ratio $\frac{\text{velocity over sea}}{\text{velocity over land}}$, is less than unity, and a wave will be bent away from the normal in crossing

a coast-line from sea to land. Eckersley (T. L. Eckersley, *Radio Review*, 1920, vol. 1, pp. 421-428) has previously made a study of the refractive effects for wireless waves crossing the Egyptian coast from the Mediterranean Sea, and obtained experimentally a refractive index of 1·02 for a wave-length of 1000 metres. A theoretical value of 1·067 was given as being applicable to this case, but in view of the above remarks a mistake would appear to have entered into the derivation of this value.

It has been shown from recent measurements (R. L. Smith-Rose and R. H. Barfield, Proc. Roy. Soc., 1925, vol. 107, pp. 587-601) that the effective conductivity of the ground in the south of England at wireless frequencies is approximately 10^8 e.s.u. If this value be used to calculate the refractive index for the English coast, taking the wave-length of 450 metres, the value of μ obtained is 0·999991. This means that the ratio of the velocities of these waves over the sea and land differs from unity by less than 10^{-5}, and it is thus difficult to account for the deviations which have actually been observed, quite apart from the fact that they are in the wrong sense. It must be remembered, however, that in such a case the deviation $\delta\phi$ of a wave crossing the boundary at an angle of incidence θ can be shown to be

$$\delta\phi = \frac{\mu - 1}{\mu} \tan \theta.$$

Hence, although $\mu - 1$ is only 10^{-5} for the case considered above, $\tan \theta$ tends to become infinite as θ approaches 90°. So that in the case of waves which pass along the coast at practically grazing incidence for a distance of several miles, the error may reach a value of two or three degrees as actually observed. Two difficulties in making a strict comparison with experimental results are that the coast-line is not usually straight for any appreciable distance, and that it is doubtful in many cases if the effective boundary between the sea and land is defined by the high-water mark used on charts. For these reasons the angle of incidence of the waves on the coast-line is a rather uncertain quantity. The conditions are further complicated in many instances by the waves

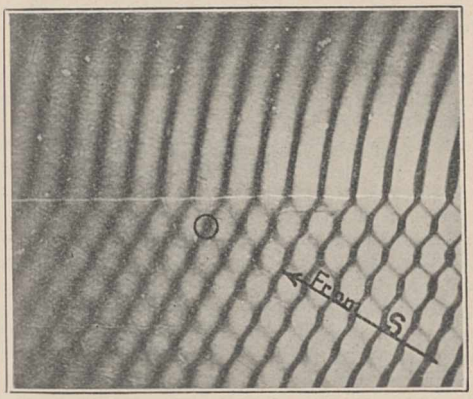


FIG. 1.—Ripple photograph. Source S and observing station O on same side of boundary. Conditions at O are complicated by the presence of a reflected wave in addition to the direct wave from S.

having to cross several coastal boundaries between transmitter and receiver, and a cumulative action may result.

It was suggested by Eckersley that it is necessary to be a few wave-lengths away from the boundary in order to allow the wave-fronts to settle down, before the angle of refraction can definitely be measured. Since the land D.F. stations are often situated within a wave-length of the boundary, it is important to know exactly what is happening at such a short distance. Providing the change from one medium to another at the boundary is reasonably sudden, there appears to be no reason for supposing that the deviations of waves crossing it is not equally

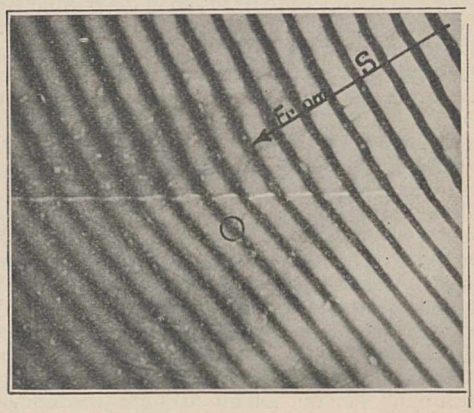


FIG. 2.—Ripple photograph. Source S and observing station O on opposite sides of boundary. The wave front observed at O is not at right angles to the true bearing of S.

sudden. This point has been very nicely demonstrated by the analogous case of water ripples in which the change in velocity is produced by an alteration in the depth of the water in the ripple tank. The photograph reproduced in Fig. 2 shows that the change in direction is quite sudden and is complete within a fraction of a wave-length. Should the change in conditions from one medium to another be gradual, the resulting refraction will be equally gradual, and at the boundary the observed deviation should be always less than the total deviation produced at a sufficient distance from the boundary for the refraction to be complete.

In many of the cases noted by me it appeared that the direction of arrival of the waves was entirely over-land, and thus any deviation could scarcely be ascribed to refraction. It was pointed out by Dr. A. H. Davis, of the Physics Department of the National Physical Laboratory, to whom I am indebted for the accompanying ripple photographs, that the internally reflected wave might be important in such a case. The effect of this wave in the case of water ripples is demonstrated in the photograph reproduced as Fig. 1, in which the waves are approaching the boundary from the same side as that on which the D.F. observing station is situated. It is evident that the apparent direction of the waves arriving at O may be altered by an appreciable amount and in the same direction as that caused by refraction, as in Fig. 2.

Although this certainly directs attention to the fact that a direction-finder may be liable to errors on waves arriving on both the land and sea side of the coast, there is still the same difficulty in explaining the matter on theoretical grounds. For, with the value of μ deduced above, the amplitude of the reflected wave will be very small except in the case of total internal reflection, which will not occur until the angle of incidence is nearly 90°.

R. L. SMITH-ROSE.

The National Physical Laboratory,
Teddington,
August 25.

Sex-determination in *Trialeurodes vaporariorum*.

THE common Greenhouse White Fly (*Trialeurodes vaporariorum*) presents a rather curious case of sex-determination. Originally (1903) Morrill in America discovered that it was parthenogenetic and that all unfertilised eggs developed into males; this finding was corroborated later on by Stoll and Shull (1919). Hargreaves (1914) and Williams (1917), investigating the same species in England, found, however, that in this country unfertilised eggs laid by virgin females exclusively gave rise to females. Random collections in America had shown a considerable proportion of males (40-50 per cent.), while in England, none or a few males were found; only one small colony found by Williams at Merton agreed with the American strain with regard to its sex-proportion.

These investigations indicate that *Trialeurodes vaporariorum* has two races, an "American," showing arrhenotokous parthenogenesis, and an "English" with thelytokous parthenogenesis, a most interesting fact, which, however, does not seem to be completely unique in the animal kingdom (cf. *Trichogramma pretiosa*, a Chalcid, Howard and Fiske, 1911). As to the progeny of mated females, Williams in the exceptional Merton colony had obtained both sexes after pairing of the mother individual, and therefore thought himself justified in concluding that fertilised eggs may give rise to both males and females. Stoll and Shull with individuals of the "American" race arrived at the same experimental result, but maintained that the interpretation might be the same as in the honey-bee, where the queen after mating can lay both fertilised and unfertilised eggs, developing into females and males respectively. Furthermore, it seemed probable that this is really the case, for they obtained in some experiments a great majority of females after mating, while if Williams's interpretation was the right one, no more than 50 per cent. should be found. Nothing has been published about the result of mating in the "English" race.

Schrader (*J. of Morphol.*, 34, 1919) has investigated the cytology of the "American" race and made out the following facts: The haploid chromosome number is 11, the diploid 22. In all eggs pseudo-reduction is completed and consequently only 11 chromosomes are seen in the maturation divisions. All eggs show two maturation divisions and undergo reduction. Unfertilised eggs give rise to males, which are haploid. Fertilised eggs develop with the diploid number to females. In the spermatogenesis the haploid chromosome number is retained without further reduction; Schrader believes that the reduction division has been eliminated and only the equation division left, but one can scarcely consider this proved.

Thus the sex-determination and cytology of the "American" race in all essentials present the same features as the honey-bee, but the case is much clearer, because the perplexing coupling and breaking-up of the chromosomes, which are met with in the bee, are not present in Trialeurodes.

I have investigated *T. vaporariorum* in Denmark and my main results are as follows: In Danish greenhouses I have found both the "American" race and the "English" race, and also mixed populations, more often the "American." As to the latter, I can confirm the results of the previous workers. With the "English" race I have made a great number of breeding experiments which show that this strain is exclusively or almost exclusively female-producing. Here it must suffice to mention that in three clones, any of them descending from a single female, 2398 females and 1 male appeared in the course of three generations. Attempts at crossing females of the "English" race with males of the "American" gave in all experiments together: in F_1 766 females + 1 male; in F_2 (parthenogenetic progeny of F_1) 999 females and 4 males. (Probably the males, which only appeared in 2 lines of 11, have originated from slight contamination of the initial material with "American" females.) Then even after the "crossing" the female-producing strain persists, *i.e.* probably no effective crossing has taken place. It is very likely, though hitherto not proved, that the rare males in the thelytokous strain do not differ genetically from the males of the arrhenotokous race. Therefore, instead of speaking about two races, one might just as well say that *T. vaporariorum* has two kinds of females: obligatorily parthenogenetic thelytokous and facultatively parthenogenetic arrhenotokous together with haploid males.

The cytological examination of the thelytokous females shows that the oogenesis up to a certain point goes on in just the same way as in the arrhenotokous ones. The chromosome number is the same; the usual leptotene and pachytene stages are met with in the prophase; a pseudo-reduction takes place, thus only 11 chromosomes are seen during the maturation divisions; two polar nuclei are produced: in short, the egg behaves just as if it was preparing for fertilisation or development with the haploid chromosome number. But afterwards the 11 chromosomes divide, and in all segmentation nuclei and later on in the larval mitoses 22 chromosomes always are found. So close a resemblance in the behaviour of the chromosomes within the same species between obligatorily parthenogenetic eggs and eggs that can be fertilised has been found in scarcely any other animal.

For further particulars and discussion I must refer to my detailed paper which will probably be published in the course of the winter. In the same paper will appear an examination of the cytology of *Aleurodes proletella*, in which species I have been able to prove that really only one maturation division occurs in the spermatogenesis of the haploid males, together with an investigation of the parthenogenesis in the coccid *Lecanium hesperidum*.

MATHIAS THOMSEN.
Royal Veterinary and Agricultural College,
Copenhagen, August 19.

Science in Poland.

THE courteous notice in your columns, on August 1, p. 168, of vol. 5 of the Polish annual *Nauka Polska* is admittedly based on the scanty French abstract contained in the volume itself, and not on the original Polish contributions. May I, therefore, claim the hospitality of your columns for a brief supplementary statement?

The writer of the notice, sympathetically as he deals with the endeavours to "prepare the conditions for a scientific advance" in the new Poland, could not be expected to give due emphasis to the fact that these endeavours are the continuation of a solid and unbroken tradition which existed in the old Poland before the partitions, ever since the Middle Ages and the Renaissance, and never became extinct during the century and more of Poland's subjection to other Powers. Of the six universities of the new Poland mentioned in the notice, Cracow University, founded in 1364, has continued its work without any interruption for five centuries and a half; the Polish University of Warsaw, changed by the Russian Government into a Russian one, has been re-established as a Polish university since 1916. Wilno had had a Polish

University since the second half of the 16th century: this passed through a period of great splendour in the early 19th century, shortly after the partitions of Poland, and it has been revived now; Leopol (which the Germans call Lemberg, and the Poles Lwow) celebrated its 250th anniversary as a Polish university in 1912.

Volume 5 of *Nauka Polska* being devoted especially to the movement called *regionalism*, prominence has been given in it (and accordingly, in the notice in NATURE) to local scientific societies in smaller provincial towns; but the fact must not pass unmentioned that learned societies for the promotion of research existed and flourished through all the vicissitudes of foreign rule in the 19th and early 20th century in such important centres of Polish life as Cracow, Warsaw, Poznan (Posen), Lwow (Lemberg), and Wilno.

Readers of NATURE before the War must have been familiar with the names of such Polish scientific workers as Smoluchowski in the field of physical science, Natanson in natural philosophy, Cybulski in physiology, Marchlewski in chemistry, Zaremba in mathematics, Nussbaum-Hilarowicz in biology—to mention only a few. Some of these men continue their work in the new Poland after the War. Others—like the lamented Smoluchowski—have since been taken from us, but new men are stepping into the breach, year in year out, from among the 40,000 university students of the new Poland. It is surely a proof of zeal for scientific research under the great difficulties which all countries experience after the War, and of which devastated Poland has more than her share, that of about 100 papers read at the International Geographical Congress in Cairo in 1925, no fewer than 22 were by Polish authors.

The writer of the notice in NATURE refers to the handicaps created by "restricted finance"; but it is a source of pride and gratification to every Polish scholar and scientist that restrictions in the Polish budget have been exercised mainly in departments other than that of education and the endowment of research: this section of Polish State expenditure, in fact, has never ceased to increase in proportion to the rest since Poland has come into renewed existence, and it represents upward of one-sixth of the total expenditure of the State in the current administrative year. With State assistance on a large scale supplementing the private efforts in the way of the organisation of research in Poland, many new institutions have arisen since the War, such as the Geological Institute in Warsaw, which has done very useful service to the nation and to science in mapping out the mineral resources of Poland.

May I mention, finally, that Polish research bodies, like the Academy of Sciences at Cracow, regularly publish abstracts of the research work of their members in the shape of French, English, and German bulletins, and that English, in particular, has always figured rather prominently in the publications of the natural science section of the Academy.

R. DYBOSKI.

Royat, Puy-de-Dôme, France,
August 23.

Electric Discharge in Gases at Low Pressure.

A PAPER by Mr. McCurdy in the *Phil. Mag.* for November 1924 has recently come to my notice, and I shall be glad if space can be afforded me to correct certain statements made in it regarding the results of my work. I have also read with great interest the joint paper by Messrs. Compton, Turner and McCurdy in the *Phys. Rev.* for December 1924, and wish to make a few comments on the subject now, leaving a further discussion of the result of my work on the nature of electric discharge through gases at low pressure for the Indian Science Congress to be held in January next.

Mr. McCurdy's information that my experiments under Sir J. J. Thomson pointed to the conclusion that striations cannot be obtained in pure nitrogen is, I regret to say, not correct. Not only did I get striations in pure nitrogen, but even in carefully purified helium—the purity of the helium being unquestionable—striations could be obtained. In argon, the absolute purity of which was not very carefully tested, remarkable striations could be obtained. The accompanying diagram (Fig. 1) illustrates three argon striations, each consisting of two entirely detached parts, one the pink spherical glow showing the red spectrum of argon, and the other the bluish-green convexo-concave glow showing the blue argon spectrum. These two glows, however, appear connected to each other at higher pressures by a faint glow.

FIG. 1.

In fact, after having worked with pure hydrogen, helium, neon, argon, nitrogen, oxygen, chlorine, iodine, I came to the conclusion that striation can be produced in all pure gases, though the ranges of pressure and current density in the discharge tube suitable for the production of striation vary widely for different gases. I must confess that I did not try the effect of discharge in pure mercury vapour, but indirectly, by introducing traces of mercury vapour in pure unstriated helium discharge, I did get beautiful and well-defined mercury striations which began to appear one after the other from the cathode end of the positive column with increasing amounts of mercury vapour.

A careful study of the discharge in pure helium under different conditions and with the help of the rotating mirror points to the conclusion that the phenomenon of discharge is essentially intermittent, and that the conditions at the cathode and anode are of the same kind but of different intensity: it means that the positive ions and electrons or negative ions are ejected from the electrodes in regular pulses and move in opposite directions with different velocities. On this view the space charge or concentration gradient, as stated by Prof. Compton and others in their paper, can be easily understood.

The experiments cited to confirm the theory that a reduction in the concentration of the excited atoms helps the formation of striations do not appear to be conclusive. For example, the selective reduction of W_2O_3 can also be easily explained by the fact that the concentration of ions and electrons in the luminous region is greater than in the darker regions, and that, due to the consequent effect of more frequent elastic collisions and to the existence of potential gradient between the axis of the discharge tube and the glass walls, more dissociated hydrogen ions reach the glass wall in the region of the striæ than of the dark spaces. Then again, even granting that the suggestion of striations noticed with increasing quantities of helium contamination in mercury was due to impurities and not a real effect, the conclusion drawn from the effect produced by helium, which is an inert monatomic gas of high ionisation potential, is inconclusive unless a comparative study of the effects of the addition of an electronegative gas and of pure nitrogen in similar circumstances is made.

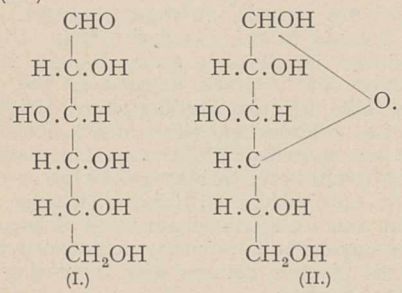
I believe, however, that a decrease in the concentration of the excited atoms and in the mobility of the negative carriers—both effects very likely produced by the presence of negative ions—help to bring out well-defined striations, especially when the electronegative and the electropositive ions have strong chemical affinity for each other.

I shall now endeavour to publish the account of my work, as I have finally given up all hopes of getting suitable opportunity to perform further experiments on the subject done in the Cavendish laboratory between 1920 and 1922. B. N. BANERJI.

Meteorological Office, Simla,
India,
August 5.

A Revision of the Structural Formula of Glucose.

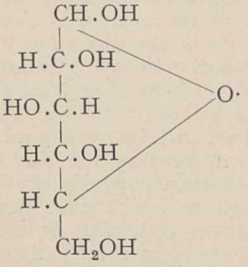
HITHERTO the balance of evidence as to the glucose structure has favoured the adoption of a γ-oxide ring formula (II.) which it is now customary to describe as a butylene- or 1 : 4-oxide structure. The property of mutarotation of sugars and the analogy which has been drawn between reducing sugars and their α- and β-methyl glucosides led to the abandonment of the older aldehyde formula (I.) for glucose in favour of (II.) :



Whilst chemists have accepted the second of these formulæ as consistent with the experimental facts, yet it must be acknowledged that no direct proof of this structure has ever been advanced, and thus the allocation of a constitution to the commonest hexose rests mainly on the supposed analogy of the sugar with its related lactone, namely, gluconolactone.

In the aliphatic section of the Annual Reports of the Progress of Chemistry for 1924, published by the Chemical Society, the present writer expressed the opinion that current views regarding the formula of glucose would probably require revision. Meanwhile new evidence has been contributed by investigations conducted in these laboratories, and will shortly be published in detail, showing that normal tetramethyl glucose gives a δ-lactone on oxidation, whilst the corresponding γ-lactone is derived from the γ-sugar.

These results necessitate the adoption of the following constitutional formula for ordinary glucose :



In this formula the oxide ring shown in (II.) is displaced from the butylene-oxidic or 1 : 4 position, and the attachment is that of a six-membered ring—that is, a 1 : 5 or amylene oxide ; and as this has been shown also to apply to galactose, mannose, xylose, and arabinose, the generalisation is reached that all aldoses exist normally as amylene oxide forms. The γ-sugars of the aldose type must be regarded as butylene oxides.

Since glucose is an essential unit in most of the natural carbohydrates such as cane-sugar, maltose, lactose, starch, cellulose, it follows that the constitutional formulæ of these substances must undergo revision in the same sense. W. N. HAWORTH.

Armstrong College
(University of Durham),
Newcastle-upon-Tyne, August 22.

Compton's Theory of X-ray Scattering.

READERS of NATURE may be interested in a short account of two experimental tests of Compton's theory of scattering which at present are being carried out here. Both of these tests deal with the total energy of the recoil electrons produced by hard X-rays.

One method is to compare the ionisation produced by the rays in very small (0·5 c.c.) air-ionisation chambers of different light substances (pure metals and salts). The ionisation in such small chambers is due solely to the secondary electrons from the walls. If these secondary electrons all had been of the photoelectric type, their number and therefore the ionisation would have been proportional to the third power of the effective atomic number of the wall substance. Thus, for example, the ionisation in a magnesium chamber should have been $8\left[=\left(\frac{12}{6}\right)^3\right]$ times larger than the ionisation in a graphite chamber. Experiments show that for hard X-rays the ratio is considerably smaller, decreasing rapidly for decreasing wave-lengths. For the hardest X-rays which we have produced, the difference between the two chambers is only about 15 per cent. For the γ-rays there is no measurable difference. This decrease is due to the production of the recoil electrons, the energy of which is independent of the atomic number, and, as I have shown (Proc. Nat. Acad. Sci., 10, p. 441, 1924 ; *Zeit. für Phys.*, 29, p. 374, 1924), this energy can readily be determined by such measurements. For very hard X-rays ($\lambda < 0{\cdot}15$ Å.U.) our experiments verify Compton's theory to within experimental errors, which may amount to about 10 per cent.

In the second method, we measure the true absorption of hard X-rays in light substances like water. Under our experimental conditions, this true absorption is practically due solely to the production of the recoil electrons. The method consists in measuring the reflection of a very wide bundle of approximately parallel (and homogeneous) rays from the surface of a large mass of the substance, and measuring also the intensity of the rays at different depths under the surface. The difference between the incoming and the reflected energy must equal the energy absorbed in the substance, this amount being obtained by multiplying the average value of the intensity in the substance by the coefficient of true absorption. By introducing a correction for the photoelectric absorption, the absorption corresponding to the production of the recoil electrons is thus derived.

For water and very hard X-rays ($\lambda < 0{\cdot}15$) we here also verify Compton's theory to within the experimental errors (about ± 10 per cent.). (Compare *Phys. Rev.*, 25, p. 581, 1925.)

It is a pleasure to acknowledge the assistance of Drs. O. Glasser and K. Rothstein in the experimental part of the investigation here described.

HUGO FRICKE.

Department of Biophysics,
Cleveland Clinic Foundation,
August 14.

The Motion of Whales during Swimming.

REFERRING to Dr. Petersen's article on this subject in NATURE of August 29, p. 327, I may perhaps be allowed to say that during the course of a voyage in one of the Castle line of steamers to the Cape of Good Hope some years ago, I had the opportunity of closely observing the motions of a small group of dolphins, each perhaps about six feet long, which continued to swim near the surface of the water, at the same speed as, and at a distance of between five and ten feet from the side of the ship, for possibly ten minutes. I was standing directly above them; the water was perfectly clear; they kept practically the same relative positions with regard to each other and to the ship, the ordinary speed of which was about 16 miles an hour; and they appeared to glide through the water without any effort or any other motion of their bodies except a continuous movement of the head from side to side to a distance of perhaps two inches or less on each side of their line of projection, involving, I assume, a corresponding movement of their centres of gravity in the opposite direction. The duration of this movement of the head for a complete cycle did not exceed, and may have been less than one second.

The movement of the rudder in a little boat, which according to Dr. Petersen may produce "a slight speed, if the motions towards the central position are the strongest," lacks the one thing needful to make it a rational means of propulsion, namely, a to-and-fro movement of its axis of suspension slightly in advance of the movement of its hinder end, in the same direction at one point of its course, and in the opposite direction at another. This double movement is, I suggest, the means of propulsion employed by the dolphin; effected simply by the snake-like bending of the flexible part of its body.

I formed the opinion that the whole of the flexible part of the dolphin's body took an active and strenuous part in the act of propulsion; that, owing to the great resistance offered by the water when being passed through at the rate of more than 20 feet per second, only slight movements were required to give the necessary impetus; and that, in these circumstances, the function of the tail-fin was to provide a thin terminal edge to the body, in the wake of which the water through which it had passed could again coalesce with the least possible degree of turbulence and loss of energy.

W. GALLOWAY.

17 Park Place,
Cardiff, September 1.

The Scale of C Subminor.

AN attempt to reconstruct the Soft Diatonic mode leads to the following nine-note scale, which combines perfectly with the diatonic scale with the exception of F (3 : 4),—the key-note, dominant, leading-note and octave being identical in the two scales. The intervals are given in logarithmic cents. The fifth column gives Tartini's *terzo suono* and Thomas Young's fourth sound where the intervals from the tonic are consonant. The fourth note of the scale forms a dissonance with the tonic, but is consonant with the subminor second, sixth, and seventh, and with the major seventh.

C (*c'*).			Steps.		Resultant Tones.
$^7D\flat$	20 : 21	85	85		
$^7E\flat$	6 : 7	267	182	(9 : 10)	F_1, a.
^7F	16 : 21	471	204	(8 : 9)	(E and 8 : 11.)
$^7G\flat$	5 : 7	583	112	(15 : 16)	A♭, e♭.
G	2 : 3	702	119	(14 : 15)	c.
$^7A\flat$	40 : 63	787	85	(20 : 21)	
$^7B\flat$	4 : 7	969	182	(9 : 10)	g, C.
B	15 : 28	1081			
	8 : 15	1088	119	(14 : 15)	
C (*c''*)	1 : 2	1200	112	(15 : 16)	

Only one note, B, is tempered, being raised 7 cents to make it a major third (4 : 5) above G, and 7 : 10, the inversion of 5 : 7, above ^7F. The insertion of diatonic D and E allows septimal tetrads, as 4, 5, 6, 7; 5, 6, 7, 8; 5, 6, 7, 9; 5, 7, 10, 12, to be sounded.

It is scarcely of use to try this scale on the pianoforte, but those who have the feeling for and a knowledge of septimal harmony will be able to appreciate its entrancing beauty.

The further addition of diatonic A (3 : 5) completes a new, septimal, chromatic scale of twelve notes to the octave, with five grades of semitone, at intervals of 85, 119, 63, 119, 85, 112, 119, 85, 97, 85, 119 and 112 cents.

I owe the appoggiatura of 85 cents to the interpretation of the enharmonic tetrachord of the Greeks offered by J. A. Serre, of Geneva, in 1752, and the step of 119 cents to B to William Chappell's "History of Music," 1874, p. 220.

W. PERRETT.

University of London, University College,
Gower Street, London, W.C.1,
August 5.

Crop-Production in India.

IN the excellent review of Mr. Howard's "Crop-Production in India" (NATURE, July 4, p. 4) a rather important mis-statement occurs in respect to legislation, for the introduction of which my Committee was largely responsible. May I explain at once that there is no law in British India prohibiting the sowing of any variety of cotton. The reference is obviously to the Indian Cotton Transport Act of 1923, which enables a provincial Government, with the consent of the local legislature, to notify for protection any specified cotton-growing zone. A notification under the Act forbids the importation of cotton, cotton-seed, or seed-cotton into a protected area except under licence. The object of such prohibition is to prevent:

(*a*) The importation of inferior cotton for purposes of adulteration—an abuse which in the past, by spoiling the reputation of superior cottons, had robbed the cotton-grower of the fruits of his enterprise; and

(*b*) To prevent the importation of inferior seed either as such or in unginned cotton.

The Indian cultivator is not asked to submit to "drastic legislation of a type to which the free-born Western would probably never submit." For the introduction of new varieties the Agricultural Departments depend on the merits of the new variety, on the organisation of the seed supply, and, most important of all, on thorough local demonstrations.

B. C. BURT,
Secretary.

Indian Central Cotton Committee,
Bombay,
July 31.

[The legislation referred to justifies, I think, the use of the term "drastic" and I must adhere to the word; but, in view of possible misconception, I gladly withdraw the reference to the Occident in the phrase to which exception is taken.—A. B. B.]

Cultural Aspects in Geology.[1]

By Prof. W. A. PARKS, University of Toronto.

THE science of geology is wide in scope and general in application; it deals with matter and with life, with time and with space; it touches the philosophical and borders on the romantic; majesty and beauty are its essentials, and imagination is necessary for its pursuit. The cultural value of such a science is not to be despised. It is my purpose to direct attention to well-known features of our science. I shall attempt to introduce no new facts, and I beg that you will consider my remarks merely as an attempt to lay emphasis on a selected few of the many great lessons of geology.

THE LAW OF TENDENCY TO THE COMPLEX.

To account for the existence of the human race and to determine the purpose, if there be a purpose, for its existence is probably the greatest and most fundamental problem with which humanity is confronted. An answer is not yet forthcoming, but it is interesting (and cultural) to inquire if the science of geology can throw any light on a problem so stupendous.

In the first place, it is to be noted that the earth is very old; its age is to be reckoned, not in millions, but in hundreds of millions of years. In the second place, living creatures have inhabited the globe, not from the beginning, but from the earliest period of which we have a definite record. Does not the inconceivably long duration of the earth itself and of life constitute a guarantee of a similar extension into the future? This assumption may not be in accord with rigid logic, but it falls within the scope of high probability. Further, geological history shows conclusively that some force or tendency has acted on the life principle to the production of higher and higher forms culminating in man. Is there any reason to assume that this long-enduring gradient should change its direction? I confidently believe that geological history teaches us that the earth, and life, and the upward tendency of life will all three reach out into the illimitable future.

The tendency towards the more complex (higher) seems to be a feature, not only of the organic, but also of the inorganic world. In the lower orders of life the tendency to the complex has acted throughout all the ages without the conscious volition of the individual. With the advent of the higher nervous complex that we call "reason" a new factor entered the field, a factor so important that many geologists now favour the establishment of a separate era, the "psychozoic," for the age of man. Undoubtedly the rise of mentality in the Pleistocene must be regarded as a geological event of profound importance. From the evolutionary point of view it may mark an event of comparable significance, in that it may be interpreted as a great saltation of the mental attributes without a corresponding physical development. The general tendency to the complex is not interrupted, but its manifestation is less material and more spiritual. It is a reasonable assumption that future evolution will be mental rather than physical, and that the long-continued upward gradient of complexity will not turn in its course.

I venture to state that the greatest lesson in geology is the tendency to the complex; if there be a purpose behind all things, the working-out of that purpose is herein revealed. It follows, therefore, that man can best fit into the scheme of things by facilitating the operation of a principle which has endured through all time and is to be regarded in the light of a revelation. The *duty* of man, if these premises be correct, is so to direct his efforts that his mental capacity may be strengthened and that a slightly better equipment may be transmitted to his offspring.

I would emphasise, also, the fact that all races of creatures and all individuals of a race do not evolve to higher forms. Similarly, it is not to be expected that all men are destined to give rise to higher types under the action of a beneficent, all-pervading principle.

The development of mentality in the human race has introduced new factors; perhaps it would be better to say it has strongly accentuated certain old factors. By reason of his superior mental equipment, man has acquired a degree of dominance never attained by any earlier race. Surely, his reason should temper his power, and he should realise the enormous responsibility that has fallen into his hands.

EVOLUTION.

Geological investigation has established, beyond all doubt, the basic facts that life has changed during the course of the ages, that this change has been uniform in direction over the whole globe, and that the general tendency has been towards greater complexity both in physical structure and in mental equipment. It has been established, further, that in certain instances, sequences are found indicating the gradual passage of one species into another. This observation is not necessarily a proof of descent, but it is a strong argument in its favour.

Life appeared on the globe in pre-Cambrian time; of its inception we shall probably never be able to obtain direct evidence. In course of time, however, recognisable protoplasmic units appeared—unicellular creatures neither plant nor animal. The second great event of life history occurred somewhat later in the pre-Cambrian—the separation of the parent stem into ancestral plants and ancestral animals. Here I would like to emphasise the fact that the difference between plants and animals lies, not only in the different nature of the metabolism, but also in the possession by the latter of a sensibility or mental equipment so vastly superior, that we are accustomed to think of it as absent in the vegetable world. In order to simplify our inquiry, let us confine the question to the animal stem, and let us imagine the primitive creature to be a generalised protozoan, as sooner or later it was. Within the pre-Cambrian occurred a third great organic event of tremendous significance—the Protozoa gave rise to the Metazoa. Having accomplished this feat, the ancestral Protozoa continued to reproduce their own kind. Despite differentiation, the making of genera and species, of offshoots that lived and offshoots that failed, the Protozoa during more than 500,000,000 years have never given rise to anything but unicellular offspring. The conclusion is obvious, that in the pre-Cambrian occurred

[1] From the presidential address delivered at Southampton on August 27 before Section C (Geology) of the British Association.

a marvellous event due to certain conditions which have never since been duplicated.

Similarly the primitive cœlenterate, presumably a sponge, gave rise to ancestral Cnidaria still within the pre-Cambrian. Never since has the sponge given rise to anything but the sponge, but the phylum has continued to exist and to differentiate within seemingly fixed bounds. Before the close of the pre-Cambrian all the phyla of Invertebrata arose successively in this manner. Possibly we may include the vertebrates, although they have not yet been found so far back in time. These are well-known principles, but reiterated here because I think that they are not always given their true value.

I would emphasise—the origin of phyla as great events in geological history, the crowding of these events into the pre-Cambrian, the continuation of ancestral stocks, and their failure ever again to give rise to new phyla. It would appear, further, that higher phyla have not developed through highly specialised genera of lower phyla. For the invertebrates this is evident in the appearances of all the phyla in the pre-Cambrian; for the vertebrates, in the first place nothing is known with certainty, and in the second place the various phyla appeared long before high specialisation was attained by the ancestral stock. Amphibia arose from primitive Devonian ganoids, not from highly specialised teleosts; reptiles were derived from early Permian stegocephalians, not from highly specialised Anura or Urodela. The eutherian mammals appeared with startling suddenness in the basal Eocene, and before the close of the period had developed into all the great classes.

Evolution in the phyletic sense is not a gradual process, not uniformitarian, but marked by great events in time. Specialisation and consequent fixation of characters are adverse to phyletic differentiation.

It is apparent that phyla can arise only through genera and species. How far the phyletic principles may apply in the lower taxonomic ranks is an interesting question, the consideration of which would unduly extend this address. I would venture to state, however, that close adaptation (high specialisation) is likewise inimical to the production of new genera and species. Further, I believe that close adaptation is the main cause of extinction.

Let us assume the existence of an organism *perfectly* adapted to its environment. Is it not a safe conclusion that *any* change in environment must result in the death of such organism? That there is now or that there ever has been a perfectly adapted animal is extremely doubtful, but all animals must be more or less adapted or they could not exist. It may be stated that *the margin between perfect and necessary adaptation* is the zone in which organic evolution is possible; further, that the nearer an animal approaches perfect adaptation, the more liable it is to extinction on the advent of changed conditions. This conclusion is in accord with the generally recognised fact that in many instances highly specialised animals have suffered sudden extinction; it is also in accord with the general observation that the geological record is one of extinction and replacement in so far as species and even higher taxonomic divisions are concerned.

The great weight of geological evidence points to the supplanting of one species by another, not to the transformation of species into their successors. A single transformation sequence may be regarded as sufficient to establish the principle, but an adequate explanation must be given of the failure of vertical seriations in the great majority of cases. This explanation is not yet forthcoming, and its lack stands as the chief item in the *contra* account of the balance sheet of evolution.

It is to the unfavourable changes that we must look for an explanation of the more deeply seated organic evolution, and by unfavourable I mean adverse to the present condition of the animal in that it is forced to further adaptation. A change of this kind is not of necessity *adverse to life*; it may even be stimulating. The animals towards the margins of a colony, by reason of their less perfect adaptation, may in a few instances survive an unfavourable change. The first impulse of these survivors will be to escape by flight, and thereby diminish the fatal suddenness of the change and thus achieve adaptation.

The new species would arise rather suddenly with but few individuals of the transition stages. Arrived at a favourable habitat, migration would cease, multiplication would ensue, and closer and closer adaptation would be achieved. Eventually an approximation to perfect adaptation would render the new species liable to extinction on the recurrence of unfavourable conditions.

This explanation of the common failure of vertical seriations emphasises migration as a factor in evolution and leads to the conclusion that transitional stages are few in number, scattered over wide geographical extents, and disposed in stratigraphically oblique lines. Barrell's "diastems," to be referred to later, support this explanation of abrupt changes in the faunas.

The Age of the Earth.

The mysteries of time and of space have long been subjects of profound contemplation and scientific inquiry; they are intimately connected with the destiny of man and bring him into touch with the infinite. High is the cultural value of the mere contemplation of infinity, and of supreme importance is any light that may be thrown on a problem long regarded as beyond human comprehension. In recent years the theory of relativity has opened to the mathematically trained mind a possible avenue to a solution, but to most geologists this avenue is a closed road.

The determination of the actual age of the earth has long engaged the attention of philosophers and scientists, and various widely divergent estimates have been made by approaching the subject from different points of view.

Kelvin, Tait, King, and other great physicists but a few years ago allowed the geologist a maximum of 40,000,000 years for the age of the earth. Recent studies on radioactive minerals have induced the same school to raise the figure to 1,710,000,000 years, a *volte face* that emphasises the danger incurred by "the dictatorial hierarchy of exact scientists" in raising a mathematical structure on an insecure foundation.

The chief methods of determining the age of the earth other than those based on radioactivity, are: the rate of decline of solar energy, the gradient of earth temperature, the quantity of salt in the seas, the rate of organic

differentiation, and the rate of denudation of lands and of accumulation in the seas in relation to the known thickness of strata made throughout the geological ages.

The determination of age by means of radioactivity depends on the fact that uranium and thorium break down into lead and helium, and that the rate of this disintegration is known. The time required for half a given amount of these elements to break down is known as the half-value period. This period, according to Gleditsch, can be calculated to within 2 per cent.; for radium it is 1660 years and for uranium 6×10^9 years. An atom of uranium breaks down into one atom of lead and eight atoms of helium; if the content in these elements can be measured and compared with the quantity of unaltered uranium in an equal volume of the mineral, it is evident that the age of the mineral can be deduced.

Lyell long ago demanded 240,000,000 years for organic differentiation, and Darwin thought 200,000,000 too short for the purpose. On stratigraphic evidence, Barrell considered 250,000,000 a reasonable estimate for the duration of geological time since the pre-Cambrian.

The history of the subject shows that high figures were originally proposed by geologists and that, later, they tried to lower their estimates under the influence of the shorter time allowed by the physicists. More recently, the greater figures endorsed by the physicists permit the geologist ample time for his processes; both lines of inquiry are now pointing to the same result—higher and higher estimates of the immense antiquity of the globe.

Intimately connected with the estimation of time are the rates of erosion of old rocks and of deposition of new. Herein lies the most dependable geological means of determining the duration of the periods; nevertheless, there are serious difficulties to overcome, among which may be mentioned: variations in the rate of decay under different conditions, variation in the rate of deposition, and the occurrence of unrecorded intervals either evident or obscure.

The rate of erosion has received much attention, but as this factor is obviously dependent on the shape and condition of the land surface, its average for all time is difficult to estimate. Barrell considers that denudation by solution lowers the land surface one foot in 30,000 years, and that mechanical degradation accomplishes this result in 13,800 years. The two forces acting together require 9000 years to effect one foot of erosion.

Barrell's estimate of 250,000,000 years since the beginning of the Palæozoic was arrived at by a study of details of deposition under the hypothesis of rhythms in geological time. According to this author, time is to be measured by rhythms or pulsations, the greater rhythms having shorter rhythms imposed upon them. The longer are to be measured in terms of the smaller, and the smaller in terms of years. A single rhythm is an erosion cycle and small partial rhythms are superimposed on it. Present erosion and sedimentation owing to the Pliocene-Pleistocene uplift is unduly high, with the result that estimates of time based on the present rate of erosion are much too short. Barrell would further increase the time by restricting the area of deposition to the zone immediately below the local base level, and making the accumulation dependent on upward oscillations of the base level or downward oscillations of the bottom.

In connexion with the rate of sedimentation and its bearing on the age of the earth, it is apparent that the intimate structure of the stratified rocks must be looked to for data bearing on the problem. To this end the character and mode of formation of these rocks are now receiving an increasing degree of attention. A better understanding of sedimentation is being obtained by direct observation on the formation of modern sediments, determination of the precipitating value of algæ and bacteria, studies on coral reefs, deep-sea investigations, studies on colloidal solutions, investigations of chemical deposits, and a better appreciation of the value of facies and vegetal terrestrial deposits. Direct investigation of the rocks themselves is leading to an increased use of the petrographic microscope and of analytical methods. Secondary features of stratified rocks are receiving greater attention, horizontal transitional stages are better understood, and the relationship of strata to sea invasions has led to a fuller appreciation of the value of palæogeography.

The Origin and Interior of the Earth.

The question of the earth's origin is evidently closely related to the problem of its age. Although geologists are inclined to disclaim this aspect of the subject, I feel that it cannot be disregarded under the title of this address. The interior of the earth is beyond direct observation; the deepest mines and bore-holes scarcely penetrate the outermost skin. Certain fundamental facts, however, may be taken as established. The interior is hot, rigid, and heavy (sp. gr. 5·6 as compared with 2·7 for the known exterior); the accessible exterior is composed of elements common to the universe. Beyond this all is vague and speculative.

It is worthy of particular emphasis, however, that while the earth as a whole acts as an almost perfectly rigid body, the external envelope with which we are familiar is by no means rigid. Adjustments have taken place throughout all geological time, and I need not quote evidence that they are still taking place. The acquisition of perfect rigidity by the globe is to be regarded as a tremendous calamity. This condition attained, the universal deluge is within sight geologically speaking, and the end of the present order of things must inevitably ensue. Earthquakes, therefore, are not to be regarded as unmixed calamities; they are evidence that the fatal total rigidity has not yet been attained.

It might be asked if there is any evidence in geological history of an approach to a condition of total rigidity or of a tendency in this direction. There can be little doubt that pre-Cambrian events were on a scale seldom, if ever, attained in later time. Cambrian and Ordovician transgressions of the sea were also on a grand scale, but later movements, on the whole, seem to have been smaller and more local in their expression, although there were notable exceptions as the Tethys sea in Europe, the great invasion of the Coloradoan geosyncline in Upper Cretaceous time in North America, the tremendous volcanic activity of the Miocene, and the grand epoch of mountain-building in the Pliocene and Pleistocene.

The general conclusions seem to be that the earth is not showing a trend towards rigidity, but that earth movements and vulcanism are becoming less profound in scope and less widespread geographically, the average of activity being maintained by more frequent recurrence.

EARTH MOVEMENTS AND ADJUSTMENT.

The causes of earth crumpling and the dynamic laws which govern the phenomena are subjects well within my theme, but their consideration would lead me to undue length. Earth movements, of necessity, are bound up with theoretical considerations of the earth's interior. Whether earth crumpling is due to loss of terrestrial heat and consequent contraction of the nucleus, or whether the modern concept of isostasy offers a better explanation, there must be a downward limit to terrestrial disturbances. This limit has been placed at 113·7 kilometres and termed the "depth of compensation."

It is obvious that a consideration of this subject would lead to a discussion of land forms and their influence on human activities—definition of nationality, physiographic control, distribution of faunas, and countless other effects, all of which extend beyond the realm of technical geology and form part of a general education if they are not "cultural" in the narrower sense. There is, however, one great lesson to be derived from the study of earth movements that bears on the general scheme of things and is worthy of especial mention—the marvellous continuity of conditions.

The diameter of the earth is about 8000 miles and the maximum of relief of the lithosphere about eleven miles, approximately 0·14 per cent. Oceanic waters have filled the depressions and continental masses have risen above the water-level—a condition that has maintained throughout all time in the opinion of most geologists. The present area of the land is 27·7 per cent. of the whole terrestrial surface, and the average height above sea-level of the continental masses is only 2120 feet according to de Lapparent. It is apparent that the actual volume of that part of the lithosphere which projects above sea-level is extremely small when compared with the volume of the whole globe.

It is well known that the power of erosion is sufficiently great to have reduced this relatively small mass to sea-level time and time again throughout the long course of the geological ages. Nevertheless, it is confidently believed that this result has never been entirely achieved. Rejuvenation has kept pace with erosion throughout the hundreds of millions of years that the earth has endured. In my opinion this marvellous nicety of adjustment between two great sets of opposing forces is one of the major lessons of geology. Is it a mere coincidence or is it evidence of design?

CLIMATE.

Climatic change must be regarded as an ever-present factor. It is highly probable that variation in climate will greatly affect the activities of the human race within a measurable number of years, and it is not impossible that the sites of our present centres of civilisation will be buried under glaciers and that a new civilisation will occupy, under a genial climate, the present inhospitable regions around the poles.

Despite the changes in any given locality, the continued existence of life is sufficient evidence that the whole globe has not experienced, from the earliest geological time, any very great universal change in climate. Grüner has proved to the satisfaction of most geologists the existence of algæ in the Keewatin of Minnesota. The great masses of limestone with disseminated graphite of the Grenville are at least suggestive of life, and Moore has brought forward convincing evidence of algæ in the Animikie of Belcher Islands in Hudson Bay. Both the Archæozoic and the Proterozoic, therefore, were warm enough to permit organisms to exist despite the intervening event of an ice age in the Huronian.

Wonderful have been the changes in climate and far-reaching their effects, but truly marvellous has been the continuity of a range of temperature permitting the existence of life from the very dawn of earth history to the present moment. Nothing short of a cosmical catastrophe can alter a condition that has maintained for nearly two thousand millions of years. Surely if culture is the cultivation of the spirit, the contemplation of geological climate should lift the mind above the mere material into the realm of the philosophical and the spiritual. If the continuity of the observed range of temperature is due to a single factor—solar energy—the endurance of that energy is a marvellous thing. If the observed climatic continuity is a composite result due to various sources of energy, it is still more marvellous.

THE STUDY OF GEOLOGY.

Whatever satisfaction is to be derived from the acquisition of knowledge, there is always a discouraging factor in the realisation of our limitations. Owing to the complex nature of the subject and the vast number of facts involved, the study of geology is peculiarly effective in this respect, and cannot but tend to a humble attitude of mind. Another potent influence to this end is the realisation of the mistakes that have been made, even in the basic principles of the science. From the fantastic theories of the cosmogonists arose eventually the doctrine of catastrophism; this conception yielded to uniformitarianism, and to uniformitarianism was added the doctrine of evolution. Le Conte described Darwin as a uniformitarian evolutionist. To-day uniformitarianism is being questioned seriously from both the inorganic and the organic points of view. We are swinging back to a conception of a milder catastrophism variously expressed as rhythm, diastrophism, and so on. The necessity of drawing conclusions from doubtful or insufficient evidence is an ever-present antidote for dogmatism. Many of our conclusions are merely inferences subject to revision in the light of further evidence.

To humbleness and caution I would add a conviction of theism as a result of the study of geology. I fear to venture on dangerous ground, but I must be allowed the opinion that materialism offers no adequate explanation of the wonders of geology. With revealed religion I am not here concerned, but I believe that the inconceivably long gradient that has led ever upward to the mentality of man has not been traced without design, and I see no reason why that gradient should terminate. I look, rather, to its upward continuation to even greater heights beyond.

Some Issues in the Theory of "g" (including the Law of Diminishing Returns).[1]

By Prof. C. SPEARMAN, F.R.S.

THEORY OF "G."

THE following communication treats of certain points in a theory which has become known as that of Two Factors or of *g*. At the present time this theory has undergone very elaborate development. The mental testing from which it originated lay at first as a foreign intruder in the midst of general psychology. Its opponents—and these were not few—regarded it as an excrescence that should be forthwith cast out; and even its best friends wondered how the general psychology was ever going to assimilate it. But, seemingly, neither of these solutions is happening to any great extent. The mental testing has waxed larger and established itself more firmly than ever *without* much assimilation with the current general doctrines; indeed, it seems more likely, cuckoo-wise, to eject *them* from the psychological nest. In particular, the theory of *g*, which arose from the mental tests, has now managed to spread itself over the whole of the cognitive side of psychology, and not impossibly it will soon extend its scope over into the supplementary or conative side.

For the present I do not propose to depict the whole elaborate theory of *g* even in outline. Such an attempt is reserved for a work that will appear shortly. But a very few words may be allowed here to indicate its essential foundation as unwaveringly preserved from the very beginning. This consists in the theorem, that the measure of *every different ability of any person can be resolved into two factors, of which the one is always the same, but the other always independent.* Suppose, for example, that any person undergoes a mental test and obtains seventeen marks for it. The theory asserts that this can actually be divided into two parts, say eleven and six, such that (on reduction to comparable units) the eleven re-occurs for this person in every other test however widely different, whereas the six is each time replaced by some other number independently.

The establishment of this doctrine falls into three distinct phases. The first is to ascertain what are the conditions under which the measures of any ability admit of such division into two factors. We may note that this phase has often been erroneously called an assumption or hypothesis. It is really nothing of the kind, but simply a mathematical demonstration. Given the said conditions, then the divisibility into such two factors must necessarily occur, just as, given that a triangle has all its angles equal, then it must needs also have all its sides equal. The second phase is to find out where, if at all, the conditions are actually fulfilled. Again, no assumption or hypothesis of any kind is involved; the matter is nothing more than observation of fact.

Then comes the third and last phase, that of supplying the factors with some plausible interpretation. Here the most cautious procedure, and one that goes not an inch beyond what has really been proven, is simply to denote these factors by the non-committal letters *g* and *s* respectively. Any interpretation going beyond this can only, in our present state of knowledge, have a provisional value; it can serve to inspire further investigation, by which it will assuredly suffer much modification itself. With this reservation, then, the hypothesis at present seeming most helpful and suggestive is that the *g* measures something of the nature of an "energy" derived from the whole cortex or wider area of the brain. Correspondingly, the *s*'s measure the respective efficiencies of the different parts of the brain in which this energy can be concentrated; they are, so to speak, its "engines." Whenever the mind turns from one operation to another, the energy is switched off from one engine to another, much as the power supply of a factory can be directed, at one moment to turning a wheel, at the next to heating a furnace, and then to blowing a whistle.

[1] Presidential address delivered at Southampton on August 27 before Section J (Psychology) of the British Association.

RECENT CONFIRMATION.

So much to serve as a general description of the doctrine. I will now bring to your notice some recent work whereby its foundations have received additional strengthening, both on the side of mathematics and on that of actual observation.

To take the former first, the earlier researches had only shown what conditions are *necessary* for the divisibility into the two factors. Later investigation has proved that these conditions are also *sufficient*. In other words, we now know, not only that under the said conditions the divisibility into two factors may possibly occur, but also that it inevitably must do so. I stress this point because some of the recent writing on the subject appears to make the contrary and mistaken statement that, even when the conditions are satisfied, still the divisibility either may or may not ensue.

As to the precise nature of these conditions, they are based upon the coefficients of correlation. Such coefficients, as is now generally understood, consist in numbers that indicate just how closely any two abilities or other characters tend to vary in proportion to one another. They are usually symbolised by the letter *r*. Thus, r_{12} would denote the degree that any ability 1 tended to vary from individual to individual proportionately to some other ability 2. Now, the conditions for the divisibility into the two factors reduce themselves to the simple equation:

$$r_{12} \cdot r_{34} - r_{13} \cdot r_{24} = 0.$$

Here the value on the left is called the tetrad-difference. When such tetrad-differences remain equal to zero throughout any set of abilities, whichever of them may be taken as 1, 2, 3, and 4 respectively, then, and then only, each of these abilities can be divided up into two factors such as we have described. Should any one ask *why* this particular equation should have the virtue of necessitating such a divisibility, I can only answer that it is but one out of all the miracles of mathematics. I never cease to be astonished at it myself. For further elucidation, reference must be made to the mathematical proof (Proc. Roy. Soc., 1923).

So far we remain in comparatively smooth waters. The chief difficulty arises when we turn to what are known as the errors of sampling. Suppose you wanted to know whether a field of potatoes was bearing a good crop. You walk about, pulling up a plant here and

there. This gives you some approximate knowledge, but not an exact one. For all you can tell, you may have been exceptionally lucky or unlucky in your selection. The degree of discrepancy between the average size of the potatoes actually pulled and that of the whole field is your error of sampling. Now, just the same befalls any coefficient of correlation between two abilities. You want to know how closely these two go together with people of some general class. You pick out, say, 100 of these people; but just in this 100 the correspondence between the two abilities may happen to be rather higher or lower than on an average throughout the entire class. Your coefficient of correlation will have an error of sampling; and our preceding tetrad-difference, being made up of correlational coefficients, will have one also.

Now, the latest advance in the theory of *g* consists in showing the general magnitude of the tetrad-differences that will arise from the sampling errors alone, even when the true magnitude is always zero. This value of the tetrad-differences to be expected merely from sampling was published last year (*Brit. J. Psychol.*).

Having got this theoretical value, there remains the momentous step of comparing it with the median value which is actually observed. The theory of *g* stands or falls according as these two values are or are not found to agree.

This step so fraught with fate has now been taken. To avoid all danger of personal bias, no work of my own was chosen for this crucial decision, but that of an investigator who, more than all others, had shown himself unsympathetic with the doctrine of *g*. Here is his table of correlations as published by himself:

Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Completion .		98	94	79	62	91	71	54	78	88	55	42	33	25
2. Hard Opposites	98		84	80	64	81	79	70	73	74	52	43	26	25
3. Memory words	94	84		62	55	82	49	56	73	71	53	40	28	21
4. Easy Opposites	79	80	62		57	52	68	53	42	56	45	29	38	48
5. A Test . .	62	64	55	57		55	54	73	39	51	39	59	25	22
6. Memory pass. .	91	81	82	52	55		53	57	59	66	54	31	28	19
7. Adding . .	71	79	49	68	54	53		45	39	47	51	57	17	25
8. Geomet. forms	54	70	56	53	73	57	45		35	49	34	56	25	25
9. Learn. pairs .	78	73	73	42	39	59	39	35		69	36	29	26	09
10. Recog. forms .	88	74	71	56	51	66	47	49	69		44	37	34	28
11. Scroll . .	55	52	53	45	39	54	51	34	36	44		31	19	27
12. Compl. words .	42	43	40	29	59	31	57	56	29	37	31		21	07
13. Estimat. length	33	26	28	38	25	28	17	25	26	34	19	21		24
14. Drawing length	25	25	21	48	22	19	25	25	09	28	27	07	24	

To work out all the tetrad-differences was no light undertaking, since they run to the number of 3003. The calculation of these was entrusted to the competent hands of Mr. Raper. When all was reported ready we met, I carrying the "probable error" of the tetrad-differences—that is, the median value that should by theory be expected to arise from sampling alone, he bringing the average value of the 3003 tetrad-differences actually derived from the above table. My number was 0·061. His was 0·074; this, in order to get from the average to the median, had to be multiplied by the well-known constant 0·845, whereby it came finally to 0·062.

It may be of interest to survey the entire frequency distribution of the values concerned. The dotted curve (Fig. 1) shows the relative frequencies that should be expected from the sampling errors alone. About half should lie between *a* and *b*; extremely few beyond *c* or *d*. The continuous rectangles show the relative frequencies that actually occurred. A better agreement of a theoretical frequency curve with one of actual observations does not, I venture to say, exist throughout psychology, or perhaps even throughout statistics.

The preceding result may be instructively compared with another one. The doctrine of Two Factors, as is only proper, has had to make its way in the face of strong resistance. But the latter has curiously adopted two contrary lines of defence. One is to question whether the mathematical criterion would really be satisfied by actual observation; and this doubt, I hope, has been met by the facts just cited. But the other opposition has instead asserted that *any* ordinary table of positive correlations would naturally satisfy it, so that such satisfaction must be devoid of peculiar significance. Recently this second line of opposition

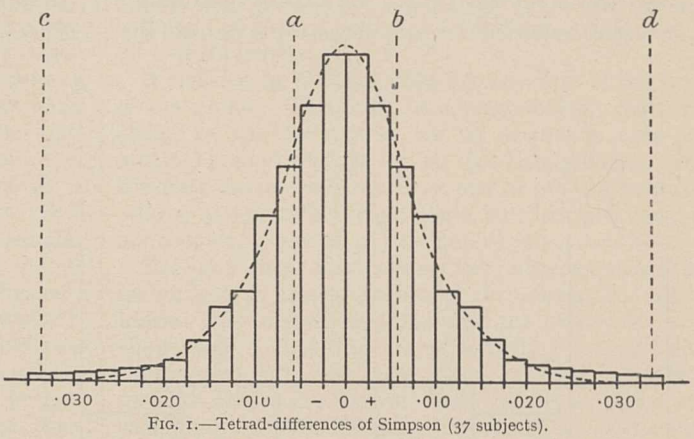


FIG. 1.—Tetrad-differences of Simpson (37 subjects).

has acquired much greater vitality, in that a table of correlations has now been brought forward as an actual example; it is not derived from mental but from physical traits, and yet, it is said, exhibits a quite similar character. Here is the table:

	1	2	3	4	5	6	7	8
1. Area of ossification ·		88	60	62	43	31	25	26
2. Ratio of ossification	88		52	58	41	21	24	29
3. Height . . .	60	52		69	44	51	45	11
4. Weight . . .	62	58	69		65	39	40	83
5. Chest girth . .	43	41	44	65		59	36	69
6. Lung capacity . .	31	21	51	39	59		46	26
7. Strength of grip .	25	24	45	40	36	46		14
8. Nutrition . . .	26	29	11	83	69	26	14	

Let us, then, look at the median tetrad-difference derived from this table and compare it with the probable error to be expected from sampling alone; the respective values are 0·089 and 0·011; that is to say, the actually observed value is no less than eight times greater than what theory demands. Here again we can examine the whole frequency distribution.

The explanation of the figure (Fig. 2) is the same as in the preceding case of Simpson (Fig. 1). Between the curve showing the values to be expected from the errors of sampling and the rectangles showing those actually observed there is this time no agreement whatever.

LAW OF DIMINISHING RETURNS.

So much for the strengthening of the doctrine. I will now proceed to describe a rather curious matter that has arisen in the course of its elaboration.

Since the very beginning it has been known that the two factors, *g* and *s*, the energy and the engines, may have widely different relative importance, according to the particular mental operation involved. With some operations the superiority of one person over another is preponderantly decided by their respective amounts of the energy. With other operations, on the contrary, the dominant factor is the engine.

Subsequent research, moreover, has been gradually outlining the cases which incline in one or the other direction. Thus the energy is in general more important for operations that are composite, the engines for those that are monotonous. This is natural enough. The composite operation really involves several different engines; the superiority that an individual may happen to have in any one of them will tend to be neutralised in the average of them all; but a superiority in the energy will make itself felt in each, and thus obtain cumulative influence. Again, the energy is less and the engine more influential whenever the operation depends much upon the efficiency of some sensory or motor apparatus. This, too, is natural enough; for such apparatus obviously constitutes a part and parcel of the engine. Yet again the energy has been found to lose in importance as compared with the engine in proportion as the operation tends less to create new mental content and more to reproduce old.

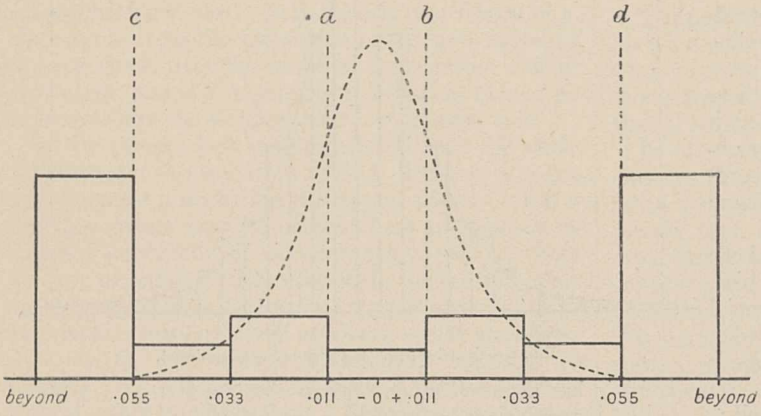


FIG. 2.—Tetrad-differences of A. Gates (115 subjects).

The point which I wish to bring forward in this place is that the relative influence of the energy and the engines changes largely with the class of person at issue. The most drastic example of this is supplied by a comparison between normal children and those who are mentally defective. The work of Abelson may be quoted, where the same tests were applied by the same experimenter to both classes. The correlations obtained for the two respectively are as follows:

NORMAL CHILDREN. (78 CASES.)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Opposites		75	78	71	62	64	72	78	57	40	46	33
2. Observation	75		72	58	60	58	67	56	58	56	52	29
3. Absurdities	78	72		53	41	44	79	68	41	46	34	29
4. Memory sentences	71	58	53		54	61	54	37	54	55	19	43
5. Crossing o's	62	60	41	54		73	48	54	38	36	52	35
6. Geometrical figs.	64	58	44	61	73		45	48	30	42	48	35
7. Discrim. length	72	67	79	54	48	45		56	49	30	31	06
8. Crossing patterns	78	56	68	37	54	48	56		30	21	27	18
9. Memory form	57	58	41	54	38	30	49	30		24	31	29
10. Tapping	40	56	46	55	36	42	30	21	24		29	18
11. Strength of grip	46	52	34	19	52	48	31	27	31	29		28
12. Interpret. pictures	33	29	29	43	35	35	06	18	29	18	28	

Mean=0·466.

DEFECTIVE CHILDREN. (22 CASES.)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Absurdities		1·0	1·0	98	97	1·0	1·0	1·0	98	94	94	79
2. Opposites	1·0		97	95	87	91	85	76	85	87	70	72
3. Crossing patterns	1·0	97		91	80	88	68	92	74	78	76	67
4. Crossing o's	98	95	91		85	77	84	67	76	81	73	55
5. Memory sentences	97	87	80	85		73	90	68	88	65	78	68
6. Observation	1·0	91	88	77	73		76	83	71	86	59	65
7. Memory form	1·0	85	68	84	90	76		65	67	70	77	75
8. Interpret. pictures	1·0	76	92	67	68	83	65		74	80	80	59
9. Geometrical figs.	98	85	74	76	88	71	67	74		65	60	62
10. Discrim. length	94	87	78	81	65	86	70	80	65		51	45
11. Tapping	94	70	76	73	78	59	77	80	60	51		61
12. Strength of grip	79	72	67	55	68	65	75	59	62	45	61	

Mean=0·782.

All round, obviously, the correlations are much smaller in the case of the normal children. This indicates that with these the influence of the energy has gone down and that of the engines has correspondingly gone up.

Compare next young children with those that are older. Here I may quote from the admirable work of Prof. Burt. Applying his test of reasoning to numerous children of different ages, he obtained the following correlations with the estimates of the teachers (in general, the older children show smaller correlations):

Ages	10-11	11-12	12-13	13-14
Correlations	78	81	64	59

No less marked is this tendency on comparing children with adults. As examples may be taken the correlations obtained by Otis and Carothers respectively for what appear to have been similar tests in each case.

Test.	Correlations with *g*. Otis, grades IV.-VIII.	Carothers, students.
Analogies	0·84	0·71
Completion	0·88	0·53
Directions	0·86	0·45
Digits, memory	0·41	0·22

Now these changes obviously follow a general rule. The correlations always become smaller — showing the influence of *g* to grow less—in just the classes of person which, on the whole, possess this *g* more abundantly. The rule is, then, that the more energy available already, the less advantage accrues from further increments of it. This is a well-known property of engines in general. Suppose that a ship at moderate expenditure of coal goes 15 knots an hour. By additional coal the rate can readily be increased another 5 knots. By doubling the addition of coal, however, the additional knots will certainly not be anything like doubled. This relation is observed not only in engines, but also widely elsewhere. In the science of economics, for example, it is expressed in the well-known law of diminishing returns. A moderate amount of capital spent on a given piece of land will produce a certain return; but on adding further doses of capital the returns will not increase proportionately.

In our psychological case of different classes of persons there enter no doubt various complications which render the theoretical interpretation more dubious. Above all, there is the fact that the classes better endowed with *g* have usually undergone more or less selection. For example, the university students of Carothers had been cleared of the weaklings who could not matriculate. This in itself would tend to lower all correlations due to *g*. However, such facts would seem capable of accounting for only part of the phenomenon,

not for the whole. There remains enough over to suggest a genuine law of diminishing returns for mental as for material processes.

Corollary of Independence.

The next and final point to be raised here is a corollary of what has been said. Since a great many abilities depend almost entirely upon the efficiency of the engines involved and this efficiency varies independently from individual to individual, we may conclude that these abilities themselves vary almost independently from individual to individual.

This theorem has, indeed, been called into question. Some authorities have asserted the existence of a general "sensory level" of ability, so that the persons who are successful at one kind of sensory performance will tend to be so at others also. Other writers have adopted a similar position as regards what they call "practical" ability; persons are taken to be either endowed or not endowed with this all round. But no such position would appear to be supported by the available definite evidence. Dr. McCrae, for example, has recently examined the correlations between different tests that have been entitled those of "performance." These, even among persons of comparatively low status, proved to be, in fact, almost independent of each other. Still more striking has been the result of a very valuable investigation by Mr. Philpott. He undertook to test the discrimination of length, a power which obviously possesses great importance in many spheres of industry. He wisely tested this discrimination in two different ways. First, he showed pairs of lines and made the subjects judge which was the longer; and then he gave them single lines and made them, in each case, draw another line as nearly as possible of the same length. As result, these two performances, that seemingly are but manifestations of one and the same power, turned out to be almost entirely independent. Those who were best at judging between the two lines already drawn did not, to any appreciable extent, excel at making a second line equal to a given one. Quite similar results were obtained for the discrimination of angles, as also for perceiving whether a line is straight or not.

Accepting, then, the conclusion that an immense number of abilities vary from one individual to another almost independently of each other, what is the practical result? Let us try to get a notion how such abilities of any person must be distributed in respect of excellence. By all experience, and also by statistical theory into which we cannot enter here, the great bulk of his abilities will tend to be mediocre; that is to say, they will be near the general average of his class. A fair number will be distinctly above this average, and a fair number below. A small number will be much above; and so also below. The whole frequency distribution will, in fact, have a bell-like shape similar to that which was shown by the curves of the tetrad-differences to be expected from sampling errors. At the extreme ends of the distribution will lie a very small number of performances for which the person is, on one side a genius, and on the other an idiot. Every normal man, woman, and child is, then, a genius at something as well as an idiot at something.

It remains to discover *what*—at any rate in respect of the genius. This must be a most difficult matter, owing to the very fact that it occurs in only a minute proportion out of all possible abilities. It certainly cannot be detected by any of the testing procedures at present in current usage, but these procedures are capable, I believe, of vast improvement.

The preceding considerations have often appealed to me on looking at a procession of the unemployed, and hearing some one whisper that they are mostly the unemployable. That they are so actually I cannot help concurring. But need they be so necessarily? Remember that every one of these, too, is a genius at something—if we could only discover what. I cherish no illusion, indeed, that among them may be marching some "mute inglorious Milton, some Cromwell guiltless of his country's blood." For these are walks in life that appear to involve a large amount of *g*. But I am quite confident that every one of them could do something that would make him a treasure in some great industrial concern; and I see no reason why some should not have even become famous, in such occupations, for example, as those of dancers, jockeys, or players of popular games.

Radiometric Measurements of Stellar and Planetary Temperatures.

By Dr. W. W. Coblentz, Bureau of Standards, Washington, D.C.

THE recent measurements of planetary radiation and planetary temperatures, especially of Mars, had their beginning in the first really successful tests at the Lick Observatory, Mt. Hamilton, California, in July 1914, when thermo-couple measurements were made on 112 celestial objects, including 105 stars, down to magnitude 6·7, and the planets Venus, Mars, Jupiter, and Saturn. (Bureau of Standards Sci. Paper, § 244, 1914.) The experimental procedure then employed, and the results obtained, have foreshadowed, in an unforeseen manner, practically everything that has been accomplished since then.

During the world strife and confusion that occurred in the meantime, nothing further was accomplished until the fall of 1921, when, at the invitation of the Lowell Observatory, I was given a further opportunity to try out a new method of measuring stellar temperatures by means of screens of quartz, water, etc., which separated the incident radiation into components containing radiation of the following wave-lengths: 0·3 to 0·43 μ; 0·43 to 0·6 μ; 0·6 to 1·4 μ; 1·4 to 4·1 μ; and 4·1 to 12 μ. In this manner the distribution of energy in the spectra of 16 stars was determined, thereby obtaining for the first time an insight into the radiation intensities in the complete spectrum of a star.

From a comparison of the observed stellar spectral radiation components with similar data, calculated for a black body at various temperatures, it was found that the stellar temperatures range from 2500° to 3200° K for red stars, up to 14,000° K or even higher for blue stars, which is in good agreement with other methods of estimating stellar temperatures.

Since then Pettit and Nicholson, using similar thermo-couples and a transmission screen of water attached to

the great 100-inch reflector of the Mt. Wilson Observatory, have been able to study long period variable stars of visual magnitude down to magnitude 9·2 and temperatures below 2000° K. In the meantime, Abbot has succeeded in measuring the distribution of energy in the spectrum of a number of the brightest stars, and has obtained temperatures in good agreement with those previously observed by the writer, using a thermocouple and transmission screens. Furthermore, using the writer's radiometric measurements, and assuming that the radiation from these stars is similar to that of a black body, Stetson has computed stellar diameters which are in good agreement with those measured directly with an interferometer.

From the foregoing results it appears that the outlook for the thermocouple as a useful instrument in stellar radiometry is very promising: (1) as a device for estimating stellar diameters; and (2) for determining the temperature of stars that are too small to measure the spectral energy distribution directly, thus supplementing the work of Abbot. The only discrepancy is perhaps in the published measurements of the radiation from Sirius. There seems to be something elusive about this star. Back in 1914 it was on the list for measurement; but because of daylight and low altitude no attempt was made to measure it. In 1921 a series of radiometric measurements gave a water-cell transmission of about 70 per cent. (in Bur. Stds. Sci. Paper, § 438, is given the uncorrected value, 65 per cent.). This would indicate that the spectral type of the companion star of Sirius is lower than A—perhaps below type F or down to type K. Owing to an uncertainty in some recent radiometric measurements on this star, further work must be undertaken to disprove or verify these results.

The results of 1921 were so promising that the Lowell Observatory extended the invitation to continue the investigation in 1922, especially of planetary temperatures, in preparation for the opposition of Mars in 1924.

In all these measurements of planetary radiation, use was made of the 40-inch Lowell reflector with focal lengths of 220 inches and 640 inches; Mr. C. O. Lampland, astronomer at the Lowell Observatory, collaborating. The measurements of 1922 and of 1924 are in agreement in showing that the planetary radiation emanating from Jupiter and from Saturn, and transmitted by our atmosphere, is very small, while the planetary radiation from Venus, Mars, and the moon is, relatively, very intense. The radiometric measurements made in 1922 indicated that about 30 per cent. of the total radiation emanating from Mars is of planetary origin, as compared with 80 per cent. from the moon. From the fact that the surface temperature of the moon is estimated to be considerably above 100° C., the writer estimated (Bur. Stds. Sci. Paper, § 460, 1922) that the temperature rise of the surface of Mars is considerable—perhaps so high as 10° to 20° C.

From the water-cell transmissions obtained by us in 1922, Menzel (*Astrophys. Jour.*, 58, p. 65, 1923), using Russell's formula, calculated the following temperatures: Venus, 50° C.; Jupiter and Saturn, −110° C.; and the moon, 120° C. From the water-cell transmissions of the radiation from Mars, observed on June 15 and 18, 1922, his calculations gave temperatures of −5° C. and −9° C. respectively, the higher value being for the smaller receiver, which intercepted 0·4 of the diameter of the planetary disk. From the large temperature gradient observed in 1924, extending from the equator to the poles and the limbs of the planet, it is evident that the highest temperature, −5° C., is an average value, which should be corrected for latitude. This would raise Menzel's values to 5° C., or perhaps even higher, when corrected for non-black body radiation.

Using our data observed in 1924, Menzel has calculated an average temperature of −30° C. for the whole disk of Mars. The temperatures of the apparent centre of the disk ranged from −5° C. on the bright areas to 22° C. on the adjacent dark areas, the predominating values being 6° to 9° C. The true temperatures would be about 10° higher, or 15° to 20° C. The temperatures derived by this method of reducing the data are in good agreement with those obtained by three other methods, all of which indicate conclusively that the equatorial temperature of Mars, at perihelion, was considerably above 0° C.

The planet Venus is one of the most interesting cases met with in radiometric observations. The surface of the planet is hidden by clouds, and its period of rotation is undetermined. Hence the thermocouple radiometer appears to be a means of obtaining further information on this question. For it was found that not only does the illuminated crescent show the presence of considerable planetary radiation, but the unilluminated part of the disk also emits a large amount of infra-red rays. This raises the question whether the radiation from the dark side of the planet is owing to a rapid rotation. If the period of rotation is long (225 days), then it seems necessary to assume that the surface of Venus is still quite warm; although the highly selective condition of the planetary radiation at 8-12 μ may perhaps be interpreted as due to radiation of the hot gases convected from the illuminated over the dark part of the planetary surface. However, since this involves distances of 800 to 1000 miles over the surface, it seems difficult to reconcile this assumption with the radiative properties of the gases which probably constitute the atmosphere of Venus.

An interesting and important observation is that the intensity of the radiation emitted from near the south cusp in the present position of the planet Venus—both for the dark and the illuminated regions—is greater than that emanating from corresponding points near the north cusp. This may be owing to differences in the surface conditions, as previously observed on Mars. Then, again, it suggests an effect of insolation due to inclination of the axis of rotation, analogous to seasonal changes on Mars and the earth. Further radiometric observations, at different presentations of the planet's surface to the earth, will be required to test this question. If this is seasonal, then it should be possible to establish the position of the axes of rotation of Venus.

From our data observed in 1924, Menzel calculated the following temperatures: Venus, 60° C.; Jupiter, −135° C.; Saturn, −150° C.; Uranus, lower than −185° C.; and the moon, 125° C. These calculations are in good agreement with those based upon our data of 1922, and they are in good agreement with Christiansen's theoretical calculations made long ago, in which he obtained the following values: Venus, 65° C.; Jupiter, −147° C.;

Saturn, −180° C.; Uranus, −207° C.; and Neptune, −221° C.

In the case of Saturn, the observations seem to indicate that the temperature is higher than can be maintained solely by the incident solar radiation. In other words, the interior of the ball of Saturn is still relatively hot. This is in agreement with the views expressed by Poynting twenty years ago, when he made his theoretical calculations of planetary temperatures, obtaining 69° C. for Venus and −38° C. for Mars. As an average value for the whole disk of Mars, Poynting's calculation of −38° C. is in good agreement with our observed value of −30° C.

The observed temperature of the moon, 125° C., is in good agreement with the values assigned to it years ago by Lord Rosse, 110° C., and more recently by Very, 150° C., by comparison of the lunar radiation against a black body.

Deinosaur Eggs.

By Dr. F. A. BATHER, F.R.S.

THE *Times* published on September 9 an interesting despatch from its Peking correspondent, giving further details of the discoveries in Mongolia by the expedition from the American Museum of Natural History, led by Mr. Roy C. Andrews. The fresh information about the fossil eggs attributed to deinosaurs suggests some comment.

Two of the recent finds are particularly worthy of note. One is a nest of twelve eggs almost perfectly preserved. The eggs were arranged in a circle, with the narrow ends pointing outwards; no doubt the broad end was, as in birds, that which first emerged, but in birds' nests this end of the egg is, as one would expect, directed outwards. Then the eggs are said to have been "in two layers of six each," those of the upper layer presumably alternating with those of the under one. This, if a correct description, suggests that the deinosaur scooped a basin in the sand, and perhaps covered the first layer with sand, as is the habit of the Nile crocodile.

The other find was a nest of five eggs, "smaller than those found two years ago, more elongated, and evidently the produce of another type of dinosaur. The shells are smooth, in contrast to the dimpled surface of the others, and very thin." Are they the eggs of a deinosaur at all? All as yet known have notably thick shells. These might be the eggs of a crocodile or a chelonian. Turtles' eggs are now being fossilised in just the same way in the sand-dunes of Western Australia.

The last question will have to be settled by the study of thin sections. It is strange how little was known two years ago about the structure of egg-shells, whether recent or fossil, of birds or of reptiles. Nathusius alone has studied thin sections of recent egg-shells, describing that of the moa in 1870, and that of a python in 1883. About 1870 also, some Cretaceous fresh-water sandstones in Provence yielded the bones of a reptile and some fragments of egg-shell. The latter and thin sections cut from them were re-studied in 1922 by Dr. Van Straelen and Mr. E. Deneyer of Brussels. The reptile is generally supposed to be some sort of deinosaur, and the eggs are assigned to it with some probability, made stronger by Dr. Van Straelen's later researches, of which a preliminary account was recently issued by the American Museum of Natural History. The following summary is based on the researches quoted and a few more general facts.

The egg of all birds and reptiles, when first formed within the body, is covered with a flexible membrane. At a large number of points in this membrane minute specks of lime appear. Round each of these specks more lime is gradually added in successive layers like the coats of an onion, thus building up little spheroids. When these spheroids meet one another, they form a complete coating to the egg, so that further layers of lime can be laid down only on the outer side of this. The layers outside any one spheroid thus build up a pile of irregularly prismatic shape and connect irregularly with the layers of the adjacent piles or prisms. On the inner surface of the first-formed coat each spheroid appears as a little hillock or mamilla; so this is called the "mamillar zone." The outer layers form the "prismatic zone." Outside the latter some of the membrane may remain as a "cuticle."

In chelonians the egg-shell is very thin, being composed only of the mamillar zone, with gaps remaining between the spheroids. In snakes the shell is still thin; the prisms are there, but they do not always join up. In crocodiles the shell is thicker than in turtles and in most birds, but the prismatic zone is scarcely developed; spaces, in the form of canals of two sizes, are left at intervals between the spheroids, so that air can reach the developing embryo. All birds have a mamillar zone and a relatively thick prismatic zone. In the Ratitæ the shell is thick and the air-canals branch as they near the outside, each ending in a group of pores. In the higher birds the shell is thinner and each canal opens in a single pore.

The deinosaur egg-shells already described by Dr. Van Straelen fall into three groups. In those associated with Protoceratops, from the base of the Upper Cretaceous, very small spheroids form a thin mamillar zone; the thick prismatic layer is traversed by relatively few air-canals, which end in minute pores and are of the same width throughout. In a Mongolian shell thought to belong to a duck-billed deinosaur the spheroids are larger, the pores a little larger, and the canals swell in the middle. In the shell from Provence the mamillar zone is much as in the last-mentioned; but above it are cavities which give rise to straight air-canals of equal bore, ending in pores of 0·1 mm. to 0·2 mm. diameter.

Thus the three types of supposed deinosaur eggs show a general agreement with one another. They differ from the eggs of all other creatures, but present certain resemblances to the eggs of crocodiles and birds, just as one would expect deinosaur eggs to do. We may therefore conclude that they really were laid by the deinosaurs the remains of which are found with them.

In addition to these three types, Dr. Van Straelen has in hand material from other parts of the world, including a probable deinosaur egg from the Oxford Clay of Peterborough and other eggs from the Oolite

of Great Britain. Now Mr. Roy Andrews tells us of one new type, of deinosaurian appearance, and another which is not so obviously deinosaurian.

The question whether all these eggs are those of deinosaurs has its converse: did all deinosaurs lay eggs? This cannot be taken for granted. The eggs of deinosaurs must have been hatched by the heat of the sun or of decaying vegetable matter, and it is natural to find them laid in rocks formed under desert conditions. To lay its eggs a deinosaur must have trod on *terra firma*. The huge sauropods that lived in the estuaries of Wyoming, Argentina, and Tanganyika can in many cases have climbed on to the land only with great difficulty, and it is even doubtful whether their limbs could have supported their enormous weight out of the water. It may therefore well be that, like the water-inhabiting icthyosaurs and sea-snakes, these monsters were viviparous. The East African Expedition of the British Museum is not likely to find their eggs in Tanganyika Territory.

Current Topics and Events.

IN the course of an interesting account of the discovery in the Gobi Desert of forty more dinosaur eggs, representing three species, given to the correspondent of the *Times* at Pekin by Mr. Roy Chapman Andrews, the leader of the third expedition of the Natural History Museum of New York to Mongolia, which appeared in the issue of September 9, it is stated that implements of a type corresponding to the Azilian period of western Europe have been discovered by members of the expedition. These implements, made of red jasper, chalcedony, and chert, were found under the sand dunes which are characteristic of the district, and include such forms as spear- and arrow-heads, axes and knives, and so forth, of careful workmanship. Pieces of egg-shell of dinosaur and giant ostrich pierced with holes were evidently used for ornament. In a more recent deposit were two fossil skulls with other evidence of a later culture, which is stated to be "probably neolithic," although bronze points are mentioned as among the finds. Other relics of early man found in this area include a few implements of Mousterian type and pictographs illustrating moose, elk, and other extinct mammals of which the relation to the other finds is not specified.

IT is obvious that this account of the discovery, apparently of primitive implements of human workmanship, must be received with all reserve until a further and more authoritative account is to hand; but it certainly holds out hopes of the fulfilment of the expectation that this expedition might well find traces of early man in Central Asia. The mention of implements of Mousterian type is of especial interest, coming as it does within a short time of the publication of the evidence for Mousterian man obtained by Fathers Licent and Teilhard de Chardin in Northern China and Mongolia, and the discovery of Mousterian implements associated with a skull of Neanderthal type in Palestine. It is stated that the earlier culture was separated from the later in stratification; but it is necessary that more should be known of the nature and character of the intervening deposits before it is possible to judge how far any wide separation in date is justified. The mention of bronze with the later culture may serve as a reminder that the contemporary use of metal and stone is of frequent occurrence. Stone implements from early sites in Mesopotamia have been known to be classified as Azilio-Tardenoisian until it was pointed out that their coexistence with copper had already been recorded. The geologists of the American expedition, however, appear to be satisfied as to the antiquity of the early deposits, which they date at somewhere "between 10,000 and 20,000 years old." The further conclusion that primitive man came to Europe from Asia is here made to depend upon a dating of the Azilian culture in western Europe of 7000 years, which is quite possibly too low.

A PLASTER cast of the skull and jaws of *Protoceratops andrewsi* has been received from the American Museum of Natural History and placed on exhibition in the Fossil Reptile Gallery at the British Museum (Natural History). This is not the type, but one of the best skulls obtained in 1923, and is nearly full grown. It is 21 in. long, 16¾ in. high, and 18¾ in. wide. The skull was found in the Djadochta Sandstone, a desert formation at the base of the Upper Cretaceous in the Gobi desert. Protoceratops is supposed to be the deinosaur that laid one kind of the famous eggs. It was herbivorous and one of the primitive Ceratopsia—a group of which Triceratops is the best-known example. It is not, however, regarded by the American palæontologists who have studied it as being in the direct line of ancestry of any of the American Upper Cretaceous genera, except perhaps Leptoceratops.

HOPES for the regeneration of China which were aroused by the prospect of liberating the funds accruing from the Boxer Indemnity seem likely to remain in abeyance for an indefinite period. The course of events at the moment is more than unfavourable to foreign intervention in domestic affairs, and in education, as in other matters, the Chinese, or at least the more aggressively demonstrative section of the population, do not hesitate to show their desire, and their confidence in their ability, to deal with the situation without outside assistance. In the meantime, the attitude of the students and the prominent part they are taking in the present disturbances lend support to the views of those with first-hand knowledge of the Chinese who are dubious of the advantages for China of an education on even partially Europeanised lines. It may be hoped, however, that this is but a passing phase which affects only the more restless and easily stirred section of the population. It must be remembered that in a country like China, in which, broadly speaking, scholarship has been the only passport to positions of authority, it was almost inevitable that the students would come to taking a hand in times of crisis, and equally inevitable that

here, as everywhere, they would tend to follow a subversive policy.

AN illuminating instance of the students' power in China, though only in what might appear a trivial matter, is given by Mr. Ellsworth Huntingdon, in *Scribner's Magazine* for September, in the course of an article in which he records the impressions of a recent visit to China. He states that the women of Fuchow have been compelled, at the order of the students, to abandon the three small swords it is customary for them to wear in their hair as a symbol of their right to defend themselves in case of need. Although Mr. Huntingdon's stay in the country was not prolonged, and it is notoriously unwise to form a judgment of the people except on something approaching intimate acquaintance, he has grasped certain essentials of the situation. There is conclusive evidence of the overwhelming desire of the Chinese man and woman for education up to the highest grade, but there are difficulties in the way in their desire for self-sufficiency. It is interesting to note that Mr. Huntingdon is in agreement with the view which holds that the use of the Boxer Indemnity money by the United States for educating Chinese outside China has not been an entire success in that it has led to the undue Americanisation of the student—a result disliked by the Chinese and not ultimately beneficial for the individual. The need for preserving what is best in Chinese culture, while allowing full scope to modern intellectual movements combined with high ideals of national welfare, has given rise to a suggested solution in a university which, combining several institutions under a common bond, might still allow free play to the aims and ideals of each of the constituent bodies. This suggestion, it may be noted, is not far removed from that which was put forward in these columns a few months ago in discussing the possibility of a scheme of co-operation between Great Britain and China.

THE decision of the Pharmaceutical Society of Great Britain to establish pharmacological laboratories for the testing of drugs to which the provisions of the Therapeutic Substances Act apply, namely, drugs the purity of which cannot adequately be tested by chemical means, has been advanced an important step by the announcement that applications are invited for the post of Director. The institution of the laboratories has been decided upon by the Council of the Society in order to afford opportunities for research in physiological methods of drug assay, to meet the demand for standardisation of therapeutic substances which will come from manufacturers, who for various reasons may not be prepared to undertake the standardisation contemplated by the new Act in their own laboratories, and also to afford opportunities for advanced students of pharmacy to receive training in the work. The Pharmaceutical Society has recently revised its examination regulations, and pharmaceutical students who have obtained the Society's qualification of pharmaceutical chemist, either directly or through the recently instituted degree of Bachelor of Pharmacy of the University of London, will be able to take advantage of the opportunities for advanced work provided by the laboratories and should eventually be able to meet the demand for persons with knowledge of physiological standardisation which will follow from the operation of the new Act. The project has the complete approval of the medical authorities, and among the members of the committee which is advising the Council of the Society on the appointment of a Director and on the lines upon which the laboratory should be organised are Sir Humphry Rolleston, President of the Royal College of Physicians, representing the British Medical Association; Sir Nestor Tirard, representing the General Medical Council; and Dr. H. H. Dale, representing the Medical Research Council. The Ministry of Health and the Medical Research Council have given the project their approval and support from the beginning, and it is felt that the laboratories will not only achieve their immediate objects in connexion with the Therapeutic Substances Act, but will also make important contributions to the advance of medical science.

THE Palæontologische Gesellschaft, an international society of palæontologists, will meet at Weimar in Thuringia on September 24-29, under the presidency of Prof. J. F. Pompeckj of Berlin. The organising secretary is Prof. Soergel of Tübingen, who also will lead several of the excursions. These include visits to travertine quarries near Ehringsdorf, where relics of Neanderthal man have been found; to old gravels of the River Ilm, with their vertebrate and cultural remains; to the Bunter sandstone of Berka, which shows worm-burrows and tracks of Chirotherium; and to the Muschelkalk of Jena, besides the museums in Weimar and Jena. Among papers announced are: Prof. O. Jaekel, "The Problem of the Skull, a Memorial to Goethe's Morphology"; Prof. Scheidemantel, "The Monuments of Weimar"; and Dr. F. A. Bather, "Arenicoloides—a Suggestion," this last bearing on the worm-burrows of Berka.

AT a recent meeting of the Aero Club of Norway, Lieut. R. Larsen outlined Captain R. Amundsen's plans for a polar flight next year. According to a report in the *Times*, Captain Amundsen has purchased from the Italian Navy a semi-rigid airship which was built in 1924 and has proved successful on several long flights. It has a cubic capacity of 670,000 cubic feet and a length of 348 feet. Three engines, each of 250 h.p., give it a maximum speed of 250 miles an hour. The crew will number sixteen, including Captain Amundsen and Signor Nobile, the constructor of the airship, who will act as navigating officer. At the beginning of 1926 the airship will fly from Rome to Pulham and thence, after overhauling, to Vernes, near Trondhjem, and if circumstances are favourable, direct to Spitsbergen. The final start will be made from King's Bay in April or May. The cruising radius of the airship is 3725 miles, and the voyage across the pole is 2235, which it is hoped will be completed in about fifty hours. Mooring masts are being erected at Vernes and at King's Bay.

DR. ALEŠ HRDLIČKA, of the Smithsonian Institution, is expected to make a short stay in England towards the end of September on his return journey to the United States after visits to India, Australia, and South Africa. The object of Dr. Hrdlička's journey to these countries was to investigate on the spot the evidence bearing upon the problems of early types of man. While in South Africa he visited the famous Broken Hill Cave in which the remains of Rhodesian man were discovered, and in examining the deposits, was fortunate enough to discover further fragments of human skeletal remains. He proposes to exhibit these at a meeting of the Royal Anthropological Institute, and to submit to the fellows of the Institute the conclusions at which he has arrived from his examination of the deposits in the caves. Dr. Hrdlička's intention, appropriately enough, is to hand these bones to the British Museum (Natural History), where they will take their place with the remains of Rhodesian man.

THE twenty-fifth anniversary of the foundation of the Mond Nickel Works was celebrated on September 12 at Clydach, Glamorganshire, when Sir Alfred Mond, chairman of the Company, unveiled a bronze statue of his father, Dr. Ludwig Mond, F.R.S., who died on December 11, 1909. Dr. Ludwig Mond's name is connected more particularly with the manufacture of alkali and alkali products. In the late 'sixties of last century, he settled at Winnington in Cheshire, where, with the late Sir John Brunner, Bart., the firm of Brunner, Mond and Co. was built up for the manufacture of soda by the Solvay or ammonia-soda process. Much of the success which the firm achieved was due to the genius of Dr. Mond. The nickel works at Swansea arose out of the discovery, in collaboration with Langer and Quincke, of the group of compounds now known as the metallic carbonyls. This work in an abstract field of research was, with Dr. Mond's characteristic aptitude for seeing practical applications, quickly turned to account, and a process developed for the extraction of nickel from its ores. Dr. Mond will also be remembered as a most generous benefactor of science. The Davy-Faraday Laboratory at the Royal Institution and the International Catalogue of Scientific Literature are two specific examples of his munificence, though practically every movement in his day for the advance of physical or chemical science owed much to him and to his wise and inspiring counsel. Dr. Mond was elected a fellow of the Royal Society in 1891, and on the death of his widow in 1923, the Royal Society and the University of Heidelberg each became a legatee for the sum of 50,000*l.*, the income of which is to be employed for the endowment of research in natural science.

A COLD spell was experienced in England at the commencement of September. The mean maximum temperature for the first 10 days of the month at Greenwich Observatory was 62°·5 F., which is 7°·3 below the average for 65 years, 1841–1905; the mean minimum was 46°·9, which is 3°·9 below the normal. The mean temperature was 54°·7 and 5°·6 below the normal. In 1922, the mean temperature for September 1-10 at Greenwich was 55°·1; the mean maximum was 64°·0, slightly higher than this year, and the mean minimum was 46°·2, slightly lower than this year. In 1912, the mean temperature for the period was 54°·7, being in precise agreement with the present year; the mean maximum was 62°, slightly lower than this year, and the mean minimum 47°·4, slightly higher than this year. These are the only Septembers in the last twenty-five years having such cold days at the commencement of the month. On 6 days of the first 10 days of September of this year, the mean daily temperature was below 55°, and on September 9 and 10 the maximum thermometer failed to touch 60°. Frost occurred in situations open to the sky on 3 nights. The coldest day was September 5, with a mean temperature 51°, which is 10° below the normal. The maximum temperature in the 10 days at Greenwich was 68° on September 1. It is not exceptional for the shade temperature to register 80° during the period, and in 1911, at the end of the abnormal summer, the thermometer on September 7 and 8 exceeded 90° at Greenwich, and in the 10 days there were 5 days with a temperature above 80°. In 1906 the shade temperature on September 1, 2, and 3 exceeded 90°.

THE experiment in agrarian colonisation in the Tripolis initiated by the Italian Government in the year 1922 forms the introductory article of the *Revista della Tripolitania*, an official publication dealing with matters relating to the Colony, of which the first issue has recently appeared. The contents are not confined to official matters, and if the promise of the first number is maintained, it should prove a source of information of value for which systematic provision hitherto had scarcely been adequate in view of its importance, especially from the archæological and historical point of view. In the present number there are several articles of interest to archæologists, including an account of the city of Leptis as a centre for the production of oil in Roman times, a well-illustrated account of archæological remains, and a description of an interesting mosaic from what apparently was a small votive shrine set up in the fields by a Roman citizen. Prof. A. Ghigi publishes the first instalment of a survey of Libyan fauna. The remainder of the first issue is composed of articles of practical interest to agriculturists, such as the cultivation of the olive, industries subsidiary to agriculture, the raising of cattle and goats in Libya, etc., and reviews of recent books dealing with the country.

A PROJECT due to M. P. Gaudillau is described in the *Comptes rendus* of the Paris Academy of Sciences of July 6, which will take advantage of the difference of level between the Mediterranean and the Dead Sea. It is proposed to construct a canal with locks from Haiffa up to a pass at the head of the valley of Esdrelon, where a tunnel two or three kilometres long will connect with another short canal leading down a valley to the head of the pipe line; the

latter will carry the water to the Jordan valley, running straight down the steep mountain-side, the available head being 343 metres. From the power-house in the valley the outflow will be in a canal, running with a moderate slope along the side of the range, down to the Dead Sea, where an additional fall of 120 metres to a second power-house can be obtained. The Mediterranean water will be pumped from reach to reach of the canal by means of electric pumps. It is proposed to store the fresh water of the Jordan, and use it for irrigation; and as the present average flow of the river is about 70 $m.^3$ per second, and this amount of water is now disposed of annually by evaporation, it is considered that, by raising the level and so increasing the surface of the Dead Sea, it should be possible to dispose of an influx of salt water of 103 $m.^3$ per second. To raise this water 80 metres to the head of the pass will require 190,500 horse-power, and 617,000 horse-power will then be available for conversion into electric energy, 426,000 of which, or 240,000 kilowatts, will be available for distribution in Palestine and Syria.

THE inaugural meeting of the forty-fifth session of the Junior Institution of Engineers will be held at the Society of Arts on Friday, December 11, when Mr. J. S. Highfield will be inducted president of the Institution by Dr. Alexander Russell and will deliver his presidential address.

MR. F. W. H. MIGEOD, the well-known African traveller and authority on native languages, has consented to assume the leadership of the British Museum East African Expedition in succession to Mr. W. E. Cutler, whose death from malaria was announced at the beginning of September. Mr. Migeod will sail for Dar-es-Salaam by the next boat.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: Senior entomologist, Ministry of Agriculture, Egypt—H.E. The Under-Secretary of State, Ministry of Agriculture, Cairo (November 1). Chemical officer in the Medical Research Laboratory, Nairobi—Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (October 15).

Our Astronomical Column.

RECENT MODIFICATIONS IN THE THEORY OF STELLAR EVOLUTION.—Prof. H. N. Russell, who shared with Prof. Hertzsprung the honour of originating the giant and dwarf theory of the evolution of stars, is contributing a series of papers to the *Scientific American* (beginning in the September issue) on the changes of view that have taken place in the last year or two.

Prof. Eddington showed from statistics that when absolute magnitude and mass were correlated, giants and dwarfs lay on a single curve, in contradiction to the earlier view that an abrupt change took place at the point where the star became too dense to act as a gas.

The recent spectroscopic demonstration of the immensely high density of the companion of Sirius was a striking verification of Eddington's conclusion that the atom when stripped of its outer electrons is capable of enormous compression without ceasing to be a gas. This completely modifies the older conception of the falling temperature in dwarf stars. It now appears that the temperature in their interiors will continue to rise far into the dwarf stage. But a full consideration of the best manner of modifying the theory in view of the new facts is postponed.

OBSCURING COSMIC CLOUDS.—Father Hagen, of the Vatican Observatory, has during recent years published successive lists of what he describes as dark nebulæ, covering considerable regions of the sky, in both low and high galactic latitudes. Prof. Öpik, of Tartu Observatory, concluded from a count of the faint stars on the Paris Astrographic Charts that these were produced by some obscuring medium.

As this would be a matter of supreme importance in all researches on distant objects, Prof. Harlow Shapley has made a fresh investigation, by taking long-exposure photographs with 24-inch or 16-inch refractors. These show stars nearly 3 magnitudes fainter than the limit (14·5 mag.) of the Paris Charts. His conclusion (Harvard Coll. Ob. Circ. 278) is that the deficiency of stars in the regions in question does not extend to these fainter stars, as it would if obscuring clouds were the cause of it. In other words, the actual distribution of the stars brighter than 14·5 is much more irregular than the laws of chance distribution would suggest. Doubtless this is a manifestation on a larger scale of the well-known tendency of stars in many regions to group themselves along regular curves.

The "obscure nebulæ" of Father Hagen are concluded to be an effect produced on the eye by the great contrast in star density between the neighbouring regions. The star deficiency is real, but the appearance of a visible obscuring medium is illusory.

U.S. NAVAL OBSERVATORY ECLIPSE OBSERVATIONS, 1905–18.—The appendix to the Publications of the United States Naval Observatory, Second Series, Volume 10, Part 2, contains an account of the total solar eclipses of August 30, 1905, and June 8, 1918, with aviators' notes on the total solar eclipse of September 10, 1923. The first account opens with the general report of the 1905 Expedition by Rear-Admiral Colby M. Chester, who was Commander-in-Chief of the special line squadron of three vessels detailed by the Navy Department. Three principal stations were occupied not far from the shores of the Mediterranean, and each station was completely equipped for photographing the corona with long and short focus cameras, for spectroscope and polariscope work, for meteorological observations, and for position observations. At none of the stations was there any interference from clouds, and the programmes in general were carried out as planned. The volume contains the individual reports of all the officers in charge of the various departments, and covers 335 pages. It is well illustrated by a large number of excellent plates.

The reports of the 1918 eclipse, occupying 51 pages, are next dealt with. This eclipse was observed at Baker, Oregon, but partial cloudiness was responsible for the meagreness of the observations. Practically no spectroscopic results were secured.

Unfortunately the weather conditions for the eclipse of 1923 were also unfavourable at all points occupied by the naval aviators. The programme included photographs of the corona and the moon's shadow on the earth. Partly from the weather conditions and partly from the inherent difficulties of making such observations from aeroplanes, the photographs are stated to have no scientific value.

Research Items.

INTELLECTUAL GROUPING OF MEN.—In a "Study of the United States Senate" Mr. Arthur MacDonald, of Washington, D.C., raises the question whether it is possible to arrive at any general principles concerning organisations of men, comparable to those already elaborated about animal organisations. He thinks that all organisations of men, especially those of long standing, act according to laws most of which are at present unknown. As a preliminary investigation, he subjects the transactions of a Senate of three sessions to a statistical examination. He studies the attendances of members during each of the three sessions, the attendances of the various political parties, of business as against professional members, the frequency of remarks for each political party, the previous life and education of the senators and their success. From these data he draws certain tentative conclusions, the most interesting of which are, that the professional men average much higher in the frequency of their remarks than the business men; that the professional men are in the majority, and that a large proportion were reared in the country; that the Democrats excel the Republicans in university education; that more than half of the legislation initiated in the Senate receives little or no attention. The method is suggestive, and a comparison with other countries would be of great interest. It would, however, be advisable, when presenting material of this kind, if instead of giving averages only some indication of their reliability were also presented.

VANISHING INDIAN TRIBES.—The urgent necessity of recording Indian languages and grammar, as well as the traditions and folk-tales of N. America, before it is too late, is well illustrated in the introductory remarks which precede the study of Wiyot grammar and texts by Gladys A. Reichard which has just been published as Pt. 1 of Vol. 22 of the University of California Publications in American Archæology and Ethnology. In 1850 the peoples speaking the Wiyot language probably numbered about 1000. In historic times they occupied a territory of about 465 square miles on the shores of Humboldt Bay and the lower reaches of the Mud and Eel rivers in north-west California. In 1910, at the time of the census, their numbers had fallen to 58 full-blooded Wiyot, 13 partly of Wiyot and partly of other Indian blood, and 81 partly Wiyot and partly white, making a total of 152. Further, there were only 11 full-blood Wiyot under twenty years of age. In 1922, when the present investigation was made, there were not more than 100 persons living as Wiyot, of whom very few knew the language. Some lived in two small settlements on Humboldt Bay, the others were distributed in groups of a few families in various townships. It is noteworthy that where a Wiyot marries a member of another tribe, whether Athapascan or Yurok, the children speak the language other than Wiyot. Seven individuals were employed in furnishing and checking the material. It was found that the difference in individual pronunciation was so great as to be almost dialectal, which makes it particularly regrettable that more extended sources of information could not be obtained. A sketch of Wiyot culture was given by Kroeber in his Californian Handbook published in 1911.

THE AMŒBA OF DYSENTERY.—There have been many claims in the past of the successful cultivation of *Endamœba histolytica*, the parasite of amœbic dysentery, most, if not all, of which have proved erroneous. Some new research has recently been published (Proc. Nat. Acad. of Sciences, U.S.A. Vol. 11, No. 5, 1925, pp. 235 and 239). Boeck and Drbohlav have now succeeded by the use of a special culture medium. This consists of slants in test-tubes of beaten-up whole egg coagulated in an inspissator. The slant is covered with Locke's solution containing 1 per cent. of crystallised egg albumin (human serum may also be employed). Inoculated into this medium, the amœbæ grow and multiply, feeding on bacteria and blood-corpuscles if these are added, and persist for five days, but are most numerous at the end of 48 hours. By sub-culturing within this period the cultivated amœbæ have been carried on for more than 90 generations. They maintained their virulence, and the ninety-third sub-culture, five months from the original culture, produced dysentery when inoculated into kittens. Chiang has been able to transmit the *E. histolytica* of human origin to rats, and the infection of rats is readily transmitted from rat to rat by association in the same cage. The results of this investigation incriminate the rat as a possible carrier of the amœba of human dysentery.

SPECIFIC IMMUNITY OF TISSUES.—*Science* for July 31 (No. 1596) contains an address by Prof. Elliott Prentiss on "Specific Immunity of the Tissues and its bearing on Treatment." He points out that every species of animal and plant has special preferences of habitat and food. This applies even to micro-organisms parasitic in the human body, many of which are localised in certain tissues (see also NATURE, February 16, 1924, Vol. 113, p. 242). Thus, in tuberculosis the tubercle bacilli rarely infect the muscular tissues. Experiments were performed by injecting tuberculous animals and individuals with emulsions of muscle, and a certain amount of benefit resulted, suggesting that the tissues resistant to a particular infection might be employed in the treatment of that infection.

INSULIN TREATMENT.—In *The Fight against Disease* (the organ of the Research Defence Society) for July, an account is given of the records of some forty cases of diabetes treated at one of the London hospitals with insulin. Three of the cases died—one from hæmorrhage after an operation, one from cancer and pneumonia, and one from coma. The remaining 37 cases have done well and have been discharged from hospital to resume ordinary life. Faith in the value of insulin is therefore absolutely justified. The article is illustrated with a striking plate showing the condition of a patient before and after insulin treatment.

SWEDISH RAINFALL.—In Part II. of the Årsbok for 1924 of the Swedish Meteorological Service are published the full figures of rainfall observations for the year. For each of the stations, which number about a thousand, beside the total fall for each month of the year, there are given the fall on the wettest day of the month, and the total number of days on which rain and snow fell. Each month is illustrated by a map, and there is a map of the year's rainfall. Comparison with previous years shows that 1924 was almost everywhere in Sweden an unusually wet year, the average excess being 16 per cent. Only in a few parts of the extreme south of the country was there a slight deficiency, which nowhere exceeded 10 per cent.

ECHO SOUNDING.—An important article on this subject appears in the *Hydrographic Review* for May 1925, the semi-annual publication of the International Hydrographic Bureau. The article is intended to

complete the information on this subject given in earlier issues of the *Review* (December 1923 and October 1924), and, while it contains little that is actually new, it collects certain scattered information from various sources in different countries. Descriptions are given of various forms of apparatus, including the sonic depth-finder of the American navy and Behm's apparatus, with a report of trials carried out with the latter by the Danish navy. The article concludes with a bibliography of the subject from 1912 to the present year. The contents of this article comprise Special Publication No. 4 of the Hydrographic Bureau.

TIDE PREDICTION.—The annual report of the Tidal Institute of the University of Liverpool, just issued, describes the work of the Institute during 1924, the sixth year of its activity. On the more routine side, its work has included analyses of tidal observations made at Liverpool (4 years) and at Portland (1 year), the latter being done for the Admiralty; at Ystad, on the Baltic (4 years' observations), for the International Hydrographic Bureau at Monaco; and at Portage Island, Canada, for the Canadian Tidal Survey. Tidal predictions of the times and heights of high and low water during 1926 have been prepared for Liverpool, Portland, and seven ports in New Zealand and Australia; these predictions, made for or through the Admiralty, have been executed on the new machine presented to the Institute last year, and installed at the Bidston Observatory. The machine, which is of the Kelvin type, and made by Lord Kelvin's firm, is described and illustrated in the report; more harmonic constituents can be dealt with than by previous instruments of a similar kind, and various useful improvements are incorporated in the design. In addition to the development of methods of analysis and prediction, with special reference to this machine, various theoretical dynamical researches on tides have been published or continued during the year. The financial expenses of the Institute have been met partly by its earnings for commissions executed on behalf of other institutions, but mainly by the Liverpool Steamship Owners' Association.

WELSH SLATE.—The Welsh slate-quarries, employing more than eight thousand men, produce the finest slates in the world, and furnish more than 80 per cent. of the total output in the British Isles. The National Museum of Wales has therefore done well to issue a small hand-book on "The Slates of Wales," written by Dr. F. J. North, Keeper of Geology in the Museum. It is a pamphlet of 66 pages, liberally illustrated, and presents an interesting subject in language intelligible to the general public. There is a general part, dealing with the nature and origin of slate and the manner in which it has acquired its peculiar fissile structure. The author might have brought out more clearly the fact that in the better-class slates practically the whole of the material has been reconstituted *in situ*, before and during the impression of the cleavage-structure. The more special part of the work includes an account of the distribution of workable slates in the Cambrian, Ordovician, and Silurian formations of Wales, some description of the getting of slate and the manner of preparing it for the market, and an interesting history of the Welsh slate industry, which dates from the latter part of the eighteenth century. There is also a good classified bibliography of the subject. This little book, published by the Museum at Cardiff at the price of sixpence, is admirably suited to engage the interest of the intelligent visitor, and to kindle a desire for fuller knowledge.

THE CONTINUOUS SPECTRUM OF HYDROGEN.—The continuous spectrum of gases is of great theoretical importance from the astrophysical point of view, as explaining the continuous spectra emitted by the sun and by stars. Messrs. H. Schuler and K. L. Wolf describe, in the *Zeitschrift für Physik*, July 18, a series of observations of the continuous spectrum of hydrogen, from which they conclude that it is due to the reunion of dissociated atoms to form molecules, and they express the opinion that this is also the case with other gases the molecules of which consist of more than one atom, including the halogens, for the continuous spectrum of which Steubing has recently given another explanation. Experiments show that the continuous spectrum of hydrogen, which reaches from about 4800 Å.U. to 2100 Å.U., is not related in intensity to the Balmer series, or to the many line spectrum of the gas. The long wave-length boundary of the continuous spectrum agrees satisfactorily with that calculated from the heat of dissociation, which confirms the authors' view as to the origin of the spectrum. It is found that the intensity of the spectrum is strongly affected by the electric field, with which it increases, and it is suggested that reunion of atoms to form molecules is facilitated in an electric field. An experiment in which a very intense continuous hydrogen spectrum, with very few hydrogen lines, was produced in calcium vapour to which a little hydrogen was added, is considered to support the above view. Franck and Cario have shown that molecular hydrogen is dissociated by means of energy derived from excited mercury atoms, and it is thought probable that calcium atoms act in the same way, and that it is the reunion of these dissociated hydrogen atoms which causes the continuous spectrum in the last-mentioned experiment.

WATER IN CHEMICAL ACTION.—A series of papers on the influence of water on certain chemical reactions, by L. B. Parsons, is published in the July issue of the Journal of the American Chemical Society. Solid potassium iodide and bromide both react immediately with moist chlorine, whereas no appreciable action occurs if the chlorine is dry. It is shown that a minimum partial pressure of water vapour, approximately equal to the vapour pressure of a saturated solution of the components present during the reaction, must be reached before reaction can take place. The reaction between hydrogen sulphide and iodine in ether solution runs to completion in the absence of water:

$$H_2S + I_2 = 2HI + S.$$

In the presence of water the reaction is incomplete:

$$H_2S + 3H_2O + 3I_2 \rightleftharpoons H_2SO_3 + 6HI.$$

The equilibrium point depends on the relative concentration of the water; diffused daylight has no appreciable effect. Atmospheric oxygen must be excluded from the system, however, as it oxidises ether to ether peroxide (Clover, 1922), thus changing the nature of the whole reaction. Many observations have been recorded of the ability of water to produce combination between various metals and iodine. It is now shown, however, that this property is not peculiar to water, but is possessed by many organic liquids. A close parallelism exists between the ability of a liquid to bring about reaction between a metal and iodine and the solubility of the metallic iodide in the liquid. Apparently the function of the liquid consists in removing the film of solid iodide from the metal surface. These researches are of importance in view of the large number of varied cases known in which water acts as a catalyst.

The Russian Academy of Sciences.

A MEETING was held at the London Central Y.M.C.A. on Thursday, September 10, in connexion with the bicentenary of the Russian Academy of Sciences, the celebration of which, at Leningrad and Moscow, has just been concluded. The meeting was arranged on the initiative of the Science Section of the Society for Cultural Relations (S.C.R.) between the peoples of the British Commonwealth and the Union of Socialist Soviet Republics (U.S.S.R.). Sir Richard Gregory, who occupied the chair, pointed out that the sole intention of the assembly was to send a message of appreciation and encouragement to scientific workers in Russia. For two centuries the torch of learning had been kept burning by the Academy of Sciences, and though at times it had flickered, it had never been extinguished since it was lit. One of the objects of the S.C.R. was "To take any action deemed desirable to forward the intellectual and technical progress of both peoples"; and the meeting could therefore appropriately associate itself with representatives of science who had gone to Russia to take official part in the celebration of the bicentenary of the Academy. Sir Richard Gregory referred appreciatively to Belopolsky's brilliant spectroscopic work at the Pulkova Observatory, and said that a forty-one inch object-glass was now being ground at the works of Sir Charles Parsons in Newcastle, for use in the largest refracting telescope in the world, to be erected in Russia.

Prof. A. N. Kriloff, a member of the Academy, gave some particulars of its establishment and early activities. He pointed out that two hundred years ago Russia differed very much from other European countries and was described as a purely Asiatic State. On the vast territory where now 150 millions have plenty of room to live, only eight millions were distributed. Almost all the inhabitants were illiterate, no schools existing except some in monasteries for the education of the clergy. Up to the time of Peter the Great, the only books were the Bible and books for church service, which were written in the old Slavonic language. When Peter the Great founded the Academy of Sciences, after having assisted at a meeting of the French Academy in Paris during one of his voyages, he invited the celebrated Leibnitz to prepare the statutes, and signed at the end of his reign an "ukase" promulgating the foundation of the Academy, but his death occurred before the work of the new institution began. Thus in a country with one single lay school created some twenty years before by Peter—the "Navigation School," which was managed by the Englishman Farquarson—an Academy of Sciences was established. It seems that such an enterprise had no sound basis, as not only "science" did not exist in the country, but the language had no actual word for it. The founders had the wisdom, however, to invite as the first members of the Academy not learned men and teachers of sciences only, but "creators" of the science, such as the two brothers Bernoulli and Euler. Euler was for fifty-seven years a member of the Russian Academy, and his far-reaching mathematical discoveries and works filled more than one half of the first hundred volumes of the proceedings of the Academy. During the first forty years of its existence, the Academy was not only a scientific body but also a school of education. The Russian members had to carry out research work in natural science and also to elaborate the Russian literary and scientific language, trying to approach the half Slavonic language of the books to the spoken language of the people. The need to organise the language, and to establish a system, was so acute that some fifty years later a special Academy for Russian Language and Literature was created. This Academy had a special name—the Russian Academy—but in 1818 the new institution was joined to the Academy of Sciences to form one of its Sections, and the Academy of Sciences entered upon its second century with three sections, namely: (1) Physico-mathematics, (2) Russian Language and Literature, and (3) History and Philology.

"At the beginning of its second century," continued Prof. Kriloff, "we see the Academy to be a purely scientific institution of world renown, in a country with a definite system of education from primary schools to universities, with a well-developed literature, an elaborate scientific language, and scientists of Russian origin in different branches of sciences. The work of the Academy proceeds quietly like the work of analogous foreign institutions, and a great deal of it is devoted, as in the beginning, to the study of the vast territory of Russia and of its natural resources. In its third century the Academy enters at a time when the country and the people, having gone through a war and a revolution, have re-created the government and are re-creating life itself on a new foundation, but now the Academy stands on a solid ground and directs with certainty its researches and work to the benefit of the people and of the country. The Academy numbers forty-one fellows and has several scientific institutions under its direction, a library with four and a half millions of volumes, and an archive. In addition to biological institutions, other institutions are: the physico-mathematical one, with a new Röntgen-ray equipment, and the seismological survey. The mechanical works attached to this institution are able to supply instruments for international geophysical and geodetic research. At the chemical laboratory a new section of organic chemistry was created in 1923; and a Radiological Institute was organised in 1922. The well-known Pulkova Astronomical Observatory is extending its activity to the south of Russia and will begin observations with new first-class instruments supplied this year from England. Seven Museums belong to the Academy, namely: the Geological, Botanical, Zoological, the Pushkin House, the Historical and Bibliographical Museum, the Museum of Ethnology and Anthropology, and the Asiatic Museum."

Prof. P. I. Schmidt, curator of the Zoological Museum of the Russian Academy, gave an account of the organisation of regional survey work which has recently been instituted in the Republics. In the course of his address he said: Science is universal, and being the highest achievement of mankind, is its most valuable treasure. From this point of view, science is certainly international. But there is a kind of scientific research which is of special value for a definite country; such are the branches which study the nature of a country, its flora and fauna, the history and the life of its population. To rule a country and to guide it to prosperity and economic well-being, it is absolutely necessary to know the natural resources of the country, its geographical and climatological conditions, as well as the character and abilities of its population. Research of this kind is of a special value in Russia with its numerous regions differing widely in climate and population. During the past two centuries the

Academy of Sciences has played the first and chief part in the investigations of the natural resources of Russia and in the history and the study of the present conditions of its population. The small towns of Russia were never deficient in people interested in natural science, archæology, history, ethnography. These people steadily accumulated an extensive knowledge of the different regions they inhabited. Small societies, local museums, archives, biological stations have existed for some considerable time. But they could not before the Revolution unite their forces for the purpose of collaboration. Now, on the contrary, the separate organisations are freely able to get into touch with one another.

The first call for the organisation of regional survey came from the Academy in 1921, when an All Russian Congress of the Societies for Regional Survey was brought together in Moscow. In January 1922 a Central Bureau of Regional Survey was organised at the Academy of Sciences, Leningrad, with a branch in Moscow. This Bureau collected information about already existing institutions for regional survey, brought them into connexion with each other, and supplied them with every kind of help. The Bureau also started a periodical, *Regional Survey*, and published monographs and text-books on this subject. In March 1923, some 231 societies, their branches and associated clubs, were on the list, with 285 museums, 21 biological stations, and 16 natural reserves or parks. But a good many more societies have been started since, and up to last June the number of institutions dealing with regional survey was more than 1000. A map of Russia, on which these societies are marked, represents a dense conglomeration of points.

Many of the regional survey organisations have developed out of the former scientific societies, such as those in Vologda, Kostroma, Saratoff, Tamboff, and other cities. Those societies had already recorded observation after long periods, and at present they have only enlarged their programmes and increased their activities. A great many new societies of regional survey have also been created in small towns and villages.

Museums represent the simplest and easiest way for the popularisation of scientific knowledge, and are therefore largely used for educational purposes. But members of the societies do not restrict their work to such purposes: they do their best to do some scientific research as well. They organise meteorological and biological stations, and arrange excursions and scientific expeditions on a small scale in order to study the local conditions; ethnographical, statistical, and economic research is also undertaken by them. Many of the regional survey societies pay especial attention to the history and archæology of the country; they collect antiquities and study the history of the region. Most of the societies start the publication of the results in their own separate papers, and such periodicals are often of great value and interest. Some societies publish descriptions of their regions, for example, the regional survey society in a small town Usman, of the Voronej province, has published a map of this district on the scale of 4 kilometres to an inch, with a fairly good description of the Usman district.

The following resolution was then moved by Sir Arthur Smith Woodward: "That this meeting of members and friends of the Society for Cultural Relations between the Peoples of the British Commonwealth and the Union of Socialist Soviet Republics sends cordial greetings and congratulations to scientific workers in the U.S.S.R. on the celebration of the bicentenary of the Russian Academy of Sciences, and in high appreciation of the great work by which the Academy has enriched the knowledge and culture of the world during the past two centuries, looks with confidence to the future for further contributions to promote the intellectual unity of mankind."

Sir Arthur Smith Woodward, in proposing the resolution, said he did so with special pleasure because he was an honorary member of the Russian Academy, and had profited much by the researches of some of the academicians and other Russian men of science. He had visited the seat of the Academy on three occasions under the old conditions in 1889, 1892, and 1903, and had learned to appreciate the facilities it afforded for scientific work. He made his home with Dr. Friedrich Schmidt, in whose rooms he met most of the active naturalists of St. Petersburg, as it was then termed. Dr. Schmidt himself was the leading authority on the rocks and fossils of the Silurian System, and was still more widely known by his investigation of the deposits in which the carcases of the mammoth occurred in Siberia. Inostransev, professor of geology in the university, was busy with Russian stratigraphy and petrology, and trained several brilliant students. Lahusen, of the School of Mines, produced the first Russian text-book of palæontology on modern lines. Yakovlev and Tolmachev were also beginning their valuable researches on palæozoic geology. Baron von Toll was studying the collections he had made in the New Siberian Islands, where he eventually lost his life. In 1903 Salensky had just mounted the unique mammoth from Bereskova in the Zoological Museum, and had completed the first memoir on it. Amalitzky was at work in Warsaw on the great collection of Permian reptiles which he had made on the Northern Dwina—one of the most important achievements in palæontology. Karpinsky was directing the Geological Survey of Russia, and publishing fundamental contributions to geology. He must be ranked among the foremost geologists of Europe, and, though now in his eightieth year, still retains all his enthusiasm as the honoured president of the Academy. Dr. Karpinsky is highly esteemed in England, and received the Wollaston Medal from the Geological Society of London in 1916.

Dr. T. R. Parsons, in seconding the resolution, referred to the physiological work of Pavlov and others which he had opportunities of seeing during a visit to Leningrad and Moscow a few months ago. The resolution was then put to the meeting and carried unanimously.

Cordial messages of support of the motion were received from the following among others: Prof. A. E. Boycott, Mr. Victor Branford, chairman of the Sociological Society, Sir Frank Dyson, Prof. A. S. Eddington, Prof. J. J. Findlay, Prof. J. W. Gregory, Prof. G. H. Hardy, Prof. L. T. Hobhouse, Prof. J. S. Huxley, Prof. J. N. Langley, Prof. A. D. Lindsay, Master of Balliol, Prof. C. J. Martin, Hon. Bertrand Russell, Prof. J. Y. Simpson, Prof. E. Soddy, Sir Gilbert Walker, Mr. H. G. Wells.

The Literature of Radioactivity.[1]

THE report before us of the Committee on X-Rays and Radioactivity of the National Research Council of the United States consists of a review of radioactivity and its problems as discussed in recent

[1] Bulletin of the National Research Council. Vol. 10, Part 1, No. 51: Radioactivity. Report of Committee on X-Rays and Radioactivity, National Research Council. By A. F. Kovarik and L. W. McKeehan. Pp. 203. (Washington, D.C.: National Academy of Sciences, 1925.) 2.25 dollars.

years. It is essentially a bibliography, not a developed account of the present state of knowledge in this subject.

The authors have taken as their starting point the year 1916, for in that year was published the well-known book of Meyer and von Schweidler, which contains an almost complete list of references to the earlier papers in radioactivity. The whole of the literature of radioactivity from that year until June 30, 1924, has been searched and the results recorded in this report. The limits of time have been overstepped in a few particular cases where earlier papers had been overlooked in previous works or where later papers were of special interest. Between the given limits the literature has been covered with remarkable thoroughness and very few, if any, papers have been missed. One result of this thoroughness is that many papers of doubtful interest or value are included, and that criticism and comment are reduced to a minimum. In general, the results and conclusions of an author are stated briefly and, unless the matter is of wide interest or of prime importance, comment is withheld.

The literature has been divided into seven main sections, under the following headings: the radioactive transformations, the α-, the β-, and the γ-rays, nuclear structure and radioactive processes, radioactivity in geology and cosmology, and the effects of the radiations upon matter. A concise account of each subject as it arises is given, and this is followed by reports on the papers published on the subject. A most valuable feature of the book is the collection of tables at the end of each chapter. In particular, we might mention the table of β-ray spectra and the table of γ-ray spectra deduced from β-ray spectra. One error must be pointed out. In the tables of p. 68 and p. 70, α-particles of range 3·8 cm. are attributed to radium C, on the authority of Bates and Rogers. These α-particles have never been detected. Their presence is inferred from a knowledge of the transformations, and their range has been calculated from the period of radium C, using the Geiger-Nuttall relation.

A point which may give rise to some discussion is an attempt of the authors to introduce a systematised nomenclature of the radioactive substances. The symbol they propose consists of the atomic number of the element, followed first by the chemical symbol of the principal member of its series, and then by a Roman numeral indicating the genetic order of the radio-elements, for which the first two parts of the symbol are the same. Thus the proposed symbol for uranium 1 is 92 U I; uranium X_1 will be 90 U I; and uranium 2 will be 92 U II, and so on. This system is simple and rational, and has many and obvious advantages over the names and symbols in general use. But the latter, however arbitrary they may appear, were born out of the irregular and adventurous history of the subject of radioactivity and will not lightly be put aside for any system, rational though it be.

The report contains references to about 1500 papers, nearly all of which have been published in the brief space of eight and a half years, that is, at the rate of 15 per month. These figures show the need for a bibliography such as this, and also indicate the magnitude of the task undertaken by the authors. They are to be congratulated on carrying out their arduous and difficult work in a most thorough way. The result of their labours is a book which should save a great deal of time and trouble to workers in radioactivity.

J. C.

University and Educational Intelligence.

CAMBRIDGE.—The E. G. Fearnsides Scholarship for research in the organic diseases of the nervous system has been awarded to Dr. T. K. Maclachlan, Pembroke College.

A STATISTICAL report on the universities of Canada for the year ended June 1924 has been published by the Dominion Bureau of Statistics. It gives a total of 18,026 regular students excluding those in preparatory (pre-matriculation) classes. Students of medicine numbered 2941, engineering and applied science 1949, theology 951, commerce 859, education 818, music 791, law 541, agriculture 526, household science 511. There was a very noticeable increase in the number of students pursuing "short courses," including courses organised in co-operation with the Workers' Educational Association, summer schools, and short courses in agriculture, journalism, "business," nursing, and other vocational subjects. Most of these courses were provided by the universities of Toronto, McGill, Manitoba, British Columbia, and Saskatchewan. 1862 students followed correspondence courses, provided chiefly by Queen's University, Ontario, and the universities of Toronto and Montreal. The current expenditure of all the universities amounted to nearly 1,800,000*l.*, the largest spenders being Toronto and McGill, nearly 400,000 each, Alberta 206,000*l.*, Saskatchewan 117,000*l.*, Manitoba 114,000*l.*, British Columbia 110,000*l.*, Queen's 100,000*l.* The report directs attention to the fact that in some cases denominational universities (in the province of Quebec) are subsidised by the government. Of the total income rather less than one-fifth was in the form of fees, one-sixth was from investments, and one-half from government grants.

A SURVEY of engineering education in the land-grant colleges in the United States is given in Bulletin (1925) No. 5 of the Bureau of Education. The following important changes, among others, have taken place since 1910. Nearly all of the colleges have eliminated foreign languages from the curriculum or made them elective instead of compulsory. On the other hand, greater attention is given to English and to economics and business administration; required or elective courses being included to an increasing extent in such subjects as corporate organisation and finance, business law, patent law, accounting and cost keeping, banking, and salesmanship. Courses in highway and automobile engineering have been added to the curricula in many institutions. There has been a marked tendency towards postponing specialisation; the first year, or even the first two years, being made common to all branches, and more attention being given to thorough training in fundamental subjects. Much attention has been given to the orientation of freshmen. Shop practice instruction has changed in character, the general tendency being toward the conversion of the college shops into shop laboratories for illustrating modern methods of shop production, and of factory organisation and management, rather than for the acquisition of manual skill such as is required in mechanics. There has been some extension of the "sandwich" or co-operative system, especially in electrical and chemical engineering, under which the student spends half his time in the university and half in some industrial plant. In the United States this practice was first developed systematically by the University of Cincinnati.

Societies and Academies.

CAPE TOWN.

Royal Society of South Africa, July 15.—A. J. **Hesse**: Note on South African Rhyncophora. There are 270 species of the polymorphic genus Brachycerus in South Africa. Their chief enemies are secretary birds, bustards, and aviculurid spiders. The eggs, which are rarely found, are deposited two or three at a time. Some larvæ are used as food by natives. Certain larval secretions form a native remedy for toothache. The adult insects are used by the Zulus as pendants for necklaces. Gradation of characters from species to species exists in certain groups.—F. G. **Cawston**: The molluscan hosts of South African Trematoda. Cercariæ have been isolated from at least eighteen species of fresh-water mollusca in South Africa, including the three genera of Ancylidæ.—R. F. **Lawrence**: Note on the Arachnida of South-West Africa. The relation of the Pseudoscorpions to the other groups of Arachnida was touched upon and, in illustration, a new species of Garypus from Sesfontein, South-West Africa, was exhibited. This species is exceptionally large, measuring 7 mm. in length, and is found under thin layers of weathering limestone. A new species of binocular spider, Diploglena, closely related to the genus Nops, which only occurs on the islands off the mainland of Brazil and Venezuela, is a striking example of the degeneration of the eyes owing to disuse in spiders living under stones.

PARIS.

Academy of Sciences, August 3.—Charles **Nicolle** and E. **Conseil**: The production of an experimental preventative serum for exanthematic typhus. Stages and solution of the problem. The serum obtainable from the ass, after experimental inoculation with the disease, has preventative properties, although the serum is not so rich in antibodies as the serum from human subjects recovering from the disease.—Maurice **Fréchet**: The law of errors of observation.—R. H. **Germay**: The asymptotic solutions of the equations which define implicit functions, and on the asymptotic integrals of partial differential equations.—G. W. **Ritchey**: A new method of construction of large telescope mirrors.—V. **Nechvile**: Determination of the proper motions of stars from the 5th to the 16th magnitude, photographed on the first negatives of Henry.—Y. **Rocard**: The diffusion of light in fluids. A comparison of the formulæ obtained by Vessiot-King, Ramanathan, and Gans.—M. **Auméras**: The state of hydration of calcium oxalate. Under the conditions of the experiments described the salt had the composition $CaC_2O_4 . H_2O$.—René **Girard**: The action of dilute solutions of acids on the ferrous metals.—V. **Thomas**: A new type of organo-magnesium compound. Starting with di-iodobenzene and magnesium, in addition to the formation of $C_6H_4I.MgI$, there is evidence that some $C_6H_4(MgI)_2$ is produced.—N. **Arabu**: Stratigraphic remarks on the fault of Ribeauvillé (Haut-Rhin), to the north of Strengbach.—L. **Jaloustre**, G. **Danne**, M. **Demenitroux**, and A. **Maubert**: The radioactivity of the waters of Contrexéville (Vosges): the Pavilion and Quai springs. The water from the Pavilion spring contains 0·85 millimicrocurie of emanation and not exceeding 0·5 millimicrogram of radium per litre. The Quai spring contains 2·5 millimicrocuries of emanation and 0·33 millimicrogram of radium per litre.—**Dedebant**: The isolation of the dynamic tendencies in regions with a large daily variation of pressure.—Louis **Emberger**: The chondriome in plants.—Emile **André** and Franck **Guichard**: Contribution to the study of the fats from American palms. Murumuru butter. Details of the usual physical and chemical constants are given for this fat, together with the results of methanolysis followed by fractional distillation of the methyl esters.—E. **Ivanoff**: A new mode of conservation and transmission of trypanosomes and spirochætes in the larvæ of *Galleria melonella*. The larvæ of *G. melonella* can be utilised for assuring the continuity of cultures of trypanosomes in the laboratory, and for despatching them on a journey lasting several days.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 11, No. 7, July).—Cornelia G. **Benedict**, Francis G. **Benedict**, and Eugene F. **Du Bois**: Human metabolism in an environment of heated air. Observations were made on five subjects (3 men and 2 women) placed in an air-tight bag through which a stream of heated, dry air (about 85° C.) was passed. Loss of weight was 5 to 13 times greater than normal, oxygen consumption increased slightly, while skin temperature was fairly uniform and only one degree or so above normal owing to the cooling effect of perspiration.—Herbert M. **Evans**: Invariable occurrence of male sterility with dietaries lacking fat soluble vitamin E. Progressive loss of sexual powers and interest occurs in male rats, but it can be prevented by feeding, from date of weaning, single natural foods which cure the corresponding female sterility. Male sterility is often cured by protracted administration of vitamin E in ether extract of wheat germ.—Karl E. **Mason**: A histological study of sterility in the albino rat due to a dietary deficiency. Progressive stages of degeneration of the testes were obtained. Feeding with lettuce, provided some normal seminiferous tubules remain, checks degeneration, or, if fed before it sets in, prevents it.—Walter S. **Adams**: The relativity displacement of the spectral lines in the companion of Sirius (*v.* NATURE, August 22, p. 285).—W. M. **Davis**: The basin range problem. A recent visit to the Great Basin region, which includes all Nevada and parts of Utah, Arizona, California, and Oregon, provided examples confirming Gilbert's fault-block theory of the origin of many of the ranges.—James **Kendall** and Beverly L. **Clarke**: The separation of rare earths by the ionic migration method. An agar-agar gel containing a mixture of salts of two rare earth metals is placed in a wide tube between similar gels containing a faster cation (near the cathode) and a slower cation (near the anode). On electrolysis, the two boundaries remain sharply defined, but great care is needed in preparing the gels. The cations of the rare earth mixture should have different ionic mobilities leading to their accumulation at the ends of rare earth gel section. After runs of about twenty days with a current of 0·6-0·8 amp. at 240 volts, during which the rare earth section was moved up to 400 cm., separation of an yttrium-erbium mixture was effected (99·1 per cent. yttrium) and considerable separation of neodymium-praseodymium and gadolinium-samarium mixtures.—R. H. **Fowler** and E. A. **Milne**: A note on the principle of detailed balancing. The principle of entire equilibrium announced by Prof. G. N. Lewis has been exploited extensively in physics in recent years under the name (among others) of "the principle of detailed balancing."—W. H. **Rodebush** and E. F. **Fiock**: The measurement of the absolute charge on the earth's surface. Copper quadrants are mounted on insulators just above the ground and earthed through a ballistic galvanometer. Rotating quadrants directly earthed can be superimposed, making the former quadrants virtually the

inside of a conductor. The results indicate that the ground is negatively charged (10^{-10} coulombs per square metre); day and night (or solar eclipse) cause little change, but at the beginning of a rain-storm the charge drops to zero and may become slightly positive.—Edward W. **Berry**: Fossil plants from the tertiary of Patagonia and their significance. A collection from Mirhoja, Chubut Territory, contains determinable forms which are American and show no traces of African relationships. The age of the deposit is Miocene, and all except one specimen, a grass, are dicotyledonous arborescent forms or lianas. They indicate a genial climate with abundant rain for the period.—Laurence H. **Snyder**: Human blood groups and their bearing on racial relationships.—Carl **Barus**: Inductance treated acoustically by differential telephones.—Albert **Björkeson**: X-ray radiation from hot sparks. The X-rays originate chiefly at the solid electrodes.—Edwin H. **Hall**: The four transverse effects and their relations in certain metals. Knowing the electromagnetic coefficients (Hall and Ettingshausen effects) enables qualitative calculations to be made of the thermomagnetic coefficients (Nernst and Leduc effects).—Gilbert N. **Lewis**: The distribution of energy in thermal radiation and the law of entire equilibrium. Anticipations of this law have been less general than is now claimed. Its application to radiant energy is a crucial test. It leads to an equation of the form of the Wien distribution equation, which is contradicted by experiment. The Wien equation really applies to an "ideal" radiation analogous to an "ideal" gas.—Leonard B. **Loeb**: Ionic mobilities in ether as a function of pressure. As in permanent gases, the newly formed ions have about the same mobilities, but that of the positive ion decreases in about 0·03 sec., due apparently to a change in the diameter of the ion with age.—Richard C. **Tolman**: The principle of microscopic reversibility. Lewis's "law of entire equilibrium" has been stated before under the name of "the principle of microscopic reversibility." It is regarded as "an unproved assumption."—John P. **Minton**: The dynamical function of the tympanic membrane and its associated ossicles. Two modes of action are suggested: at low frequencies, the drum vibrates as a piston and the ossicles act as multiplying levers setting up relatively large pressure changes acting on the oval window; at high frequencies, they conduct flexural vibrations of the drum to the oval window. This explains middle-ear deafness to low frequency sounds and other effects.—Linus **Pauling** and Albert **Björkeson**: A new crystal for wave-length measurements of soft X-rays. The plane 00·1 of the hexagonal crystal β-alumina (Al_2O_3) gives very strong first and second order reflections. It has the unusually large grating constant of 11·2 Å.U. and should be valuable for wave-length determinations with soft X-rays.—J. **Hadamard**: (1) On quasi-analytic functions. (2) The approximate evaluation of definite integrals. A better value is obtained by combining Simpson's value with the Euler-Maclaurin correcting terms.

Official Publications Received.

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 8: Elementary Instruction of Adults. Report of the National Illiteracy Conference Committee. Pp. v+33. 5 cents. Bulletin, 1925, No. 10: The Rural High School; its Organization and Curriculum. By Prof. Emery N. Ferriss. Pp. vi+74. 10 cents. Bulletin, 1925, No. 4: Land-Grant College Education, 1910-1920. Part 3: Agriculture. Edited by Walton C. John. Pp. v+108+8 plates. 25 cents. Bulletin, 1925, No. 5: Land-Grant College Education, 1910-1920. Part 4: Engineering and Mechanic Arts. Edited by Walton C. John. Pp. v+75+7 plates. 20 cents. (Washington: Government Printing Office.)

The Physical Society of London. Proceedings. Vol. 37, Part 5, August 15. Pp. xix+266-355. (London: Fleetway Press, Ltd.) 6s. net.

Technical College, Bradford. Diploma and Special Day Courses, Session 1925-26. Pp. 192+26 plates. (Bradford.)

Year Book of the Michigan College of Mines, 1924-1925, Houghton, Michigan. Announcement of Courses, 1925-1926. Pp. 121. (Houghton, Mich.)

Ministry of Agriculture and Fisheries. First Progress Report of the Foot-and-Mouth Disease Research Committee. Pp. 43. (London: H.M. Stationery Office.) 1s. 3d. net.

British Museum (Natural History). Precious Stones. Series No. 1, Set D3. 5 cards in colour. Series No. 2, Set D4. 5 cards in colour. Series No. 3, Set D5. 5 cards in colour. Series No. 4, Set D6. 5 cards in colour. British Flowering Plants. Series No. 7, Set F10. 5 cards in colour. Series No. 8, Set F11. 5 cards in colour. (London: British Museum (Natural History).) 1s. each set.

Journal of the Indian Institute of Science. Vol. 8A, Part 1: The Photochemical Oxidation of Aromatic Hydrocarbons, I. By J. J. Sudborough, H. E. Watson and B. T. Narayanan. Pp. 7. 8 annas. Vol. 8A, Part 2: Kachi-Grass Oil. By Bijoor Sanjiva Rao and J. J. Sudborough. Pp. 9-27. 1 rupee. Vol. 8A, Part 3: Argemone Oil. By S. Narayana Iyer, J. J. Sudborough and P. Ramaswami Ayyar. Pp. 29-38. 12 annas. Vol. 8A, Part 4: Essential Oil of *Cyperus rotundus*. By B. Sanjiva Rao, P. B. Panicker and J. J. Sudborough. Pp. 39-47. 8 annas. Vol. 8A, Part 5: Dehydration of Rectified Spirit by means of Anhydrous Calcium Chloride. By J. J. Sudborough and P. Ramaswami Ayyar. Pp. 49-54. 8 annas. Vol. 8A, Part 6: The Hydrolysis of the Amides of $\alpha\beta$=Unsaturated Acids and of their Saturated Analogues. By A. R. Yathiraja and J. J. Sudborough. Pp. 55-69. 1 rupee. Vol. 8A, Part 7: (1) Studies relating to the Acetone-producing Organisms, by Gilbert J. Fowler and V. Subramanyan; (2) Mahua Flowers as Raw Material for the Acetone-fermentation Process, by A. G. Gokhale. Pp. 71-87. 1 rupee. Vol. 8A, Part 8: Studies in Esterification. By B. V. Bhide and J. J. Sudborough. Pp. 89-127. 1.8 rupees. Vol. 8A, Part 9: Constituents of the Marking Nut, *Semecarpus anacardium*, Linn. By D. Satyanarayana Naidu. Pp. 129-141. 8 annas. Vol. 8A, Part 10: Notes on some Indian Essential Oils. By Bijoor Sanjiva Rao, J. J. Sudborough and H. E. Watson. Pp. 143-188. 2 rupees. Vol. 8A, Part 11: Bromo-Derivatives of Para-methoxycinnamic Acid. By K. V. Hariharan and J. J. Sudborough. Pp. 189-219. 1.8 rupees. (Bangalore.)

Nyasaland Protectorate: Geological Survey Department. The Physiography of the Shire Valley, Nyasaland, and its Relation to Soils, Water Supply and Transport Routes. By Dr. F. Dixey. Pp. 22. (Zomba.)

Annual Report of the Executive Council of the National Institute for the Blind for the Year ended March 31st, 1925. Pp. 78+15 plates. (London: 224-8 Great Portland Street.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1922. Pp. v+176. (London: H.M. Stationery Office.) 6s. net.

Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. Syllabus of Classes, Session 1925-1926. Pp. 113. (London.)

Department of Agriculture, Trinidad and Tobago. Administration Report of the Director of Agriculture for the Year 1924. (Council Paper No. 52 of 1925.) Pp. 26. (Trinidad.) 1s.

Battersea Polytechnic, Battersea Park Road, London, S.W.11. Calendar of Evening and Afternoon Classes for Session 1925-1926. Pp. 23. Free. Technical College for Day Students, and Day School of Art and Crafts. Calendar, Session 1925-1926. Pp. 43+10 plates. 3d. Domestic Science Training College. Session 1925-1926. Pp. 23. 6d. Department of Hygiene and Public Health. Pp. 26+4 plates. 3d. (London.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 36, Part 2, August 21st. Pp. 107-202. (London: Edward Stanford, Ltd.) 5s.

The Hundred and Third Report of the Commissioners of Crown Lands, dated 30th June 1925. Pp. 36. (London: H.M. Stationery Office.) 3s. net.

The North of Scotland College of Agriculture. Calendar, Session 1925-1926. Pp. viii+120. (Aberdeen.)

Diary of Societies.

TUESDAY, SEPTEMBER 22.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—Oliver G. Pike: Birdland Cameos.

FRIDAY, SEPTEMBER 25.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—J. Vacy Lyle: From Domesday to the "Scrap of Paper." (A look round H.M. Public Record Office.)

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Conference at Balliol College, Oxford), at 8.45.—Dr. R. S. Hutton: The Present Position with regard to the Association of Special Libraries and Information Bureaux.—A. E. Twentyman: The Classification of a Specialist Library.—Prof. F. E. Sandbach: Some Notes on the Library Co-operation Committee and its Scheme of Inter-Loaning between University Libraries.

SATURDAY, SEPTEMBER 26.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (Conference at Balliol College, Oxford), at 9.30.—Miss R. Rankin: The Special Library Movement in America.—T. Coulsen: Impressions of the 16th Annual Conference of the Special Libraries Association at Swampscott (Mass.), June 1925.—M. Otlet.—Prof. Alan Pollard: L'Institut International de Bibliographie and its Methods.—Prof. Gilbert Murray: Some Notes on the Work of the Committee on Intellectual Co-operation of the League of Nations.—At 2.30.—T. H. Burton: Abstracting.—L. S. Jast: Some Special Methods of Cataloguing Temporary Material.—H. L. Robinson: A Central Index of Technical Publications.—R. Borlase Matthews: Efficient Filing.—At 5.30.—Dr. A. E. Cowley: The Relation of the Bodleian to Special Libraries.—At 8.—H. A. Slack: The Information Work of the Daily Press.—L. Pendred: The Inquiry Service of the Technical Press.—Major W. E. Simnett: Co-ordination of Technical Intelligence.