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CONTENTS.

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Needs of Empire.

THE many recommendations submitted to and passed by the delegates of the recent Imperial Agricultural Research Conference have a familiar ring. In substance they are almost identical with those endorsed by the delegates to the Colonial Office Conference held earlier in the year, and in principle they do not differ from those which were submitted to the Imperial Conference of 1926 by the Research Sub-Committee over which Lord Balfour presided, or those contained in the Report of the Imperial Agricultural Research Committee which was published this year. Unfortunately, this Conference, like those which preceded it, has not been able to base its recommendations upon an assured income guaranteed by the Imperial Parliament or the beneficiary governments of the Empire. It has not even been definitely promised that necessary financial provision will be made for any part of the programme of activities outlined in the recommendations. The Conference had to be content with vague hints that support for various schemes of scientific research and technical development would be forthcoming from the Empire Marketing Board, the Department of Scientific and Industrial Research, and other bodies with public funds at their disposal, and the expressed hope that Dominions and other overseas governments might be found willing to contribute to a central fund.

The sub-committee of the Conference which dealt with 'Recruitment and Training' emphasised the need for the "immediate reinforcement of activity" to attract candidates of the highest class for the colonial agricultural service and to equip them with the best possible training. They are to be attracted by the "immediate betterment of emoluments, facilities for work, and superannuation arrangements." "The inducement in the form of scholarships of any kind" must be considered "wise and fair only if the service be made to provide really good careers." This sub-committee realised that persons with a distinct *flair* for research must be offered special inducements to take up duties in comparative isolation in any of the existing or proposed links in the chain of the overseas research stations. Yet in introducing the report on 'Research Stations' Major Walter Elliot suggested that £20,000 per annum was "the sort of figure which one could have in mind in considering the setting up of a station" for the running of which "something like 10 highly qualified men will be necessary as the superior staff."

It is difficult to see how really good careers are to be provided out of this estimated annual cost of running a research station, which is to include the salaries of the staff (superior and minor), equipment and materials, and presumably, travelling expenses—a considerable item. It is not without significance that this estimate passed unchallenged by any member of the Conference. Of even greater significance, perhaps, is the fact that throughout the Conference no authoritative and definite statement was made as to what scale of salary was regarded as synonymous with a really attractive career. Undoubtedly there are other important considerations to be taken into account. The intrinsic interest of the work, the facilities offered for and the degree of freedom in research, the scope given for trying-out large scale experiments, will directly influence the choice of a research worker for a particular institution. But these are the considerations which weigh with those who have already specialised in a particular branch of science. Those which usually carry most weight with headmasters who are advising boys on their choice of subjects at the universities are the material rewards offered by the careers associated with their university studies. However deplorable it may be that very few facilities exist in our boys' schools for biological training, the fact has to be faced that there is little demand from parents for such facilities, the absence of the demand being determined by the present comparative material unattractiveness of biology as a career. Once it is realised by parents and headmasters that not only are trained biologists essential for the development of certain branches of industry, but also that governments and leaders of industry are sufficiently appreciative of the need for such services to offer substantial inducements to those who can provide them, some training in biology will be provided in the schools.

This Conference was given every facility for putting the claims of scientific research before the Empire. Those responsible for the press arrangements did their work most efficiently; it is the members of the Conference who are to blame for not making better use of their opportunities for publicity, the quickest and surest way of stirring the imagination of the public. From beginning to end of the Conference no speech was delivered which dealt arrestingly with the problem of agricultural research as a whole, which attempted to place before the public even a rough estimate of the annual cost to the Empire of the neglect of research, or of the annual yields to the Empire of certain specific results obtained in agriculture through the application of research.

For example, no reference was made to the triumphs of Clouston and Howard in India in connexion with crop production, the amazing rapidity with which application followed research: no estimate was given of the value of the work of Theiler in stamping out the rinderpest in South Africa: the public was provided with no accurate information regarding the additional area placed under cultivation in the Empire as the direct results of experiments in plant acclimatisation and adaptation to soil conditions. Similarly, none of the arresting and illuminating statistics were given of the losses sustained by agriculturists through the ravages of insect pests, fungi, unsound irrigation and faulty drainage, or those due to unscientific storage, packing, and transport. Diseases afflicting domestic stock in various parts of the Empire were mentioned, but no emphasis was laid upon the financial aspects of animal disease, or the disastrous effects of cattle epidemics on the social life of the primitive peoples for whose welfare we have assumed responsibility. Again, no clear picture was drawn of the fallow but potentially crop-producing area in the Empire, the possibilities of British tropical and sub-tropical Africa as the greatest cotton-producing area in the world, of the future capacity of Canada and Australia for wheat cultivation, or of New Zealand's exceptional advantages for cattle-raising.

More serious still was the omission of detailed statistics regarding the cost to the various governments represented at the Conference of those departments dealing with the inspection and cure of ailing plants and animals. This cost was not compared with the sums made available for applied research, although it appeared to be realised that the results likely to accrue from research are incalculably greater than those from the application of empirical specifics. None of the parliamentarians present took the opportunity of bringing to the notice of the delegates or the country the sums allocated to agricultural research by the United States or by Holland.

It may be urged that information on these several points was already in possession of the delegates. Even if this were true—and it certainly is not—advantage should have been taken of a favourable occasion to place such information before that larger public which is still indifferent through ignorance to the claims of scientific research for more generous treatment. Since it was not, we can only commend to the attention of the Empire Marketing Board the possibility of

bringing some at least of this information before the public through the medium of posters. The work of Lawes and Gilbert, although the beneficence of its scope is not confined to the British Empire, places them on at least an equal footing as Empire builders with the statesmen, soldiers, and sailors whose portraits adorn our hoardings. It may be a vain assumption, but we incline to the opinion that were the facts regarding the beneficial effects of research on agriculture and industry in general better known, the public would not merely acquiesce but demand greater provision for expenditure under this head.

From many points of view, however, this Conference was a success. It brought together experts and those responsible for the administration of the agricultural services from the overseas parts of the Empire to co-operate with those who bear like responsibilities at home. Not only the overseas delegates, but also many of the home delegates, were granted exceptional facilities for making themselves acquainted at first hand with the work of the staffs at most of the important research institutions bearing on agriculture in Britain. The series of reports resulting from their joint labours are invaluable contributions to the cause of agricultural research. The principles enunciated in the report on "Recruitment and Training" are unchallengeably sound. The only pity is that no appendix was attached with information regarding existing methods of appointment and conditions of service in the various home and overseas departments of agriculture and research institutions, together with an estimate of the number of vacancies likely to occur within say the next five years.

In the report on "Tropical and Sub-Tropical Research Stations," the opinion is expressed that "the control of a station should be so vested as to ensure that the work of the institution should not be diverted from a programme of free research" and that such research should be of "long range" and "wide range" character, serving the needs of several territories, reinforcing but neither impairing nor replacing the scientific work properly undertaken by the agricultural department of any government in its vicinity. In addition to the existing stations, namely, the Imperial College of Tropical Agriculture, Trinidad, and the Amani Institute, Tanganyika—lately resuscitated—the provision of five new research stations is indicated. The Australian Commonwealth Government already has a definite plan for the establishment of a station to deal chiefly with animal husbandry, nutrition and pathology, and other stations are contemplated in Ceylon, the Federated Malay States, and an additional centre in East Africa for animal diseases research, although the report indicates that the South African Animal Research Station at Ouderstepoort must have first consideration as the primary centre for such work. This particular report concludes with a recommendation for the establishment of a central research station to investigate the subject of irrigation, including its engineering, agricultural, chemical, and physical aspects.

The third report on administrative matters deals with the establishment and development of effective clearing-houses for the interchange of information of value to research workers in agricultural science throughout the Empire. The committee recommended and the Conference agreed to the establishment of three bureaux, a Bureau of Soil Science attached to the Rothamsted Experimental Station, a Bureau of Animal Nutrition attached to the Rowett Institute, and a Bureau of Animal Pathology in London. In addition, it is proposed to set up correspondence stations, for animal genetics at Edinburgh, for agricultural parasitology at the London School of Hygiene and Tropical Medicine, for plant genetics at Cambridge and Aberystwyth, and for fruit production at the East Malling Research Station. It is estimated that the three bureaux will cost £13,000 per annum, and the four correspondence centres £7000 per annum.

These last recommendations stirred Sir Daniel Hall to the observation, "I grudge every penny of research money which is diverted to the administrator, to the editor, to the indexer, and people of that type. . . . £20,000 a year represents an estimated cost on an Empire Research Station of the first order." His objection was overruled, both by administrators and research workers. But the principle underlying his objection is sound. It is not more administrators of research that are wanted, but more research workers, and although the sum of money involved may seem an insignificant item of expenditure spread over the budgets of the Empire governments, it assumes significant proportions in relation to the expenditure of these governments on true agricultural research. We can only suggest that the research workers themselves give their serious attention to the diversion of their energies on matters of administrative routine having little bearing on high policy, and be ready to present a working plan of their own for the interrelation of their activities to the next Conference, which is to assemble in Australia in five years' time.

Teaching and Research in Organic Chemistry.

Recent Advances in Organic Chemistry. By Prof. Alfred W. Stewart. Fifth edition. Vol. 1. Pp. xiv + 387. 21*s*. net. Vol. 2. Pp. xiv + 382. 21*s*. net. (London: Longmans, Green and Co., Ltd., 1927.)

THE new edition of Prof. Stewart's account of recent advances in organic chemistry conveys an immediate impression of the immense current activity in this field, since the author has now found it necessary to expand the work from one volume to two. The rising tide of research papers in chemistry, and particularly in organic chemistry, has, indeed, become something of an embarrassment during the last few years. Despite the introduction of a rigorous scrutiny of contributions, the publication committees of chemical periodicals find difficulty in compressing the material submitted within reasonable limits; librarians are becoming concerned at the increasing demands which are being made upon their housing accommodation; and last, but not least, individual members of chemical societies view with pardonable disquietude their unenviable duty of making pecuniary provision for the printing of a vast output of literature, which for the most part is so highly specialised as to carry little general appeal.

Notwithstanding this state of affairs, few chemists will welcome the recent suggestion to observe a ten years' armistice in research. Moreover, although many may be able to accept in its literal sense Prof. Stewart's opinion that if seventy per. cent. of the known organic compounds had never been synthesised, we should not miss them, few will regard the task of preparing them as a work of supererogation. Cannot that somewhat pathetic array of 'still-born organic compounds'—the epitaphs of which, according to our author, are inscribed in Beilstein's truly monumental "Handbuch"—be regarded more hopefully as by-products in the acquirement of experience in research?

Formerly, it was lamented that so little chemical research was being conducted in Great Britain. During the last few years, however, there has been a growing demand in the British chemical industry for chemists with a postgraduate experience of research and this demand is being fulfilled. Whether suitable candidates for such appointments have gained the Ph.D. degree or not, it may be admitted that each one of them in a sense "represents so many new compounds," and thus contributes to the "enormous flood of synthetic material" for which Prof. Stewart holds the German university and factory system ultimately responsible. Granted that a supply of properly qualified candidates for industrial posts has been achieved at the cost of several thousands of new but relatively unimportant compounds, we shall scarcely hesitate to pay in full this price of admiralty, although we may regret the necessity of supplementing it by some £125 for the new 18-volume edition of the monumental Beilstein. After all, it falls only to a Lavoisier to achieve originality in chemical science, and yet to discover "no new body, no new property, no natural phenomenon previously unknown."

A work of the nature and scope of Prof. Stewart's book must inevitably raise many interesting problems concerning teaching and investigation in organic chemistry at the present time. One of the most important of these considerations is the trend of contemporary research. It is striking that the old lament over the neglect of organic chemical research should have been succeeded within the space of a few years by a growing criticism of the alleged tendency towards over-indulgence in formal and comparatively barren investigations, which, in Prof. Stewart's words, do not "lead to a fresh avatar of the subject." This state of affairs is attributed in part by Prof. Stewart to a transference of the more original minds from organic chemistry, which, on the theoretical side, "is apparently resting on a dead centre of perfection," to the more mobile and spectacular fields of inorganic chemistry and radioactivity. Is it not due also in part to the nature of the Ph.D. system, which accounts largely, although by no means wholly, for the greatly increased output of research in recent years?

The Ph.D. degree is granted for organised research under supervision, and is the hall-mark of the potential rather than the mature research worker. The provision of appropriate subjects for research, which shall yield results suitable for publication within a limited time, is often a matter of considerable difficulty; and there is little doubt that much of the formal work appearing in the current journals is an outcome of conditions which often compel an aspiring junior investigator to play for safety. Adjudicators of Ph.D. theses would do well to consider to what extent a bold conception, backed by competent practical work, may be allowed to weigh against a succession of negative results: a sympathetic handling of such cases would do much to lessen the formality of

research work conducted under the ægis of the Ph.D. system.

Prof. Stewart does not despair of the future of organic chemistry. Like many of his contemporaries, he foresees the acquirement of renewed inspiration and vigour from a return to the study of compounds produced by natural methods in plants and animals. There is, indeed, much to be said in favour of an increasing diversion of the activities of organic chemists to investigations dealing with the manifold chemical problems presented by living matter.

"For example, nine-tenths at least of our laboratory reactions lie outside the temperature-limits under which the plants and the animals exist, yet plants and animals succeed in producing quite considerable yields of certain materials which we can obtain in the laboratory only with some difficulty. It seems not impossible that a study of reactions which can take place at ordinary temperatures and in the absence of violent reagents, might open up an entirely fresh line of development in organic chemistry. Our increased modern knowledge of catalysts and their action makes this field much more promising than it once was; and the possibilities involved in the use of colloidal reagents need only be mentioned in order to suggest lines of investigation which could hardly prove unfruitful. There is one obvious advantage which would be conferred by a return to Nature such as is here suggested. Research of this kind would clearly centre round the very simplest of our known reactions—the addition or removal of the elements of water: for these two processes evidently play a prominent if not a predominant part in the natural syntheses. Thus some incentive would be given to a study of the mechanism of our simplest chemical changes, a subject which would certainly repay a good deal of investigation."

It is nowadays a generally accepted dictum that vitality in teaching is dependent upon a correlated appreciation of contemporary research. In organic chemistry, the delicate equilibrium which exists between teaching and research has been disturbed in recent years by several influences, and not least by the remarkable growth of the subject. It is no longer possible to offer a fairly complete conspectus of this branch of chemistry to the advanced student. Excessive teaching, like excessive formalism in research, inculcates the spirit of Beilstein and represses that inborn spirit of adventure which is as essential in the scientific investigator as in the Arctic explorer. Wherefore, the wise teacher selects certain fields of work for special treatment, fixes a judicious limit to the number of his lectures and to the amount of information which he strives to impart, and gives discreet indications of subjects suitable for independent reading and study. Such a teacher will approve of the plan of Prof. Stewart's work, the general character of which will already be familiar to him.

The first volume of the new edition contains a treatment, designed for third-year students, of a series of themes which the author regards as a convenient basis for discussing the recent investigations presented in the second volume. These themes are not necessarily concerned with recent work; for example, the development of the chemistry of the menthones and other monocyclic camphors has not been traced much beyond 1907. The second volume, to which the title is more particularly applicable, will be appreciated by honours students and research workers who seek compact and up-to-date accounts of carbohydrates, sesquiterpenes, alkaloids, anthocyanins, chlorophyll, depsides, organo-alkali compounds, abnormal valency, theories of the natural syntheses of vital products, and applications of electronics to organic chemistry. The selection of themes for a work of this kind must obviously be determined to a large extent by the particular interests and predilections of the writer; the general tenor of the author's introductory remarks, however, would seem to call, *inter alia*, for a consideration of recent work on hormones and on the application of catalytic methods in the production of simple organic compounds. The fruitful field of modern organic chemistry has been harvested by a multitude of labourers; much of the grain necessarily remains in ear, but upon his thrashing-floor of 769 pages Prof. Stewart has rendered yeoman service in purging a good deal of it from the superabundant chaff.

JOHN READ.

Structure of Tropical Cyclones.

Tropical Cyclones. By Dr. Isaac Monroe Cline. Pp. 301. (New York: The Macmillan Co., 1926.) 21*s.* net.

BEFORE we can explain the origin and life cycle of a tropical cyclone, it is essential that we should have accurate pictures of the air motion at all levels throughout the storm. Dr. I. M. Cline, of the U.S.A. Weather Bureau, endeavours in the work before us to give such a picture for all tropical cyclones that have moved in over the Gulf of Mexico and South Atlantic regions during the twenty-five years 1900–24.

The number of observing stations falling within the storm area was always small, but, with hourly readings of the ordinary meteorological instruments

available, each was made to furnish the equivalent of a number of simultaneous scattered observations, by plotting the hourly readings on a single diagram of the cyclone divided into four quadrants. These quadrants were fixed with reference to the instantaneous movement of the cyclone and not according to the points of the compass: thus the two front quadrants lay on either side of the line of instantaneous motion and were separated from the rear quadrants by a line drawn perpendicular to the line of instantaneous motion. With such an arrangement the observations from each station when plotted form a chain running across two or even three quadrants of the cyclone.

The distribution of surface winds, of upper winds deduced from the motion of clouds, and of rainfall, was obtained with a reasonable amount of detail for sixteen storms; and the diagrams, constructed in the manner just described, themselves suggested an appropriate grouping as follows:

I. Large cyclones (diameter more than 450 miles) that continued to advance after moving inland.

II. Small cyclones (diameter 300-450 miles) that continued to advance after moving inland.

III. Small cyclones which did not continue to advance after moving inland.

The observations from all the cyclones in each of these groups were plotted as though they had been made in a single storm. In this way three composite cyclones, representative of the three groups, were sketched in great detail. Justification for the method adopted for plotting the hourly observations was then apparent, for where the chains of observations for two different cyclones crossed, the wind directions nearly always agreed well. It seems scarcely possible to improve upon this method of making the most of a limited number of observing stations, and no other part of the world liable to tropical cyclones can at present supply a closer network of well-equipped observing stations near sea-level. The value of the work is greatly enhanced by the publication in full of all the hourly observations.

We may now consider the diagram representing the winds and rainfall in cyclones of Class I. The wind system here depicted differs greatly from the symmetrical whirl around the small central eye of light winds and lowest barometric pressure that one is led to expect from general descriptions of the tropical cyclone. It is only in the two left-hand quadrants, where on the average the winds outside the 'eye' are least strong, that such motion is found: a large part of the front right quadrant contains winds flowing in towards the centre, while in the right rear quadrant the motion is almost entirely parallel to the direction of motion of the centre. A considerable amount of convergence results from these last two currents, a little in advance of the line separating the two quadrants, and the distribution of hourly rainfall shows a maximum hereabouts, with a general absence of rain in both rear quadrants. It appears as though the right rear quadrant contains a current of air which, ascending and turning to the left, condenses its moisture so as to supply most of the rainfall in the cyclone.

In the case of the small travelling cyclones (Class II.) the above general description applies equally well: the similarity between the wind systems and the position of the region of maximum rainfall is striking and suggests that the observational material used has been sufficiently accurate and abundant to reveal for the first time essential features of tropical cyclones—at least of those passing through this region along normal paths.

Turning now to cyclones of Class III., that is to say, those which failed to pass on inland, the distinctive features of the winds in the two right-hand quadrants are no longer evident, and the cyclone as a whole has much more the character of a circular eddy. At the same time the precipitation is no longer localised, the amount in the rear half being at least equal to that which occurs in the front half. These storms were found to die out before long, or to move away as very weak, ill-defined disturbances. The winds considered so far have been those observed at the surface, and those deduced from the motion of clouds of low and moderate elevation; the convergence between the winds in the right sectors that is so marked at the surface appears to diminish at higher levels, a fact which is in accordance with the suggestion made above that the winds that enter the right rear sector and supply the bulk of the precipitation turn to the left as they ascend above the opposing barrier of the winds of the right front sector. The wind at the height of the cirrus clouds (about six miles), so far as may be judged from the scanty observations of the motion of these clouds available, has little or no relationship with the winds in the lower layers, and shows little regularity. It appears that the direction of motion is often about the same as that of the cyclonic centre in the large travelling cyclones, whereas in the smaller travelling storms it is generally across the cyclone from

left to right. For those cyclones which ceased to advance, left to right movements also predominated; the number of cases where the motion had a component opposite to that of the centre was greater than for the other two classes of cyclone.

There is little to add to the above summary, which includes the most striking features of the storms revealed by this new method of analysis. It must be remembered that the results obtained do not necessarily apply to the cyclones of other tropical regions, or to the earlier stages of the same storms. It may be assumed that those considered here had nearly all been in existence for several days; they were as a rule approaching the time of their recurve out of the tropical belt of easterly winds into the westerly winds of temperate latitudes. One would like very much to know the origin of the air that enters the system through the right rear quadrant, but since this would normally arrive from some point between east and south, *i.e.* from the open sea, the construction of trajectories can scarcely be possible, owing to paucity of observations. The author was unable to find in the surface temperature records any traces of discontinuity between the converging wind currents, but since both supplies of air must generally have been over warm ocean for many days, this does not prove that they were not in reality of widely different origin when traced sufficiently far back.

In conclusion, it may be said that although an explanation is still wanting of the precise mode of origin of tropical cyclones, a notable step forward has been made. Dr. Cline is to be congratulated on having produced a collection of facts which must prove indispensable to anyone seeking to provide such an explanation. E. V. NEWNHAM.

Psychology of Mental Imagery.

Les visions du demi-sommeil (hallucinations hypnagogiques). Par Dr. Eug.-Bernard Leroy. (Bibliothèque de philosophie contemporaine.) Pp. xv + 132. (Paris: Félix Alcan, 1926.) 12 francs.

THIS is a small book, but an important contribution to the study of mental imagery in general, and in particular of that kind of imagery which is experienced in the hypnagogic state. Many people, just before falling asleep, or waking fully from sleep, pass through a stage in which they have visual (and sometimes other) imagery of a very striking kind. The fact has been known and reported upon in psychological literature for something more than a century; but the interesting problems to which it gives rise have for the most part been cursorily and not very satisfactorily dealt with. Dr. Leroy limits himself to a psychological treatment of his subject, and puts his book before the public as a contribution to the psychology of hallucinations and dreams. For the physiological and pathological aspects of hypnagogic imagery he believes that methodical experimental work is still greatly needed; but in the present investigation he relies mainly upon his own experiences and those of persons whose sincerity he is able personally to guarantee.

In a very careful and detailed description of 'hypnagogic visions,' for which he has drawn upon the available literature as well as cited a number of original accounts, Dr. Leroy passes in review and compares with them after-images, phosphenes, entoptic glow (*Eigenlicht*), and the like. He then turns, in a second chapter, to an examination of the conditions of emergence of these images. This chapter is closely reasoned and particularly well documented. It leads to the important conclusions that such images are frequently hindrances to thought (which may go on in this transition stage between sleeping and waking), and that an appeal to the unconscious to explain their occurrence is "to invoke the *deus ex machina* of embarrassed psychologists." Psychoanalysts will scarcely agree with this opinion; and, indeed, Dr. Leroy omits altogether any consideration of psychoanalytic doctrine from his work.

Chapter iii. is concerned with the interpretation of hypnagogic imagery, which is here compared with normal memory imagery, the eidetic imagery reported by Jaensch, hallucinatory imagery and illusions. The characteristic most insisted upon is the involuntary nature of the hypnagogic images. The will can only influence them indirectly; and they require for their development a certain degree of psychic automatism.

In the final chapter, hypnagogic images are compared with those of the dream; and the transition from the half-waking state to that of sleep is discussed. The images are spectacles at which we passively assist; the dream is an adventure in which we take part.

Over and above the interest attaching directly to these different kinds of images in themselves, there is the greater interest in the different mental states which give rise to them. In theory and in practice the question is one which concerns both pure psychologists and psychotherapists; and Dr. Leroy's book will be read by both with profit.

Savoyard Highlands.

Rambles in High Savoy. By François Gos. Translated by Frank Kemp. Pp. 169. (London: Longmans, Green and Co., Ltd., 1927.) 21*s.* net.

THIS is a beautiful book, the sepia illustrations alone giving it a delightful character. They are reproductions of photographs, not by the author but by well-known Alpine photographers, including his celebrated father, Émile Gos. There are two prefaces by climbing friends, Mr. Geoffrey Winthrop Young and M. F. Regaut, president of the French Alpine Club, who was also the commander of the Alpine Corps, the famous 'Diables Bleus,' in the War. It may be that many would prefer a simple preface by the author himself, but that feeling is tempered by the pleasure which anything written by Mr. Young on his favourite subject must convey, and by the fact that the camaraderie of the War, in which the author served in the Alpine Corps under M. Regaut, has evoked highly interesting reminiscences of the great struggle from the latter in the course of his preface.

As its title implies, climbing in the chain of Mont Blanc is not the main subject of the book; it is more a description of walks and minor climbs in the foothills of that great chain, week-end rambles among them, from Geneva as base of operations. For anyone living at Geneva, or paying long visits to that delightful city, it is indeed ideal. For, as Mr. Young so admirably says, "We cannot think of Savoy as only glacial peaks and passes, nor as . . . alps of summer flowers, nor yet only as romantic villages bright with festal costumes and musical voices. We think of it in single pictures which combine all three simultaneously."

How delightful many of these rambles can be! For they usually culminate in the arrival at the top of some eminence such as the Salève, the Môle, the Brezon, the Aravis, or the Col d'Anterne, from all or any of which we see, growing in immensity and wonder and clearness of detail as we approach the closer, the whole or greater part of the great chain of the most beautiful snow mountains in the world, culminating in the exquisite white dome of Mont Blanc itself, the highest peak of the European Alps, 15,782 feet above the sea. M. Gos writes in a very entertaining manner, and has given us a volume which it will ever be a pleasure to open. Moreover, the author has not suffered from his translator, who has maintained the author's own atmosphere quite remarkably well, and happily gives us the numerous poetic quotations in the original French.

A. E. H. TUTTON.

Our Bookshelf.

Economic Biology for Students of Social Science. By Dr. Philippa C. Esdaile. Part 1: *Harmful and Useful Animals.* Pp. xv+175. (London: University of London Press, Ltd., 1927.) 7*s.* 6*d.* net.

THE author rather seeks to disarm criticism by stating in the preface that much ground was of necessity left untouched, and that the critic who cavils at this restriction must be even more ambitious than herself! It is not so much the ground which has not been covered, but the whole point of view from which the book is written which calls for criticism. It deals briefly with the structure and life histories of those animal types which students of biology are required to study during their course in social and household science at King's College for Women. There are already a number of text-books of zoology which do the same sort of thing, and since this is a specialised course, which has special reference to social science and applied biology, it surely would have enhanced the value of this book if those applied aspects had been dealt with in detail, and the student referred to one of the general text-books for structure and anatomy.

Such important questions as the control of venereal disease, treatment of children for infection with Nemathelminthes and Platyhelminthes, and the ridding of houses of insect pests, etc., are not described with any practical detail, and for the average student who does not know where to look for further information, and has little or no general scientific knowledge, the treatment of the subject is too scanty. One feels that a valuable opportunity has been lost of producing a book which might have opened the eyes of social workers, and incidentally of a large section of the general public, to the importance of applied biology. Much might have been done through a text-book for special courses, and by helping the students by a carefully chosen range of reading, but there is not even a bibliography appended. H. E. B.

Theory of Machines: a Textbook covering the Syllabuses of the B.Sc. (Eng.), A.M.Inst.C.E., and A.M.I.Mech.E. Examinations in this Subject. By Louis Toft and A. T. J. Kersey. (Engineering Degree Series.) Pp. ix+408. (London: Sir Isaac Pitman and Sons, Ltd., 1927.) 12*s.* 6*d.* net.

ALTHOUGH written primarily as a text-book for students reading for an engineering degree, this volume should prove equally useful to engineering draughtsmen and designers as a reference handbook spanning the gulf which is still sometimes thought to exist between scientific principles and workshop practice. In the first four chapters the authors lay a sound theoretical foundation, and treat such matters as the laws of dynamics and simple harmonic motion with skill and clearness. Their experience as teachers has taught them where the beginner's difficulties generally lie. The rest of the book is concerned with the application of fundamental principles to actual mechanisms in everyday

use, from the simple crank and connecting rod to the gear box and Ackerman steering of a motor-car.

On the whole, the ground is well covered, but it is suggested that future editions might contain paragraphs on the reactions exerted by oscillating bodies at their supports; on the properties of the centre of percussion and on the theory of the hammer and pile driver. The theories of toothed gearing and of machine balancing are adequately treated, and the chapter on friction and lubrication, including a discussion of the Michell and ball bearings, is up-to-date.

The book is illustrated with a large number of clear diagrams, while each chapter concludes with a good selection of examples from examination papers and other sources. An appendix on units and dimensions is seriously marred by the astonishing definition of the engineers' unit of mass as the ratio of the weight in pounds of a body to its acceleration in feet per second per second when falling freely; which ratio is stated to be constant.

A. L. RAWLINGS.

Medical Views on Birth Control. By Dr. H. Crichton-Miller, Prof. Leonard Hill, Dame Mary Scharlieb, Dr. Arthur E. Giles, Dr. R. C. Buist, Dr. Letitia D. Fairfield, Sir Arthur Newsholme, Sir John Robertson. With an Introduction by Sir Thomas Horder. Edited by Sir James Marchant. Pp. xx + 175. (London: Martin Hopkinson and Co., Ltd., 1926.) 6*s*. net.

THIS book consists of a number of essays by prominent members of the medical profession, with an introduction by Sir Thomas Horder. The latter rightly warns his readers against expecting to find a complete solution to all the problems that have to be considered in association with contraception. The spirit of scientific inquiry has guided the authors, and when personal views are indicated it is quite evident that there is by no means unanimity of opinion. In general, it is recognised that contraception is justified in some circumstances, though one contributor is uncompromisingly antagonistic. To those who seek medical advice on the subject, the question will be a personal one; the general practitioner will therefore find of most interest the chapters on the medical and psychological aspects. The physician has to remember that if he is ever to advise limitation of the family, he must also be prepared to advise a method. Abstinence cannot honestly be recommended, except under conditions which are prohibitive for the average married man and woman. The practitioner will find guidance in the comments and criticisms of other methods given by various contributors.

Standard Methods of the Division of Laboratories and Research of the New York State Department of Health. By Dr. Augustus B. Wadsworth. Pp. xx + 704 + 12 plates. (London: Baillière, Tindall and Cox, 1927.) 34*s*. net.

THIS book is devoted to a detailed account of the methods used by the division of Laboratories and Research at the Department of Health for the State of New York, situated at Albany, with a branch in New York City and numerous associated laboratories throughout the State. General bacteriological technique, preparation of media and glassware, and diagnosis, for the greater part bacteriological, are fully described, and a large section (326 pp.) is given up to the preparation of vaccines and sera. A chapter deals with sanitary chemistry, and at the close of the book a brief account is given of the general organisation of the institute.

It is, altogether, a very interesting book and should prove a useful reference to those engaged in public health laboratory work and the manufacture of biological products. One is left with an impression that the institution concerned has developed a high degree of efficiency in routine work, a fact which tends toward making the presentation of the work outlined a little stereotyped.

The Prospective Development of Peru as a Sheep-breeding and Wool-growing Country. By Prof. Alfred F. Barker. Pp. xii + 174 + 8 plates. (Leeds: The Author, The University, 1927.) n.p.

PROF. BARKER, at the request of the Peruvian Government, went to Peru in 1926 to study the development of Peruvian flocks and of Peru as a wool-growing country. The present illustrated volume is the report of that visit, with a number of valuable appendices on different aspects of wool. The wool production of the Peruvian tablelands in the high Andes is steadily growing and the number of sheep has doubled in five years. Peruvian wool has many good qualities, and it loses little in scouring because of the cleanliness of the pastures, but the fleece is very light compared with Chilean, Argentine, and Australian fleeces. Prof. Barker discusses the cross-breeding and selection necessary for increase in the weight of the fleeces, and incidentally he points out that the problems involved in these researches make them a valuable field of study in genetics that should appeal to every university. The report is beautifully illustrated, with some of the plates in colour.

The Psychology of Childhood: Normal and Abnormal. By Dame Mary Scharlieb. Pp. xi + 194. (London: Constable and Co., Ltd., 1927.) 6*s*. net.

THIS little book is by an authority competent to instruct as well as to advise respecting the practical and non-theoretical relationships which should exist between parent and child. Dame Mary Scharlieb with correct intuition speaks of the great burden, yet great honour, of bringing up children, and the necessity of guidance. Parents of all classes will find her conclusions of real help in child-management. Happily, the outlook is not that which prevailed during the War. Those qualified to judge found that the young suffered much from their mothers' privations and anxieties. Children knew neither legend nor fairy-tale. There is a prefatory note by Mr. R. F. Graham-Campbell, a London magistrate, who sees much to commend in a chapter which deals with the action of conscience, the influence of suggestion, and of equable discipline upon juvenile delinquents.

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.*]

Cranial Characteristics of Gorillas and Chimpanzees.

IN NATURE of Feb. 7, 1925, p. 195, Prof. Raymond Dart announced the discovery of a fossil skull of a young anthropoid ape which had been found in a lime-stone quarry at Taungs, Bechuanaland. This discovery brought to light an extinct kind of great anthropoid, which differed from the three living genera —the gorilla, chimpanzee, and orang—in having a long or dolichocephalic skull. After having read Prof. Dart's account, Prof. L. Bolk, of Amsterdam, drew attention to the skull of a gorilla in his collection which was quite as dolichocephalic as the Taungs skull (*Kon. Akad. van Wetensch. Amsterdam*, 1925, vol. 28, No. 2, p. 1). In the same year, Prof. Wingate Todd, of the Western Reserve University, Cleveland, Ohio, informed me that the accepted idea of round-headedness or brachycephaly prevailing amongst gorillas was wrong, several skulls in his collection being dolichocephalic.

In 1926, Dr. H. A. Harris, of University College, London, examined Lord Rothschild's collection of gorilla skulls, 49 in number, and found that when the shape of the cranial cavity was determined by an exact radiographic method, the head form of the gorilla was highly variable—running from a low dolichocephaly to a high brachycephaly (*Amer. Jour. Physic. Anthrop.*, vol. 9, p. 157; 1926). The width of the cranial cavity, he found, might be as low as 72 per cent. of the length, or it might be as high as 86·8 per cent., the mean width of all 49 specimens being 79·1 per cent., the intrinsic skull form of the gorilla lying therefore in the upper register of mesocephaly. Thus in the gorilla, which the majority of authorities regard as manifesting a greater structural resemblance to man than any other living form, there is found as wide a range of cranial proportions as is found in any mixed group of human skulls.

As Lord Rothschild's skulls came from widely separated districts, it was possible that the high degree of variability was due to a mixture of local breeds or races. A collection of gorilla skulls, 42 in number, which my friend Dr. N. A. Dyce Sharp has presented to the Museum of the Royal College of Surgeons, shows this is not the case ;[1] all the skulls come from one locality, where there can be no question of mixture of races, and the variation in them is just as great as that found by Dr. Harris in Lord Rothschild's collection.

Dr. Sharp was stationed as medical officer in the Ossidinge division of the British Cameroon. In the forest upland of the northern part of this division is found the ultimate distribution of the gorilla towards the west of Africa; Dr. Sharp believes that the habitat of the gorilla extends only a very short distance beyond the Eastern Nigerian frontier. The native villagers of this area hunt and eat both the gorilla and chimpanzee, the gorilla being the more highly esteemed as food. After a village feast the skulls are thrown aside, and it was from the remains of such feasts that Dr. Sharp gathered his specimens. Unfortunately, brains are also valued, and hence some of the skulls were not so intact in the occiput as a craniologist could desire. Five years ago, Mr. F. W. H. Migeod visited the same area of the Ossidinge district and succeeded in obtaining five skulls of gorillas, which he presented to the Museum of the Royal College of Surgeons, so that I have at my disposal 47 gorilla skulls from the same area on which to determine the variability in size and shape of the skull. The specimens represent both sexes and all ages, from the full eruption of the first permanent molar teeth upwards. The dimensions of the cranial cavity were taken by direct measurements. Dr. Sharp also presented 20 chimpanzee skulls from the same district. They show a much higher degree of uniformity than the gorilla skulls.

[1] Dr. Sharp's collection was exhibited at a meeting of the Zoological Society on Nov. 15, 1927.

In 23 skulls of male gorillas from Ossidinge the mean length of the cranial cavity was 121·6 mm., the mean width, 95·8 mm., the width being thus 78·8 per cent. of the length, but there was a range from 72 per cent. to 88 per cent.—from pronounced dolichocephaly to ultrabrachycephaly. The mean cubic capacity of 17 skulls of adult males was 503 cm.^{3}, varying from 355 cm.^{3} to 620 cm.^{3}. In a local group of gorilla the brain varies in mass just as much relatively as among members of any human community. In 24 skulls of female gorillas from Ossidinge the mean length of the cranial cavity was 112·2 mm., and the mean width 91·3 mm., the width being 81·3 per cent. of the length, but this figure fell as low as 72 per cent. and rose as high as 87 per cent. As in human skulls, that of the female is the rounder or more brachycephalic. The capacity of the female skull is much smaller than that of the male—to a greater degree than is the case when human skulls are measured. The mean capacity of the adult female skulls (19 in number) was 425·8 cm.^{3}, varying from 370 cm.^{3} to 530 cm.^{3}. The sexual differentiation is more pronounced among gorillas than in any other group of higher primates.

The degree of variability in gorilla skulls is even more pronounced when external measurements are taken in a manner which gives dimensions comparable with the length and width as usually taken on human skulls. The external length varied, in male skulls, from 113 mm. to 155 mm., the mean being 138·3 mm., while the mean width fluctuated between 92 and 101 mm., the mean being 97·2 mm. The width thus varied from 60 per cent. of the length to 79·8 per cent., the mean cephalic index being 66. In female skulls the mean width was 68·6 per cent. of the mean length, the proportion varying from 61·7 to 80·6 per cent. There is even a greater variability in the form of the face of the gorilla. In the Ossidinge breed it varies from being short and wide to long and narrow—a variation of a similar kind being also noticeable in all human communities. The Kivu gorilla, which represents the most eastern distribution of the genus, shows the same variability in form of face.

It is interesting to compare measurements taken on Dr. Sharp's collection of chimpanzee skulls with those taken on gorillas from the same district. In 10 male chimpanzee skulls the cranial capacity varied from 325 cm.^{3} to 430 cm.^{3}, the mean being 368 cm.^{3}. The range was thus 105 cm.^{3} compared with 265 cm.^{3} in the male gorilla skulls. In female chimpanzee skulls the capacity varied from 330 cm.^{3} to 395 cm.^{3}, the mean being 358 cm.^{3}, and the range 65 cm.^{3}, compared with 160 cm.^{3} in the corresponding group of gorilla skulls. The mean difference between the capacity of male and female chimpanzee was only 10 cm.^{3}, the sexual difference among gorillas being 76 cm.^{3}. The length of the cranial cavity in 10 male chimpanzee skulls varied from 98 mm. to 108 mm., the mean being 105·7 mm., while the width fluctuated between 86 mm. and 92 mm., the mean being 89·3 mm. The mean proportion of width to length was 84·5 per

cent., the chimpanzee being thus markedly brachycephalic. The index or proportion varied from 79·6 to 90·1, a range of 10·5 units, as compared with 16·1 units—the range of variation in the skulls of male gorillas. If external measurements are compared, the skull of the male chimpanzee has a width which is 75 per cent. of the length, but it may fall to 71 or rise to 78 per cent. In female chimpanzee skulls the internal length varies from 98 mm. to 114 mm., and the width from 86 mm. to 93 mm., the mean length being 105·5 mm., the mean width, 88·8 mm. The mean width is thus 84·1 per cent. of the mean length, but the proportion varies from 78·9 to 91·8 per cent. Thus there is no significant difference between the form of the cranial cavity of the male and female chimpanzee, whereas in gorillas the difference is of a decided character.

One other point relating to the differentiation of species amongst gorillas and chimpanzees may be mentioned here. Lord Rothschild has directed attention to the external characters which distinguish gorillas of one district from those belonging to other districts. There should be no hesitation in distinguishing a gorilla of the western frontiers of Uganda from one native to the eastern frontier of Nigeria, but when I have sought in skulls for recognition marks, I have hitherto failed to find any certain distinctive and constant mark. It is quite true that it is possible, in a certain proportion of cases, to distinguish the skull of a Kivu gorilla from those from other districts, but for one which can be picked out from a miscellaneous group there are four which cannot be identified, except by their labels. I am sure Lord Rothschild is right in dividing both gorillas and chimpanzees into local races or subspecies, but the degree of differentiation has not yet affected the cranial or dental characters to a degree which permits the racial identification of the majority of individuals.

ARTHUR KEITH.

Royal College of Surgeons,
London, W.C.2, Dec. 5.

Consistent Dynamical Units in Solar Radiation.

SIR NAPIER SHAW—*facile princeps*, in the group of disheartened but persistent advocates of reform in our heterogeneous units of weight and measurement—proposes in volume 1 of his "Manual of Meteorology" a consistent dynamical unit based upon the C.G.S. system for records of solar (likewise terrestrial) radiation. The unit he suggests is the kilowatt per square dekametre per minute, that is, 0·0143 of a gram calorie per square centimetre per minute. It will perhaps be granted even by those who favour the retention of the calorie that the minute is not a desirable interval; and that it will be better to use the hour. Thus we are in agreement with electrical measurements of light and power. A gram calorie being approximately 4·183 joules, it will require 860,300 calories to equal 1 kilowatt hour.

This unit equals 3411 British Thermal Units, and it is worth noting that there is constant liability to confusion here with British Trade Units. Some teachers still prefer to express work in foot-pounds, and energy output in horse-power, but even these must grant that the horse is fast disappearing from highways and is even replaced on farms by tractors. Hence in a few years this unit h.p. (0·746 kilowatt) will go the way of barley corns, once sub-multiples of the inch.

It would seem to those desiring simpler fundamental units that Sir Napier Shaw has a strong case when he says that the gram calorie per square centimetre per minute "is only tolerable when radiation measurements are regarded as belonging to a separate physical compartment and the transformations of energy in the atmosphere which are the natural results of radiation are ignored, although the comprehension of those transformations is the very purpose of the measurement of solar and terrestrial radiation so far as meteorology is concerned."

The use of the new unit has been opposed on two grounds; namely, (1) that uniformity is desired; and (2) that future measurements may be easily compared with older results.

It will appear below that uniformity is best secured by a unit which is not confined to heat capacity alone. As for the second objection, this would be a case of bringing the colours back to the regiment instead of bringing the regiment up to the colours. The old values are easily read, remembering that one calorie per square centimetre per minute equals 1·161 kilowatt hours per square dekametre. (The square dekametre is 1076 square feet.)

A good start in the use of the new units has been made by Dr. H. H. Kimball (*Monthly Weather Review*, April 1927, p. 157), who has assembled values for different observatories. As the table may not be generally known, it is here reproduced.

AVERAGE ANNUAL AMOUNT OF SOLAR ENERGY RECEIVED ON A SQUARE DEKAMETRE OF HORIZONTAL SURFACE IN KILOWATT HOURS:

Habana	184,488	Lourenço Marques	169,462
Lincoln	160,906	Johannesburg	175,696
Mt. Weather	148,824	Davos Platz	174,043
Washington	145,403	Rothamsted	83,133
Madison	139,523	South Kensington	78,569
Toronto	106,460	Stockholm	79,267
New York	97,856	Sloutzk	70,296
Chicago	89,424		

ALEXANDER McADIE.

Blue Hill Observatory,
Readville, Mass.

Absorption of X-rays in Various Elements.

IN a recent letter to NATURE (Nov. 12, p. 695), Dr. E. Jönnson concludes from his measurements on the absorption of X-rays over a wide range of wave-lengths that the so-called 'jump' δ_K of the absorption coefficient in passing the K-absorption limit is given by

$$\delta_K = \frac{E_K}{E_{L_1}},$$

where E_K and E_{L_1} are the energy levels corresponding to the K- and the L_1-levels respectively. Mr. Jönnson does not define δ_K, but I assume that, in accordance with current practice, δ_K is the ratio of the *fluorescent* absorption coefficient infinitely near to, but on the short wave-length side of, the K-limit to that coefficient infinitely near to, but on the long wave-length side of the K-limit.

A relation substantially identical with this was suggested by the writer some years ago (F. K. Richtmyer, *Phys. Rev.*, vol. 23, p. 292; Feb. 1924). But it is difficult to harmonise this suggestion with our present concepts of atomic structure. If we accept the usual quantum-photoelectric picture of the absorption of X-rays, it follows that this ratio δ_K is numerically equal to the ratio of the number of $(K+L+M\ldots)$ photoelectrons to the number of $(L+M\ldots)$ photoelectrons expelled by a beam of X-rays of wave-length $\lambda<\lambda_K$, where λ_K is the wave-length of the K-limit. If, then, $\delta_K = \frac{E_K}{E_{L_1}}$, it follows at once that *the relative numbers of K- and of L-photo-electrons must be independent of the relative numbers of*

K- and of L-electrons in the atom. This, if true, would be a very surprising result, for it is more or less obvious, *a priori*, that the probability of the photoelectric expulsion of an electron from a given group should depend, in part at least, on the number of electrons in that group. Several different investigators have derived expressions on theoretical grounds (for a summary, see F. K. Richtmyer, *Phys. Rev.*, vol. 27, p. 1, 1926. Also *ibid.*, Dec. 1927) showing that the probability of the photoelectric ejection of an electron from a level in which the binding energy is E and containing n electrons is proportional to nE^2—a prediction which, however, agrees only qualitatively with experiment.

A precise experimental check of any theory of the absorption of X-rays is rendered very difficult by the fact that, of necessity, the *measured* values of absorption coefficients must include scattering. We have at present no means, either experimental or theoretical, of determining, with anything like acceptable accuracy, the scattering coefficients at various wavelengths by means of which to determine from the measurements the actual values of the *fluorescent* absorption coefficients. As an illustration of the ambiguity in measuring δ_K may be mentioned the fact that δ_K for silver is either 6·4 or 6·0 according as the (mass) scattering coefficient is taken as 0·8 or 0·2. For gold, the respective values of δ_K are 6·4 and 4·0.

However, there is no reason to reject an *experimentally* determined relation just because it happens to conflict with theory. Accordingly, the full text of Mr. Jönnson's paper will be awaited with interest.

F. K. RICHTMYER.
(Cornell University.)

Göttingen, Nov. 21.

The Mechanism of the so-called 'Posterior Sucker' of a Simulium Larva.

IN NATURE of July 30, p. 154, Dr. R. J. Tillyard criticised my letter that appeared in the issue of April 23, p. 559, under a misapprehension. The delay in reply has been due to the fact that until my arrival in Edinburgh I was not able to consult Tonnoir's paper in *Ann. Biol. Lacustre*, **11**, p. 163. My reference to it in the first letter was based on information contained in Dr. Puri's paper (*Parasitology*, **17**, pp. 295-369; 1925).

My object in writing my letter in NATURE of April 23 was not to lay claim to a discovery, but to lend support to Tonnoir's views regarding the function of the so-called 'suckers' of the Simulium larvæ. The publication of Dr. Puri's paper showed that the work of Tonnoir was not fully accepted, and I considered that further remarks on the subject were desirable. It was a matter of great pleasure to me that my observations corroborated Tonnoir's account in all essential respects.

Dr. Tillyard has objected to my use of the word 'strong' for the muscles of the posterior 'sucker,' and in support of his arguments has referred to Dr. Puri's figure (pl. viii, fig. 10). I wonder if Dr. Tillyard took the trouble to study carefully this figure and to understand it from the account given by the author. Besides mentioning a number of slender muscles, Dr. Puri (p. 321) points out that "a very stout muscle originating dorsally from the anterior end of the seventh segment, and dividing into two strands, is also attached within this space." Moreover, while discussing the action of the posterior appendage, Dr. Puri (p. 311) says that "my observations, however, show that there are *fairly strong muscles connected with the centre of the disc*," etc. (Italics are mine.)

In support of his view regarding the function of the 'sucker' Tonnoir has said, "La dissection montre, d'ailleurs, qu'il n'existe pas de faisceaux musculaires destinés à la formation de cette coupe." Dr. Tillyard justifies this statement by pointing out that "Tonnoir had the blepharocerid larva in mind (on which he was working at the time) when he wrote" this. In his paper Tonnoir gives no indication of this fact, and, even if it be so, to me such comparisons between the structures of two different organisms of a very different build seem misleading.

There is one more point to which I must refer here. I have described an abnormal mode of progression and not "the true method of progression." The larvæ were allowed to crawl on a wet slide and the progression was effected, under the conditions, without the help of the posterior appendage. In a letter to NATURE I could not discuss my observations in detail and I thought it appropriate to illustrate the salient points by the photograph published on April 23. I hope to discuss in detail, at some later date, the function of the organs of attachment in the fauna of torrential streams.

SUNDER LAL HORA.

Zoological Department,
University of Edinburgh,
Nov. 14.

Partial Transit of Mercury in May 1937.

THE older text-books indicate a transit of Mercury on May 11, 1937. Thus, Rev. S. J. Johnson, in "Eclipses and Transits in Future Years" (1889), p. 6, says: "Mercury on the sun from 8 h. morn. to 9.2 h. approximately." On the other hand, Prof. S. Newcomb, in his paper on transits of Mercury in vol. 1 of *Papers of the American Ephemeris*, describes the event as a near approach. It does not appear, however, that this statement was the result of accurate computation; it was merely an inference from the large diagram of transits contained in the paper.

I have lately made a computation from Newcomb's tables of the sun and Mercury; I obtain the result that, while there will be no transit in the northern hemisphere, a portion of the planet will encroach on the sun as seen from some southern stations. The time that I chose for computation was May 11·37755 U.T. The actual least distance of centres was a few minutes earlier. I obtain true heliocentric longitude of Mercury referred to mean equinox of date 230° 12′ 12″·86 latitude − 19′ 15″·81, log. radius vector 9·6575860. True longitude of sun 50° 15′ 23″·78, latitude + 0·07″, log. radius vector 0·0044402; true semidiameter 949″·84. Least distance of centres (geocentric) 957″·96. The apparent least distance is 1″·65 greater through differential aberration. Since the differential parallax is 7″·1 and Mercury's semidiameter 6″·0, there is an overlap at the point of greatest phase of 13″·1 − 8″·12 − 1″·65, or 3″·33. If the tabular places are exact, there will be a small encroachment of the planet on the sun as seen from Port Elizabeth, but probably not from Cape Town. The occasion will be a favourable one to search for a ring round the outer portion of Mercury, due to refraction in its atmosphere. In England the least distance of Mercury from the sun's limb will be about 6″, so it should be possible for spectroscopists to see it projected on the chromosphere.

Such partial transits of Mercury are very rare, occurring only once in several centuries. When they occur, we get two May transits twenty years apart; thus there is another short transit in May 1957, this time at the sun's northern limb. It happens that the other rare event of two November transits at an interval of six years also occurs this century, in 1993

and 1999. In consequence, the number of transits in the century, fourteen, is slightly above the average.

In the course of this work I detected an error in the *Nautical Almanac* for 1878, p. 402; the least distance of centres of sun and Mercury should be 4′ 47″·4, not 3′ 47″·4. It is well to note this, as it is likely to confuse those who are using the 46-year cycle to predict the circumstances of future transits. I used methods of this kind in my paper on transits of Mercury in the *Observatory* for 1894, p. 394. I there obtained 16′ 1″ as the least geocentric distance of centres in 1937; this estimate took no account of perturbations, but its close agreement with my present more careful result serves as a check on the latter.

A. C. D. CROMMELIN.

Mathematical Theory of Relativity.

THOSE results in the mathematical theory of relativity that have received experimental confirmation are connected with problems that might be classified as the single-line type. These problems are in the same category as those discussed in particle dynamics and their analogues in geometrical optics.

When, however, we come to problems involving a congruency of lines, logical difficulties arise. It seems clear that we can no longer identify any one of the fundamental co-ordinates with 'time.' Thus, consider the question of 'volume.' In the classical theory the element of volume is invariantive. In the case of a four-dimensional continuum, it is the fourfold element that is invariantive, whereas the threefold element is defined by the four components of a tensor.

Now, taking the four-dimensional continuum, the ground-form of which is given by the equation,

$$ds^2 = dx_4^2 - dx_1^2 - dx_2^2 - dx_3^2,$$

we readily obtain a group of a type similar to that of the rotations about a point in Euclidean geometry, which forms the basis of the treatment of the angular velocities of a rigid body. This, however, simply provides us with one fourfold continuum suffering displacement through another, which is not exactly what is required. We have, in fact, introduced a fifth variable, namely, the parameter by which the infinitesimal transformations of our group are defined. Thus a supplementary relation, preferably of a differential type, is needed to define our moving system, and this must be invariantive in character. The above-mentioned parameter will then furnish a time measure for the system as defined. It seems that in only some such way can we provide a logical geometrical picture of rotation, which is an undoubted physical phenomenon.

At present difficulties arise through the necessity of using the old technical nomenclature in connexion with the new ideas, and thus often for purposes for which it was not strictly intended. In the case of the historical dispute concerning the measurement of 'force,' the difficulties were eventually dissipated by the emergence of the concepts of 'momentum' and 'energy.' It may be anticipated that something similar might happen with regard to the new theories.

Einstein has lately indicated that he has not found the new differential geometry any more capable of giving the required generalisation of the electromagnetic equations than the older Riemannian geometry, though the former was introduced with this purpose in view. May it not be that too close an analogy with Maxwell's equations has been contemplated? Thus one would suggest the introduction of a time measure for the electromagnetic field by some such general method as indicated above, together with some compensating addition to the set of equations.

J. BRILL.

The Oogenesis of Daphnia by Intra Vitam and Post Vitam Staining.

RECENTLY the claims of neutral red as an intra vital stain for the Golgi bodies have been urged by Dr. Parat and his pupils.

Daphnia is easily stained intra vitally in weak solutions of neutral red, the stain colouring these animals bright pink in a few hours. Janus green solutions also work perfectly on such fresh-water crustaceans.

We have found that the growing oocytes of Daphnia exhibit bright red granules after staining in neutral red. In the gland and gut cells also, red granules are conspicuous. The youngest oocytes and oogonia do not exhibit such red granules, the latter appearing at the time of yolk formation.

Daphnid ovaries fixed in Champy's fluid and stained in iron alum hæmatoxylin show empty vacuoles, with a chromophile cortex, which correspond in position and size with the neutral red granules of the intra vitally stained specimens.

These vacuoles are merely the familiar yolk spaces within the Golgi bodies as described by Ludford, Brambell, the present writers, and many other authors. The dictyosomes or Golgi bodies of the oogonia before the inception of yolk formation stain pink in neutral red, and it is only when the yolk spaces are formed that their acidic contents stain bright red in neutral red.

The mitochondria stain green in Janus, and occupy the usual position in the early and growing eggs.

These results may be confirmed by the Nassonow and Da Fano methods, although the latter causes much shrinkage, and is extremely capricious on crustacean material.

With the assistance of Miss Kennelly, we have tried these stains on Limnæa and certain other fresh-water molluscs. The neutral red will stain a Limnæa bright pink in a few hours, and the molluscs appear to live quite happily in this condition.

We have been unable to confirm Mme. Karpova's claims as to a 'vacuome' in mollusc spermatocytes. On the contrary, neutral red vacuoles only appear during oogenesis, as already described in Patella and Limnæa by Ludford, Brambell, and one of the present writers.

ANNIE GLENDON HILL,
J. BRONTË GATENBY,

Zoological School,
Trinity College, Dublin.

Variation of Intensity Ratios of Optically Excited Spectrum Lines with the Intensity of the Exciting Light.

THE principle referred to by Prof. Wood in his letter to NATURE of Nov. 19, that the product of a two-stage absorption increases at first as the square of the intensity of the light, that of a three-stage absorption as the cube, and so on, is evidently capable of wide application.

The necessary data for the examination of the photographic action from this point of view have now been obtained at this Observatory, where the principle was recognised some time previous to its statement by Prof. Wood (see *Proc. Roy. Soc. Edin.*, **47**, p. 47 footnote; 1927). The results show a striking similarity to those found by Prof. Wood for mercury vapour. The latent image (in so far as it is developable) is made up for the most part of a slowly developing image resulting from a two-stage absorption process, and of a rapidly developing image formed by absorption in three or more stages. By an extension

of the principle to the effects of varying the exposure time, the emissions as well as the absorptions may be examined; in this way the three-stage absorption product is found to develop readily only when accompanied by one intermediate emission—unless this emission occurs, the product is a so-called 'reversed' grain.

It may be noted that while grain counts of fully blackened grains refer to both the two stage and the three or more stage absorption images, counts of grains containing one or more 'nuclei' after partial development refer to the three or more stage absorption product only.

These results, if accepted, would place the photographic action among the phenomena of phosphorescence.

E. A. BAKER.

Royal Observatory,
Edinburgh, Nov. 22.

Misleading Uses of the Term 'Self-Adaptation.'

MAY I be permitted to direct attention to the use of loose terminology that occurs all too frequently even in some important scientific articles? The particular term that I refer to is that in which plants and animals are said to have *adapted themselves* to some particular environment, etc.

Thus in an article in NATURE of Nov. 26, p. 786, giving the substance of a paper read by Dr. C. M. Wenyon to the Royal Society of Edinburgh, flagellates are said to have *adapted themselves* to life, etc., and this expression is used in the article no less than three times.

Such expressions as animals *adapting themselves*, and *shade-loving* plants, etc., and even the term *mimicry*, are highly undesirable, though the last term is far too well established for any protest to be effective now. The reason why they are undesirable is that they savour of anthropomorphism; and in these days when one hears so much about natural selection from all quarters, it is imperative to guard scientific terminology most carefully.

These expressions, of course, do not cause any misconception in the mind of the trained scientist, but they are too frequently copied in text-books, elementary and otherwise, and there do a great deal of harm by giving the young student and the lay reader a totally wrong impression. Again, it becomes a very difficult task for the teacher to discourage the use of expressions of this kind amongst his pupils when they are used by leading authorities.

Such is the desire of the everyday citizen for scientific knowledge at the present time, that no scientific writer is free from the possibility of having his articles appear in a popular form in general literature; the responsibility for accuracy on his part is therefore great.

A. G. LOWNDES.

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Regularities in the Spark Spectrum of Silver.

ACCORDING to the theory of Hund, the fundamental terms of the spark spectrum of silver would consist of a deep $^1S_0$-term (combination d^{10}) with metastable triplet and singlet D-terms ($d^9\,s^1$). These would combine with a set of triplet and singlet F, $\bar{D}$, and P-terms ($d^9\,p^1$).

I have been able to identify the fundamental triplet and singlet D-terms, and the second set of terms. Higher Rydberg sequence to the fundamental D-terms has also been obtained. It has thus been possible to calculate the approximate value of the metastable D-terms. The deepest $^3D_3$-term has a value of about 138,000, corresponding to an ionisation potential of 17 volts, the consecutive differences being $1577(^3D_3\text{-}^3D_2)$, $2999(^3D_2\text{-}^3D_1)$, and $2306(^3D_1\text{-}^1D_1)$.

The arc spectrum of silver is a purely doublet spectrum, the metastable inverted D-terms which are such prominent features of the analogous metals copper and gold being either totally absent or failing to occur under the usual conditions of excitement. The fundamental $^1S_0$ will have thus a much higher value than $^3D_3$. For Cu^+ the corresponding value has been calculated by Shenstone to be 22,224. Taking the corresponding value for silver to be 40,000, the ionisation potential of Ag^+ comes out to be about 22 volts, subject to the approximate nature of the assumptions made in the calculation.

K. MAJUMDAR.

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Nov. 3.

Solution of the Equation $\sin\theta/\theta = c$.

MAJOR A. E. LEVIN (NATURE, Nov. 26) points out that the usual solution of the above equation by the method of successive approximations is more simple than that which I gave in NATURE of Oct. 1. The expression which I gave is only intended as a first approximation, and as such should only be compared, if comparison is necessary, with the first approximation ${}_1\theta_a = \sqrt{6d} = \sqrt{6(1-c)}$, in the method he indicates.

If such comparison be made when $1/c = K = 1{\cdot}072502$ and $K = 1{\cdot}5707963$, my expression gives errors $+5'\,32''$ and $+1°\,6'\,49''$, whilst ${}_1\theta_a$ gives errors $-22'\,48''$ and $-5°\,23'\,54''$, the true solutions being $36°\,52'\,12''$ and $90°$.

It will be seen that over this range the relative error resulting from the use of my expression is about one-fifth of that with the expression ${}_1\theta_a$. This meets that part of Major Levin's letter that refers to my original remarks, which I confined to the range $0°$ to $5°$.

There are, however, other advantages that make my expression worth consideration as a first approximation. Thus, if $c = 0{\cdot}1909860$ and $d = 0{\cdot}8090140$, my expression gives the answer with an error $+2°\,17'\,49''$, an error that can be removed by a further stage of approximation, the true answer being $150°$.

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Calendar of Discovery and Invention.

IN this week's issue appears the last group of notes of the Calendar of Discovery and Invention which I have had the pleasure of contributing to NATURE during the past year. This calendar has aimed at recalling some of the most important advances in science and some of the principal mechanical inventions, and is supplementary to the Calendars of Scientific and Industrial Pioneers which appeared in 1921 and 1922. In the preparation of these notes I have received assistance from many sources, and I should like to take this opportunity of thanking Dr. W. Clark, Mr. A. Gomme, Mr. B. A. Behrend, Dr. R. T. Gunther, and Sir Charles Sherrington for their kindness in placing information at my disposal. The late Dr. Daydon Jackson also kindly sent several interesting notes, which were included in the Calendar, referring to botany and the Linnean Society.

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Reform of the Calendar.

THE appointment of a special committee of inquiry into the subject of calendar reform was the natural result of a movement which had been gathering force for some twenty years at least. Before the outbreak of the War, chambers of commerce and other bodies had agreed in expressing a strong desire for amending certain defects and inconveniences in the existing calendar, and on the termination of the War and the establishment of the League of Nations, it was almost inevitable that a matter so largely bound up with the commercial and industrial life of the nations in general should be taken in hand by the League.

The questions involved being concerned with religious as well as commercial interests—especially as regards the growing desire for the stabilisation of Easter—the League's Advisory and Technical Committee for Communications and Transit, which undertook the discussion of the matter, invited the Holy See, the Œcumenical Patriarch of Constantinople, and the Archbishop of Canterbury to nominate representatives to assist the Committee at a meeting held at Geneva in August 1923, and at the conclusion of that meeting a special committee of six (including the three ecclesiastical representatives) was appointed to review the whole situation. The result is the report and its appendices now before us.[1]

The Committee had a large mass of material available for discussion. Prior to its opening session, the general secretary of the League had communicated to the various governments and religious authorities a resolution passed by its Advisory and Technical Committee for Communications and Transit, and invited comments and observations which might be of help in the inquiry. In addition, the special committee itself distributed a *questionnaire* to a large number of international, educational, industrial, and other organisations, and at its second session it heard Dr. Adolf Keller, representing a large number of Protestant religious communities, and also many of the chief rabbis of Europe and America. The Committee further received more than 180 schemes for reform from private correspondents. All this material has been very carefully sifted and classified and is set out in three annexes. The first deals with calendar reform in general. The second with the Easter problem, and the third summarises the proposals received under nine main groups.

The report itself contains a historical survey of the circumstances leading up to the appointment of the Committee and a clear statement of the chief defects of the existing calendar. The Committee resolved to treat the questions of general reform and of Easter separately, and the report is divided under these two headings.

As to general reform, the Committee was instructed "not to consider any changes in existing conditions unless such changes were definitely demanded by public opinion for the improvement of public life and economic relations." Accordingly, all proposals which involved tampering with the year, either as regards its commencement (such as a suggestion that this be advanced to the epoch of the winter solstice) or its length (including proposals to correct a small outstanding error in the Gregorian year, and to obviate difficulties arising from the 365th day by the adoption of a leap week at appropriate intervals, etc.), were ruled out. Full consideration, however, was given to suggestions for equalising the *divisions* of the year as well as to proposals for rendering the calendar perpetual by introducing a principle of *dies non* or *blank days*.

As regards the divisions of the year, suggestions for reform mostly follow one of two courses (treated as three in the report). The first is to modify slightly or readjust the lengths of the present months so as to equalise the quarters; the second is to divide the year into 13 months or periods of four weeks each. The respective advantages and disadvantages of both methods are clearly set out in the report. Regarded from the purely business point of view, and quite apart from any consideration of the great inconveniences which changes must inevitably involve in other respects, the real point at issue is whether the quarters or shorter divisions of time based on the week are of primary importance. The replies to the Committee's *questionnaire* indicated that the present twelve-months year is in general preferred. The Committee has, however, merely recorded the facts without making any recommendation, though it has directed attention to the growing tendency among private organisations to make use of an auxiliary calendar of their own, especially that based on thirteen four-weekly periods as adopted by the British railways and many American organisations.

Under both of the proposed lines of general reform referred to, the odd day (two days in leap years) over and above fifty-two weeks remains an obstacle to perpetuity in the calendar, and it is strongly urged by many supporters of both systems that such days should be excluded from the regular sequence of the days of the week. This proposal has met with very strong opposition in certain religious quarters, and here again the Committee has simply recorded the facts, though urging a fresh examination by the opposing religious bodies of the principle of a blank day.

As regards proposals to stabilise the festival of Easter, the Committee is rather more definite in its expression of opinion: and in view of the almost universal desire for this measure of reform, such an attitude is natural. It is pointed out that most of the replies apparently favour the second Sunday in April for Easter Day, but it is suggested as a slight modification of this proposal that the Sunday following the second Saturday might be preferable, so as to avoid the clashing of Passion Sunday and the Feast of the Annunciation which would occur whenever Easter fell on April 8. It is, however, emphasised by the Committee that Easter is essentially a religious festival, and that the approval of the

[1] League of Nations, Geneva. London: Constable and Co., Ltd., 1926 and 1927.

Churches is needed before the proposed reform can be properly effected. From a perusal of the documents contained in the report, it appears that the authorities of the Eastern and Anglican Churches have already accepted the principle of stabilisation, but require as a condition that the change should take place by general agreement of the Churches. The Roman Church admits that there is no objection to the change on *dogmatic* grounds, but asserts that such a departure from ancient tradition and custom, even if the change were demanded by the general good, could only be considered on the advice of an Œcumenical Council. The opinions expressed by the various Protestant communities are almost universally favourable to the proposal.

Taking the report as a whole, it may be said that its chief value lies in its very clear presentation both of existing defects and of the main trend of critical thought which aims at reform. The *pros* and *cons* of the schemes submitted are fairly set forth, so that anyone interested is able to acquire a knowledge of the points at issue very quickly. But it seems important to emphasise the view of the Committee that public opinion in general is as yet nowhere sufficiently informed to press for definite action in any particular direction of general reform (that is, apart from the Easter question). For example, the replies received from the various governments show that only certain scientific bodies have as yet been consulted, and it is suggested that now the preliminary eliminations have been made, the principles underlying the main groups of proposals should be carefully studied and explained, and that to this end the investigation should be organised in each country on official or semi-official lines. It is the view of the Committee that until this is done an international conference to effect general reform could have no chance of success.

The Second Greenland Expedition of the University of Michigan.

By Prof. WILLIAM HERBERT HOBBS, Director.

THE first Greenland Expedition of the University of Michigan was carried out in the summer season of 1926 within the Holstensborg district of south-west Greenland and was preliminary only in its nature. It was to pave the way for the second expedition, that of 1927–28, the primary object of which was to be to set up upon a mountain, as near as might be practicable to the inland-ice of Greenland, a meteorological and aerological station, and to continue observations there for the period of at least a year. Some account of the first expedition appeared in the January number of 1927 of the *Geographical Review*. The second expedition left Copenhagen on June 4, 1927, by Danish Government steamer a week behind the scheduled sailing of this vessel. The expedition reached Holstensborg, south-west Greenland, on June 20, and two days later left for the Söndre Strömfjord (Kangerdlugssuak) on the *Hvalrossen*, a 22-ton motor schooner hired from the Danish Government at Holstensborg.

On the way down the coast, one of the worst summer storms for this coast in many years was encountered, and the little craft was driven for shelter to a small inlet, the Inugsugtussok, where the expedition was storm-bound for seven days. On June 27, during a temporary lull of the storm, the little craft ventured out, but after being buffeted for several hours was compelled to put back after two boats had gone adrift, but, fortunately, had been recovered.

On July 2 the expedition reached its objective at the head of the great Söndre Strömfjord, one of the longest and largest fjords in the world, and in its lower reaches probably unsurpassed for grandeur of scenery. The expedition was fortunate in finding at the head of the fjord not only a suitable landing-place and base site supplied with running water, a rare thing in Greenland, but also in the immediate neighbourhood was found a mountain 1290 feet in height, easy of ascent and dominating the entire horizon. Only fifty feet below the summit is a lake of excellent water, and the gradients were such as to make the transport of material to the summit not too difficult. This mountain has been named Mount Evans, and upon it has been located the aerological station of the expedition.

After the first organisation of the camp and protecting the stores from the weather, the heavy task of moving the building material to Mount Evans was at once begun. Lumber, supplies and equipment, the heavy radio batteries and generator, provisions for the year, and fuel for the winter, had all to be carried up from the fjord mainly on the backs of four of the seven members of the expedition and the four Greenlanders who had been brought in from the coast.

By July 20 the central room of the hut, 9 ft. by 14 ft. on the ground, had been built and equipped, and one of the store-rooms as well. On this date Mr. Clarence R. Kallquist, the aerologist, and Mr. P. C. Oscanyan, jr., the radio operator, took up their residence in the hut, already equipped with self-recording instruments—barograph, thermo-hygrograph, single-register anemometer, etc.—and with the aerological equipment. Beginning on July 21, a daily pilot balloon has been sent up, and all the instruments regularly observed.

As later completed in early September, the station hut is represented in Fig. 1. It was designed and constructed very largely under the direction of Fred Herz, a member of the expedition who has for years been associated with Prof. J. E. Church, another member of the expedition, and long the director of the Mount Rose Snow Surveys of California. The design has grown out of the experience at the Mount Rose mountain station, though it has been modified to meet the extreme conditions in Greenland. Its form is that of a low flat dome banked with sod and rock in such fashion as to give the wind but slight hold upon it. The inner living room is insulated by store-rooms along

the sides which have outer walls of sod and rock, and sod walls largely cover the ends of the building as well. The side walls of the inner room are of extremely thick canvas heavily waterproofed, and the room is lined with balsam wool one inch in thickness and in part covered with canvas. The room has a floor with balsam wool beneath it. The end walls and roof are constructed in much the same manner except that here additional board walls afford rigidity and additional insulation. The two windows at the ends are of plate glass and double, with air space between. Ample ventilation is supplied at both ends of the room and at the ends of the store-rooms.

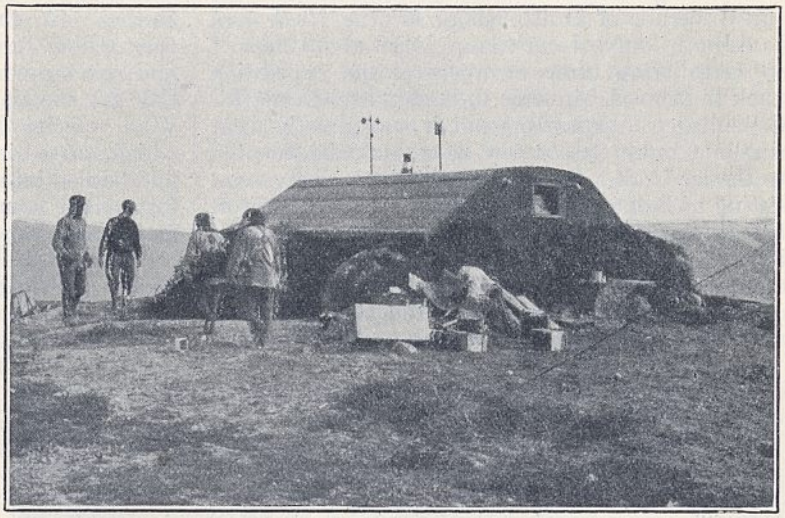


FIG. 1.—Meteorological station near the margin of the inland-ice of Greenland.

The site for the station was chosen at the head of this great fjord in south-western Greenland because a long arm from the inland-ice pushes out nearly to the sea on the south side of the fjord, and it was thought that this arm (unique in Greenland) would condense the moisture arriving in the 'lows' making their way up Baffin Bay. This judgment seems to have been confirmed by the experience of the past season, for during the months of July and August, rains were of almost daily occurrence at the Danish settlements on the west coast, though we enjoyed clear skies at Mount Evans. The clearness of the atmosphere within this hinterland of south-west Greenland is best attested by the fact that the average run of our pilot balloons has been fifty minutes, and the average distance to which they have been followed has been thirty kilometres.

FIG. 2.—Mr. Kallquist, the aerologist, following a balloon with the theodolite at the meteorological station on Mount Evans; Mr. Oscanyan is behind the instrument.

On Sept. 9, a free-rising captive balloon was sent up to a height of 1200 metres, but the days were seldom calm enough for the purpose, and the temperature relationships aloft are at such times much less interesting than when the wind is blowing. Efforts will therefore be made to use kites carrying the light Fergusson meteorograph, of which the station is provided with three. The pilot balloon work will be continued once daily so far as practicable throughout the winter, making use of small lanterns during the dark period.

The balloon studies thus far carried out already indicate that even in summer the Mount Evans station is almost entirely controlled by the inland-ice circulatory system, the northern glacial anti-cyclone. With few exceptions the surface wind has been constantly from the easterly quadrants, and these extend upward to a height of about 1000 metres, where they are replaced by currents from the west which pass in over the ice. On Aug. 4 a very remarkable condition, and thus far unique in our experience, was discovered by the pilot balloon ascent. A 73-minute run to 13,000 metres and 37,000 metres distance showed that the east wind, although weak at the surface, continued to the highest point reached. This was so remarkable that a second balloon was at once sent up and followed for 55 minutes, with the result that it checked almost exactly with the first. It will be interesting to learn what conditions were observed elsewhere on that day.

The delays at the beginning before reaching our base and the heavy labour of erecting the station on Mount Evans, left the expedition handicapped in its effort to advance over the inland-ice. Two reconnaissances had early been carried out and the inland-ice reached near the head of the great valley

which extends the present fjord to the ice margin. In this district the inland-ice pushes out two tongues, which have been named the Russell and Leverett glaciers.

It was not until Aug. 8 that it was found possible to set out upon the expedition to the inland-ice, and arrangements had already been made with the Governor of Holstensborg for the *Hvalrossen* to come to our base at Camp Lloyd about Sept. 1 so as to bring three members of the expedition back to the coast in time to depart by steamer for Copenhagen. On setting out it was already clear that not more than a few days could be devoted to the ice itself. On Aug. 19 this little party, consisting of Belknap, Church, Herz, and the director, had reached the margin of the ice and set out upon its surface with stores and equipment loaded upon an Alaskan sled with harnesses for the four members of the party. At this time of the year the ice is without any snow cover whatever, and after leaving

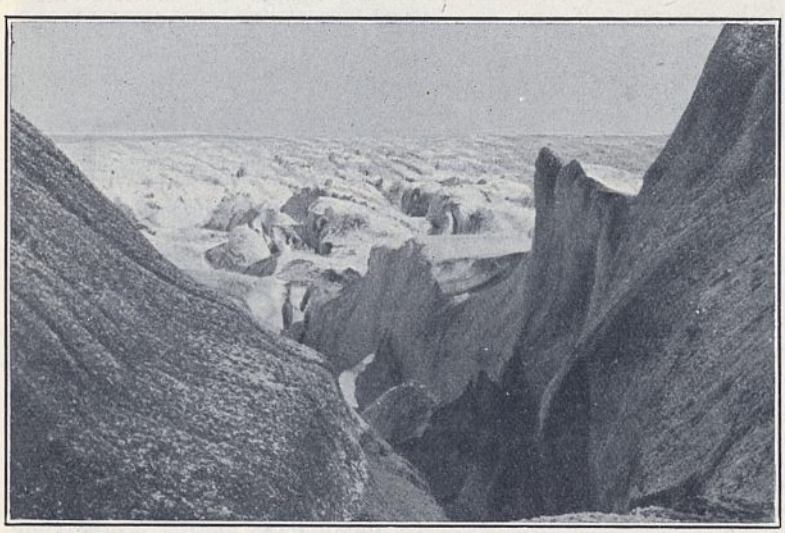


FIG. 3.—The rough surface of the inland-ice of Greenland over which the expedition had to advance.

the immediate margin its surface was found to be so rough that the sled had to be relieved of most of its load and this carried forward in relays upon the shoulders. Without the crampons or climbing-irons one could scarcely advance at all, and in the six days spent upon the ice an advance of less than eight miles was made. Pilot balloons were sent up on Aug. 23, and the party returned to its base after a 21 days' absence. Before turning back, an altitude upon the ice-surface of 2200 feet had been reached. On the return, depots of provisions and equipment were left behind for the use of a winter ice-cap party which will make the attempt to invade this region after the winter blizzards have filled the channels and packed the snow, and when the tundra surface separating Camp Lloyd from the ice margin is deep in snow and suitable for the use of dog-sleds. The winter party will consist of Mr. Helge Bangsted and Prof. J. E. Church, who have been making their preparations at Holstensborg.

The station on Mount Evans was finally completed on Sept. 3 and provisioned and fuelled for the winter. A balloon inflating shelter large enough for captive balloons has also been constructed, and this greatly facilitates the aerological work. In such a location every structure must be made low, be built around with sods and boulders, and be heavily anchored if it is to withstand the winter storms. A summer storm of hurricane force occurred on July 21, the day after the central room and one store-room had been completed, and on this day the single-register anemometer recorded a wind velocity of 81 miles per hour. This storm, which started in the south-east over the inland-ice and hauled into the south-west, preceded by about forty-eight hours, as we learned by our radio, the great storms along the whole Atlantic seaboard.

The powerful short-wave radio station on Mount Evans has taught us much concerning conditions of transmission within the district. Except during strong aurora displays, reception has been generally good, and the New York *Times* news broadcasts have been received with great regularity. On the other hand, up to late September, transmission on short-wave by our 250 watt tube transmitter has been only rarely possible to distances beyond one thousand miles. Beginning late in September, contacts were established with the New York *Times* so that news despatches could be sent out. The station is equipped with a long-wave receiver, and its signals were heard distinctly at times when short-wave signals were blanketed out.

The ice-cap has been found to act apparently like an ocean, and the long waves come across it much better than they come to the station from other quarters. The weather announcements from long-wave stations at Angmagssalik, on the east coast of Greenland, and from Reykjavik, Iceland, have been picked up regularly. It is hoped that amateurs and others will endeavour to communicate with our station during the winter. Its call is the Denmark-Greenland call with 1XL.

Because of the dog epidemic in north Greenland, it will be necessary for Bangsted to make up a team of dogs for the winter expedition from dogs available in the Holstensborg district. The difficulties of this expedition are fully realised, but Mr. Bangsted in mid-winter of 1926–1927 spent six weeks upon the surface of the inland ice to the eastward of Umanak, pushing his way a distance of eighty miles from the margin, turning back to a point twenty miles within the margin, and there carrying out meteorological observations for eighteen days before returning to Umanak. He will spend such time upon the ice and push his way to such a distance as conditions in the winter will make possible, starting out from the Mount Evans station and returning to it from the ice.

Progress of Aeronautical Research in Great Britain.[1]

By H. E. WIMPERIS, Director of Scientific Research, Air Ministry.

IN all countries alike the two most disquieting aspects of aviation to-day are the frequency of accidents to service aircraft and the necessity for subsidising nearly all civil aviation enterprises; it is therefore natural that research should concentrate upon the problem of increasing the safety of aircraft in addition to striving towards improving what is known as 'performance.'

There are obvious reasons why any craft moving in a three-dimensional medium should be safer than the older two-dimensional form of transport; that this is not yet the case is largely because all conventional types of aeroplane depend for their sustenance upon a *horizontal* speed of some 50-60 miles an hour, relative to the surrounding air. If this necessary speed be lost, the loss of control which almost invariably follows is highly dangerous unless the height be sufficient for the aircraft to recover speed. If we can ensure that it will merely fall at a fairly steep gliding angle instead of starting to spin, then there is every prospect of a very considerable reduction in the number and serious nature of aircraft accidents.

In England the problem has been attacked with vigour and a form of control has been evolved which, even at very large angles of incidence, has neither of the long-recognised defects of the conventional ailerons in stalled flight, namely, rapid weakening of power to bank the aeroplane, and the introduction of a yawing moment, which, if not countered by adequate rudder control, causes the aircraft to enter into a spin. This result has been achieved by the use of a slot in front of the aileron. The slot opening, which for convenience of design may or may not be quite zero in normal flight, increases as the aileron is depressed. Full scale tests have been carried out on a number of types of wing section and aircraft, and there would seem no doubt that the principle of the method can be made generally applicable. In the last few months a further simplification of the use of such a slot has been made by Mr. Handley Page: this is now under test and shows great promise. At the same time, the influence of the rudder-power on the control in stalled flight has been investigated. Although there is no evidence that safety in stalled flight can be achieved merely by increasing the rudder-power, research has indicated that the size of this control has a large influence on the rapidity with which a spin following a stall can be stopped.

It is common knowledge that some types of aircraft, when stalled, go normally into a spin and are not easily brought out, whilst other types of aircraft are difficult to spin. On what features of design does this difference depend? Can we, by a manipulation of the form and arrangement of wings, by disposal of the centre of gravity with respect to the centre of pressure or by some arrangement of the control surfaces, ensure that a civil aircraft will never spin, and that a service aircraft will only have such degree of ability to spin as may be necessary for its particular duty? We know, for example, that a forward position of the centre of gravity will lessen in some degree the danger of an involuntary spin; we know that when positive stagger is reduced, the spinning properties of a biplane are more dangerous, but the picture is far from complete; though it may be said that the mechanism of a spin in undisturbed air is now generally understood.

A somewhat extreme example of an aircraft designed primarily to affect control at and beyond the stall, is the Pterodactyl, a tailless aeroplane, designed and constructed by Capt. G. T. R. Hill, with the financial assistance of the Air Ministry. This aircraft provides adequate control at low speeds by virtue of the fact that the fairly large floating control surfaces at the wing tips are fully effective at all probable angles of incidence of the main planes. Successful full scale trials have been carried out with a lightly loaded tailless aeroplane, and it has been demonstrated that the aircraft has no tendency to autorotate. A tailless aircraft with higher wing loading is being built to the order of the Air Ministry.

It will be seen that much is being done to counteract the disadvantages arising from the natural limitation of the conventional fixed wing aircraft, namely, the dependence for sustenance upon a considerable forward speed. An alternative is the helicopter. We in Great Britain have from time to time looked not unhopefully along that road, but we have been compelled to turn away, always, indeed, with a little greater knowledge, but with a still greater respect for the magnitude of that attractive if elusive problem. But the task now seems not so hopeless as it once did. We have in England to-day a rotating wing aircraft having very attractive stability and controllability characteristics; I refer to the autogiro, the invention of Senor de la Cierva, belonging to the class we now call the 'Gyroplane.' This aircraft, by virtue of the hinging of the blades so that they can rise and fall as they rotate, escapes the instability which seemed at one time to be inevitably associated with rotating wing aircraft. Although not a helicopter, since it is not able to rise vertically from the ground, it is capable of almost vertical descent in a moderate wind. It cannot yet be said that it will compete with the more conventional types of aircraft at high speeds, but for some purposes it would be advantageous to sacrifice high speeds in order to achieve safe landing in confined spaces. Research is proceeding, a number of gyroplanes are being built, and the nature of the forces involved in the flapping motion of a rotating wing are being investigated theoretically and by experiments in a wind tunnel. Moreover,

[1] From a paper presented to the International Air Congress at Rome, October 1927.

the possession of a full scale rotating wing aircraft, the characteristics of which can be studied in actual flight, represents an exceedingly important advance towards the solution of the helicopter problem.

Of the other researches which are proceeding with the object of increasing the safety of aircraft, perhaps the work on wing flutter is of most general interest. It is well known that certain types of aircraft exhibit a dangerous wing flutter when diving at high speeds. We, in England, have not escaped this trouble, but happily we are within reach of an appreciation of the features of design which cause it. Theoretical investigations which have been carried out at the National Physical Laboratory, and recent wind tunnel experiments at that establishment, have shown that it is possible to reproduce on a specially constructed model the various types of flutter indicated by theory. Research is proceeding, but already it is clear that the mass distribution and aerodynamic loading of the ailerons is a factor of prime importance. Full scale experiments have also supplied very valuable data on the nature of wing flutter, and tribute must be paid to the skill and courage of the many pilots who willingly face the risk of diving aircraft at such speeds that flutter ensues; the knowledge so gained is of the utmost value, but it is better to substitute work on the model scale for such dangerous tests wherever possible.

On the subject of increasing aircraft 'performance,' one's thoughts turn naturally to the engine. One of the most amazing of modern engineering achievements is the production of a reliable power unit weighing little more than 1½ lb. per horsepower at ground level. For special purposes, such as for the recent Schneider Trophy competition, engines have been constructed weighing considerably less than 1 lb. per horsepower, but of course these engines are not yet suitable for general purposes.

Engines with gear-driven and with exhaust-driven superchargers have been built and have shown satisfactory power outputs at altitude, but our knowledge of how far the advantage of increased power is outweighed by the increase of weight, head resistance, fuel consumption, and of fire risk with the exhaust-driven type, is still incomplete.

There is another direction, however, in which attempts are being made to meet the need for operating in an atmosphere of variable pressure. It is well known that engines running at ground level, on ordinary aviation spirit, exhibit a tendency to detonate if the compression ratio exceeds about 5:1. At altitude the decreased air density and temperature allow higher compression ratios to be used without detonation, and for this reason most engines are designed to have a compression ratio larger than 5:1, detonation at low altitude being avoided by throttling the engine. Conditions such as these have led to a search for a suitable fuel which will stand a higher compression ratio without detonation. Tests on variable compression engines have shown that by adding some 20 per cent. of benzol, the compression ratio can safely be increased to 5·8:1, with a resulting decrease of the weight per horsepower and a decreased fuel consumption, but for many reasons this method is unsatisfactory.

It seems not unlikely that the best solution will be the addition to petrol of small quantities of 'dope,' the best known being a mixture of tetra-ethyl-lead and ethylene dibromide. Indeed, it is not too much to say that the discovery of a 'dope' entirely suitable in its supply, use, and storage, would mark a new era in engine design. The decreased weight-power ratio and fuel consumption consequent upon the use of high compression ratios would seem only to be limited by the skill with which the designer could deal with the higher explosion pressures without undue increase of weight. It is clear that there is no lack of incentive to work in this direction. In England intensive research has been carried out at the Air Ministry Laboratory, at the National Physical Laboratory, and at Oxford on the physical and chemical nature of the phenomenon of detonation and on the effect of using 'doped' fuels. Much progress has lately been made; according to Prof. Callendar, working at the first-named establishment, detonation is due to the formation of organic peroxides which become concentrated in the nuclear drops during compression and ignite the drops simultaneously when the detonation temperature of the peroxide is reached. Although much has been done, it still remains to discover a 'dope' which will be entirely satisfactory in an engine, be non-poisonous, and will not deteriorate in storage. For civil aviation purposes, such a 'dope' would be invaluable, since the need for power at ground level at present conflicts with the necessity for using engines having a low compression ratio.

Every decrease of the weight-power ratio of aero engines inevitably focusses attention on the problem of effecting economy in fuel consumption. The average aero engine consumes its own weight of fuel in four or five hours, and it may well be argued that efforts to reduce the fuel consumption have not kept pace with the reduction of the weight of the engine itself. For long-range civil aviation, this problem is of particular importance. If, by the use of 'dopes' it were possible to use as high a compression ratio as, for example, 10:1, a substantial reduction of fuel consumption would be achieved. There is, however, another avenue of progress—the heavy oil engine. If the prospect of using compression ignition engines on heavier-than-air machines is still distant, the advantages to be derived therefrom are so important that the ultimate displacement of the petrol engine by the heavy oil engine can scarcely be doubted.

With regard to the design of the aircraft itself, it would seem that any signal advance must await the discovery of a new alloy or some new treatment of an existing metal or a new aerodynamic principle. There is room, however, for progress along less spectacular lines. Fundamental aerodynamical investigations are proceeding, and the later R.A.F. wing sections have been successfully designed in

accordance with the Kutta-Joukowski aerofoil theory. Preliminary experiments have been made on the removal of the boundary layer from the upper surface of an aerofoil by suction from points well forward in the section; it has been found that the maximum lift is considerably increased thereby. Similar results could no doubt be obtained by the emission of air under pressure; but it will be appreciated that this is in reality the principle of the Handley Page slot, which, moreover, has the advantage of being independent of any pumping plant.

News and Views.

THE Council of the Physical Society has awarded the Duddell medal for 1927 to Dr. F. E. Smith, Director of Scientific Research at the Admiralty. This medal is given annually for work in connexion with the development of scientific instruments or of materials used in their manufacture. Dr. Smith's work at the National Physical Laboratory on the development of electrical standards is too well known to require emphasis. He was trained at the Royal College of Science, 1895–1900, under the late Sir Arthur Rücker, entering the National Physical Laboratory in 1900. There he formed one of the band of pioneers who, under Sir Richard Glazebrook, did so much to raise the scientific work of the Institution to its present high level. His earliest work was concerned with modifications of the Wheatstone and Kelvin bridges for precise measurements of resistance, and the development of bridges for accurate platinum resistance thermometry. A classical piece of work followed on the current balance, by means of which it was found possible to evaluate a current of the nominal value of 1 ampere to within 1 part in 50,000. In the course of this work he developed the silver voltameter which bears his name and is generally accepted as the most trustworthy form of voltameter, in that there is no envelope between the anode and cathode. The successful development of the modern mercury-in-glass resistance standards is largely due to Dr. Smith's work. His specification for the Weston normal cadmium cell is the one generally followed. It is now no uncommon experience for a batch of twenty standard cells to be made commercially in which the E.M.F. given by the cells agrees to 1 part in 10,000. Dr. Smith was also responsible for the design of the Lorenz apparatus (the Viriamu Jones Memorial) installed at the National Physical Laboratory. He has also developed various magnetometers for the measurement of the magnetic intensity of the earth's field; one of his instruments now forms the standard for the measurement of the horizontal intensity at the Magnetic Observatory at Abinger. In 1920, Dr. Smith left the National Physical Laboratory to take up his present post at the Admiralty. He was president of the Physical Society for 1923–24. As one of the honorary secretaries of the British Association, his organising ability is being devoted in a striking manner to the advancement of science.

MR. ROBERT MOND has been appointed a member of the research council of Imperial Chemical Industries, Ltd., to which reference was made in our issue of Dec. 10, p. 850. Mr. Mond has carried out notable research in pure and applied chemistry and has given particular attention to electrolytic problems. He was associated with his father, Dr. Ludwig Mond, in researches on the metallic carbonyls and the action of nitric oxide upon them. In other directions Mr. Mond has also contributed in a substantial way to scientific progress by his original work and personal influence, and he is as highly esteemed for his Egyptological explorations and studies as he is for his contributions to physical and chemical science. He is honorary secretary of the Davy-Faraday Laboratory of the Royal Institution and honorary treasurer of the Faraday Society; and many other societies and scientific organisations are indebted to him for generous support and encouragement.

IT has long been known that the difference between good and poor pastures is not dependent alone upon the energy value of the herbage or the proximate food constituents—carbohydrate, protein and fat. The consequent investigations of mineral deficiencies, notably at the Rowett Research Institute, have already proved to be a well-directed inquiry. The discussions at the recent Imperial Agricultural Research Conference have made it abundantly clear that malnutrition consequent upon mineral deficiencies in pastures is widespread through the Empire. From South Africa one hears that 'styfsiekte' in cattle arises on certain veld soils, the vegetation of which contains less than the optimum requirements of phosphorus. The ruminant stock of the North Island of New Zealand have for some time been troubled with 'bush sickness,' a condition of anæmia and general emaciation which has now been shown by Aston to be correlated with iron deficiency. In the Bihar district of India low milk yield is consequential upon a low phosphorus content of soil and crops. The high mortality among sheep in the Falkland Islands has been found by Godden to be collateral with low lime and phosphorus percentages in the pastures. Similar evidence of malnutrition among Australian sheep is forthcoming. The pastoral industry of Australia contributes about 25 per cent. of the national income, a fact which makes the immediate investigation of mineral deficiency diseases imperative. These deficiency diseases are becoming more evident with the increasing population of the colonies, and the subdivision of the larger holdings. Stock migrated from one area to another in earlier days and so unconsciously secured adequate mineral supplies. The continuous maintenance of stock on the same area has now given rise to this new problem in nutrition, which is to receive full and immediate investigation largely through the co-operative efforts of the Empire Marketing Board, the

Australian Council for Scientific and Industrial Research, the University of Adelaide, and the Rowett Research Institute.

AT the thirty-second winter general meeting of the Institution of Water Engineers, held in the rooms of the Geological Society on Dec. 9, the following resolution was proposed by Capt. W. N. McClean, seconded by Mr. S. R. Raffety, and unanimously carried: "That there is urgent need of an organisation which will ensure a continuous record of the flow and storage of surface and underground water, and this Meeting desires the Council of the Institution to consider and report in what directions such investigation might be profitably developed." It is satisfactory to learn that water engineers are themselves dissatisfied with the present position in regard to the records of the flow and storage of surface and underground water. The subject is one of national importance; and for the adequate and equitable utilisation and development of the available water supplies, it is essential that statistical information should be generally available in regard to the distribution and amount of the supplies.

THE proposal in the Electricity Bill (1926) that all the electricity supply companies in Britain should supply alternating current energy at a standard frequency of 50 was the proposal which was most criticised. It was pointed out that in order to standardise the frequency it would be necessary to change over some of the largest supply systems in the country. The National Electricity Board, instructed by the Electricity Commissioners, is now supervising this change. The Electricity Department of the Glasgow Corporation is one of the first to change over. Glasgow, which generates at a frequency of 25 cycles per second, is included in the area covered by the central Scotland scheme. The problem presented by the change over was quickly solved by instructing the English Electric Company to build for the Dalmarnock Power Station a 50 cycle turbo-generator set which has an output of 25,000 kilowatts. This unit takes the place of one of the existing 25 cycle machines. All the other units in the station will gradually either be converted or replaced. Active steps are thus being taken to secure for Great Britain the great boon of an electric supply of standard frequency.

IN connexion with the Associated Edison Illuminating Companies' Convention at Colorado Springs, a spectacular method of illumination was shown. The sunken garden of the Broadmoor Hotel was flooded with invisible ultra-violet rays from quartz tube mercury vapour lamps fitted with powerful reflectors. The light was filtered through special lenses made of Corning glass which obstructs all the visible light. It also prevents the band of short wave energy deleterious to the eyesight from passing through. As silvered glass reflectors absorb ultra-violet rays it was found necessary to make the reflectors of polished aluminium. The flowers, shrubbery, and evergreens were sprayed with chemicals which fluoresced under the ultra-violet rays. The chemicals used were zinc sulphide, eosin and rhodamine. Each individual leaf, twig, or flower glowed in various colours. The water in the fountain in the centre of the garden was also treated with fluorescent chemicals so that it became brilliantly luminous when the rays fell on it.

LEPLAY HOUSE, 65 Belgrave Road, London, S.W.1, deserves wide publicity. Founded in 1920 on sociological principles laid down by Frédéric Le Play, principles that have been interpreted and enlarged by Patrick Geddes in studies associated with the Outlook Tower at Edinburgh, the House has worked steadily toward the better understanding of the complexity of city and regional life. Its work may well be styled the sociology of locality, the study of intricate and multifarious parts and functions as members one of another. From the beginning the main purpose has been to promote and assist discussion, study, and research in the field of sociology, and to apply the results to practical civic developments. This has been done by surveys undertaken through its own members or by voluntary and public organisations acting under its inspiration and advice. No one doubts to-day the wisdom of such surveys. The days of haphazard growth are past. Some scheme or plan of future development based on accurate knowledge of conditions is essential if a better future is to grow harmoniously out of an indifferent present. Local surveys cannot, however, be isolated from each other. Distance is the function, not of space, but time, and new means of transport, of thought no less than goods, are changing rapidly the geographic values of places. Regional surveys need themselves to be surveyed from a national viewpoint. This in practical politics means a central bureau capable and willing to advise and to co-ordinate. Leplay House fulfils these conditions, and the appeal by the Committee for Civic and Regional Institutes made on its behalf for personal and financial support should meet with ready response.

PREVIOUS to the founding of the *Zeitschrift für Krystallographie und Mineralogie* in 1877 by Prof. P. von Groth, whose recent death at the age of eighty-five years we regret to announce, crystallographic papers in Germany had been published mainly in the *Annalen der Physik und Chemie* (Poggendorff), and mineralogical papers in the *Neues Jahrbuch für Mineralogie, Geologie*, etc. The want of a journal devoted to crystallography was then beginning to be felt, but in order to gain a circulation it was at first necessary to add also mineralogy. When, in 1921, the editorship was taken over by Prof. P. Niggli, crystallography had made such rapid advances, due to the new X-ray methods of investigation, that a journal devoted to it entirely could be self-supporting, and the title was accordingly changed to *Zeitschrift für Kristallographie*, as originally planned by Groth. In the current issue—the first part of vol. 66—Prof. Groth gives an interesting historical review and recounts the support he received from workers in many countries during his forty-four years of editorship.

As further marking the jubilee of the *Zeitschrift für Kristallographie*, some other changes are now intro-

duced with the view of making the journal still more international in character. On the wrapper the names of eighteen well-known workers (in twelve countries) are given as associate editors, the representatives in England being Sir William Bragg, Prof. W. L. Bragg, and Sir Henry Miers. Of the fourteen papers contained in this issue, nine deal with the structure of crystals as determined by X-ray methods, and two of these are printed in English. There are also two separately-paged appendices giving connected reviews, rather than a disjointed series of abstracts, of special branches of the subject. Although the *Zeitschrift* is printed and published in Germany, the editor in chief, Prof. Niggli, is Swiss, and an inspiring teacher in Zürich. Such international co-operation in science is a healthy sign and promises well for the future. As further evidence of international goodwill in mineralogy, mention may here be made that, at the annual meeting of the German Mineralogical Society in Breslau last September, Sir Henry Miers and Dr. L. J. Spencer were elected honorary members, and that at the last meeting of the Mineralogical Society of America, Dr. Spencer was elected an honorary life fellow.

EXCAVATIONS at Ur were closed down prematurely last year on account of lack of funds at a moment when exceptionally important finds of jewels and other antiquities gave every promise that the expedition was on the eve of discoveries of the greatest interest. This promise has been amply fulfilled by the opening of the current season. Excavations resumed at the same point have already brought to light a royal tomb of two chambers built of large unhewn blocks of limestone, with walls three feet thick. This is in itself remarkable in an area in which this material was entirely absent, and was, therefore, extremely costly. The tomb had unfortunately been rifled, and the royal chamber produced little; but the outer chamber, in which the king's attendants had been buried, contained one body which had not been disturbed. With this were personal ornaments of gold and silver. A number of copper vessels had been crushed by the roof, but a silver vessel with fluted sides was recovered. Notwithstanding the disappointment of finding the tomb rifled, the discovery is of importance for the light it throws on royal burials in early Mesopotamia. An adjacent grave, however, in which the coffin was intact, has provided a rich treasure. Mr. C. L. Woolley, who describes the find in the *Times* of Dec. 16, considers that it must have been the grave of a member of the royal family, though not of a king. The name Mes-kalam-dug is inscribed on each of the gold vessels taken from the coffin. A great variety of articles in silver, copper, and gold—personal ornaments, axe-heads, lance-points, saws, chisels, etc., as well as gold and silver vessels, was found. One of the most remarkable objects was a gold peruke which completely covered the head of the skeleton from the forehead to the nape of the neck. It is interesting to note that four lances with gold-mounted shafts had been placed, one at each corner of the grave.

IN Germany, high pressure voltages exceeding 100 kilovolts have been used for the transmission of electric power over long distances for nearly twenty years. The cities of Berlin, Magdeburg, Leipzig, and Dresden are provided with electrical energy by means of an extensive 100 kilovolt network, which is supplied by the super-power stations situated in the lignite districts in Central Germany. Overhead lines also transmit at this pressure power obtained from waterfalls throughout the States of Baden and Württemberg. Dr. Cohn, in the October number of *AEG Progress*, published by the Allgemeine Elektricitäts Gesellschaft of Berlin, describes and gives a map of the super tension networks erected and projected in Germany. The development of these networks, although retarded, was not interrupted by the War, and has been taking place very rapidly ever since. It is stated that if we have to consider economy, electric power can only be transmitted about 130 miles at 100 kilovolts. To transmit power economically from southern to central Germany, a distance of about 360 miles, would require a pressure of at least 220 kilovolts. Lattice girder poles are exclusively used for high pressure transmission in Germany. For 220 kilovolt lines the distance between the poles varies from 300 to 400 metres, but when the lines have to cross rivers and valleys much greater lengths of span are used. The Water Power Conference at Basel in 1926 recommended the linking up of the power systems in various countries, as this is to their mutual advantage. In the near future important developments in this direction are expected.

IN 1924, Finland invited representatives of the States bordering on the Baltic Sea to a conference from which resulted the setting up of a Baltic Geodetic Commission to deal with geodetic matters in which co-operation between these States is of importance. The second conference was held in Stockholm in 1926, the countries which took part being Germany, Finland, Sweden, Denmark, Danzig, Esthonia, Lettland, Lithuania, and Poland. The annual contributions of member-States are 500 dollars for the first three and 250 for the remainder. The conferences are held annually, and the report of the 1926 meeting has just been issued. The matters dealt with included re-measurement of the base lines in the various countries by the same observers with the same instruments; the measurement of triangles overlapping two States by observers of each State, independently of each other; the longitude differences between the standard stations in the various States; and measurements of gravity. The Commission considered the enlargement of its scope to include magnetic surveying over the Baltic Sea and adjoining lands, but a decision on the matter was postponed until the 1927 conference.

AN illustrated article by E. H. Wilcox contained in the *Scientific American* for December describes how in the United States large areas are protected from lightning strokes by a ring of high steel towers, the tops of which are connected by wires. The wires are provided with numerous steel points, which dissipate the ground charge induced by a lightning cloud. By continual point discharges the potential gradient

between the cloud and the ground is kept below the value necessary for the occurrence of a lightning flash; the principle of the method is thus opposite to that of the ordinary lightning conductor, which is designed to offer an easy and safe path to the lightning discharge. The wires carrying the discharging points are all well grounded and connected electrically with the reservoir or other object which is to be protected. The method has been applied to great open reservoirs of petrol in California, where temporary over-production has necessitated this method of storage.

PROF. HENRY J. SPOONER has an article in the *Society of Industrial Engineers Bulletin* (vol. 9, No. 9), on the progress of the movement for the reduction of noise. He discusses noise in the home, in the streets, rubber roadways, noise in the work-place, and the cost in human wastage and in depreciation of property. He complains that research bodies have so far done nothing or next to nothing with regard to the problem. With much of what the writer says everyone will be in agreement. The reduction of noise would be of very great value to the community, and there is little doubt that the noise made by some machines could and ought to be diminished. The scientific study, though, of the effects of noise on individuals, whether that noise be in the form of street noises or of particular noise from machines, is not easy. Efforts are being made now by the Industrial Fatigue Research Board to collect data with regard to the effect of noise-making machines in clerical work. So far there has been no evidence of more sick leave or of a higher labour turn-over in departments using noise-making machines than in other departments. The individual reactions to the noise are complicated. One question that arises is how Prof. Spooner has arrived at his calculation of £50,000,000 economic loss through the effects of noise. There are so many variables in calculating the effects of any economic factor that one would like to know whether the figure belongs to the domain of scientific fact or popular fiction.

APPARENTLY there are only a few more parts of that monumental work, "A Critical Revision of the Genus Eucalyptus," by J. H. Maiden, yet to be published, 68 parts having already been issued, so that students of the Australian flora are awaiting the completion of the book, and particularly the key to the species, with eager anticipation. The almost inevitable postponement of publication of the key until the whole work is finished, is one of the chief defects of a monograph of this type in which publication is continued over a period of years, the first part of the present work having been issued in 1903. The difficulties arising from this are enhanced by the fact that no comprehensive scheme of classification of the genus has appeared in Mr. Maiden's "Revision." No doubt this will be remedied in the last parts, but certainly the usefulness of the book up to the present has been greatly impaired by these omissions, unavoidable though they may be. It has been announced that the manuscript for the last parts was completed by Mr. Maiden before his death, so that these may be expected to round off the whole work. In addition to much valuable information of the usual type found in monographs, there is a great deal of subsidiary matter (*e.g.* classification of barks, timbers, fossil records, enemies, ecological notes), often illustrated by copious figures. The economic aspect of the genus has been dealt with fully, while numerous references to other work on the timber, oils, gums, etc., are included. However, unless some arrangements have been made for the issue of special sets bound up differently from the normal, it seems that the morphological and additional information will remain scattered here and there throughout the latter parts of the book. Criticisms in detail are best left until the work is complete: it may be pointed out, however, that the late Mr. Maiden collected an enormous amount of information together, and even as it stands the book is invaluable to anyone working on the flora of Australia.

A SECOND International Conference on Bituminous Coal will be held at the Carnegie Institute of Technology in Pittsburgh, Pennsylvania, U.S.A., during the week commencing on Nov. 19, 1928. The first conference was held at the Carnegie Institute in November 1926, and was devoted to discussions of the better utilisation of bituminous coal. It was attended by 1700 persons, including delegates from thirteen different countries. No definite programme for the second conference has been made, but it is expected that the latest developments in obtaining substitutes for petrol from coal, power from coal, low and high temperature distillation processes, smokeless fuel, gasification of coal, utilisation of coal tar products, coal as a source for fertiliser, and coal in relation to the production of fixed nitrogen, will be discussed.

THE *British Journal of Actinotherapy* for October (vol. 2, No. 7) contains an article by Prof. Birch-Hirschfeld, of Königsberg, on the value of ultra-violet rays in ophthalmology, particularly in the treatment of ulcers of the cornea and conjunctiva. This journal, which is devoted to the medical and scientific aspects of ultra-violet rays, is now published at 17 Featherstone Buildings, W.C.1.

THE Ministry of Health has issued new Regulations (Statutory Rules and Orders, 1927, No. 1004), to date from Jan. 1, 1928, revoking the Public Health (Pneumonia, Malaria, Dysentery, etc.) Regulations, 1919. Trench fever drops out, as it is apparently now an extinct disease. Although malaria remains notifiable, the new Regulations exempt from notification a case of malaria in which the disease has been induced in an institution for therapeutic purposes (*e.g.* the treatment of general paralysis). But such a case, if liable to relapses, must be notified at least four days before discharge to the medical officer of health of the district in which the patient proposes to reside.

THE exhibition by Mr. Burchell and Mr. J. Reid Moir at the rooms of the Society of Antiquaries of finds of archæological interest from Sligo has led two correspondents to express their views in letters to the Editor. Mr. Henry Dewey, of the Geological

Survey and Museum, Jermyn Street, London, S.W.1, states that he has seen the specimens and documentary evidence, and is of opinion that "certain features shown on the 'implements' could be formed only by human agency . . . a parallel as regards their form and technique can be found among the Levallois implements discovered at Northfleet, Kent." Mr. R. Vernon Favell, Penberth, St. Buryan, Cornwall, states that he was greatly impressed by the exhibit, and that "the implements and cores are undoubtedly of human workmanship in the Mousterian manner."

MR. W. E. MILLER, writing from Avenue Rambert, Clarus, Switzerland, describes observations on four occasions recently of a third rainbow bow inside the primary bow, and asks for an explanation of the phenomenon. The rainbow appears to have been a supernumerary (German, *sekundäre*) bow. The optics of these bows is described in the third volume of the "Dictionary of Applied Physics," page 525; in Dr. Humphreys' "Physics of the Air," page 463; and in Pernter and Exner's "Meteorological Optics," 2nd edition, page 531 onwards. On page 594, Pernter and Exner give some notes as to the deductions about the size of the raindrops which can be drawn from the observation of these supernumerary rainbows. It may be of interest to recall that in NATURE of Nov. 9, 1911, there is an account of an observation by Mr. E. Newbery of a number of brilliant rainbows. At one time six rainbows were simultaneously visible, of which four seem to have been supernumerary bows. The colours of supernumerary bows appear usually to be green and violet, but that is not invariably the case. One of the supernumerary bows observed by Mr. Newbery was nearly white.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just circulated Catalogue No. 155 of some 400 new and second-hand books on entomology. It will be sent free upon application.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A demonstrator in physical chemistry in the University of Leeds—The Registrar, The University, Leeds (Jan. 10). A head of the chemistry and industrial chemistry department of the Technical College, Cardiff—The Principal, Technical College, Cardiff (Jan. 21). Lecturers in the Massey Agricultural College, New Zealand, as follow: Inorganic chemistry and soil chemistry, botany and field husbandry, agricultural economics and book-keeping, veterinary science and animal husbandry, agricultural bacteriology, agricultural zoology—The High Commissioner for New Zealand, 415 Strand, W.C.2. A junior assistant chemist under the directorate of explosive research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18.

Our Astronomical Column.

SKJELLERUP'S COMET.—A new orbit of this comet, differing considerably from that of Mr. H. E. Wood, has been computed by Mr. B. H. Dawson, of La Plata, and distributed by the I.A.U. Bureau, Copenhagen.

T	1927 Dec. 18·200 U.T.	
ω	20° 58′	1927·0
Ω	78 43	
i	82 41	
log q	9·5092	

EPHEMERIS FOR 0^h.

	R.A.	Decl.
Dec. 22.	17^h 59^m 12^s	4° 46′ S.
26.	18 7 44	0 17 N.
30.	18 14 24	2 34 N.
Jan. 3.	18 20 10	3 31 N.

The new orbit agrees better than Mr. Wood's with a telegram received by the Astronomer Royal from Mr. Chidambarier, assistant at Kodaikanal Observatory, stating that the comet was seen there (evidently in full daylight) about two diameters east of the sun on the morning of Dec. 15. It was then at its nearest to the earth, log Δ being 9·812.

The new orbit makes the comet brighter than the former one did, but much lower down, and better placed for observation before sunrise than after sunset, though it may perhaps be seen in both positions. The comet was observed at Hanover and Hamburg on Friday evening, Dec. 16, and had an appreciable tail.

JUPITER.—Mr. B. M. Peek and the Rev. T. E. R. Phillips discuss (*B.A.A. Jour.* for November) some recent observations of bright spots on Jupiter's north equatorial belt. The chief point of interest is that the rotation period of the spots was intermediate between the equatorial rate (9^h 50^m) and the temperate rate (9^h 55^m); also the period appeared to increase during the series of observations, thus approximating more closely to the temperate rate. It is very rare to find spots showing these intermediate values. Mr. Phillips suggested that the increasing period might be due to their rising higher in the Jovian atmosphere so that their diurnal circle became larger.

At the meeting of the Royal Astronomical Society on Dec. 9, Prof. Turner exhibited some beautiful photographs of Jupiter taken by Prof. Douglas in light of various wave-lengths. Some of these were arranged to give a stereoscopic effect, by combining exposures a few minutes apart.

THE LIGHT CURVE OF MIRA CETI.—This well-known variable has recently passed through maximum, so it is of interest to note the results of observations in the last few years. There is an article on it in *L'Astronomie* for November, giving the results of three observers, L. Jacchia at Udine, C. Popovici at Galatz, and E. Loreta at Bolognia. Minimum, mag. 9·3, was passed on 1924, Sept. 26, and maximum, mag. 3·4, on 1925, Jan. 10, or 106 days later; there was a curious pause on the decline, in February 1925, when it remained for 16 days at mag. 4 (Observer, C. P.). The next maximum occurred on 1925, Dec. 5, according to E. L., but 6 days earlier according to L. J. Both gave the mag. as 3·1. The next was on 1926, Oct. 24, according to E. L., 3 days earlier according to L. J. Both gave the magnitude as 3·1. The light-curves, as drawn, progress quite smoothly except in February 1925. The last two minima could not be observed, as the star was too near the sun. On the other hand, the maxima now occur with the star near opposition, so the conditions for observation are very good.

Research Items.

ANTHROPOMETRY IN CENTRAL AUSTRALIA.—A first instalment of the results of the University of Adelaide Expedition to Central Australia at the beginning of 1927, which appears in Vol. I of the *Transactions of the Royal Society of South Australia*, gives a general introductory account of the expedition and its method of working, and deals more specifically with the results of the anthropometric observations by Dr. T. D. Campbell and Mr. C. S. Hackett. Two halts were made, one at Ross Waterhole, 40 miles north-east of Oodnadatta, and one at Stuart Town, Alice Springs. The natives observed were Arunta with a few Luritcha, numbering 57 in all, 44 male and 13 female, and with a few exceptions all were full blooded. In addition to the anthropometric measurements, a number of investigations were carried out, including a study of aboriginal songs, and the expedition was fortunate in obtaining a kinematograph film of a circumcision ceremony as well as other films of technological interest. A striking method of locomotion involved in an extreme case of platycnemia provided a film of exceptional interest. The means of the anthropometric measurements given are: stature 1630 mm., head length 189·6 mm., head breadth 142 mm., nose height 52·1 mm., and nose breadth 48·6 mm. Cephalic index 74·7, facial index 81·3, nasal index 93 mm. It is to be noted that the head is slightly broader than that of other records. The larger size of the nose is probably due to the greater preponderance of males. Comparing these results with other records by various workers, it is now possible to give a generalised picture of the Australian as a dolichocephalic, platyrhine with pronounced supra-orbital ridges and protruding lips, in colour dark brown, with low to deep waves on the hair, which is occasionally curly but never frizzy.

SOME CHINESE FROGS AND TOADS.—Mr. Karl Patterson Schmidt, in his "Notes on Chinese Amphibians" (*Bull. Amer. Mus. Nat. Hist.*, vol. 54, Art. 5, Oct. 1927), describes the Chinese amphibians in the American Museum of Natural History, most of which were collected by the third Asiatic Expedition. Amongst these are four new species and one sub-species—three Rana, one Bufo, and one Batrachuperus, which are described in detail. The distribution of the common toads of central China is interesting; a sub-species of *Bufo bufo* being common round about Shanghai and the east, *Bufo bankorensis* very abundant in the west, whilst in between both species occur. Notes on the food of *Bufo bankorensis* show that it eats beetles, ants, grasshoppers, millipedes, centipedes, earwigs, and spiders; also plant remains were found inside it, and even a small toad. *Bufo raddei* had fed entirely on beetles, and *Kaloula borealis*, as is apparently usual in the group to which it belongs, had eaten ants almost exclusively. Careful notes and descriptions are made of all the forms identified, and photographic illustrations given of six species.

NEMATODES OF BIRDS.—Eloise B. Cram (*Bull. U.S. Nat. Mus.*, 140, pp. 465: 1927) has prepared an account of about 500 species of nematodes in approximately fifty genera of the sub-orders Strongylata, Ascaridata, and Spirurata found in birds. Many of the descriptions are from obscure publications, and the author has done her best, often with inadequate data, to produce a critical account. Only seven new species are described. The main emphasis has been placed on the Spiruroidea, which may be regarded as primarily and characteristically bird parasites. These have intermediate hosts which are eaten by birds: the water birds eat the entomostracan intermediate host, and the insectivorous birds acquire the spirurid from insects. The author directs attention to the observation of Seurat that infective third stage larvæ of spirurids in arthropods when eaten by hosts other than the final one, *e.g.* by rodents, migrate into the tissues of such a host and again encyst as third stage larvæ. Such an infected rodent would serve as a passive vector and would account for the infection of birds of prey. Keys are given to the orders, sub-orders, families, genera and species, which will greatly facilitate identification of these parasitic worms, and appended are a list of hosts with their respective parasites, a bibliography, and an index. The Filariodea and the Trichurata are not dealt with in this memoir.

THE NATURE AND EVOLUTIONARY SIGNIFICANCE OF MUTATIONS.—Considerable attention has been refocussed on the problems of evolution by this year's presidential address to the British Association, and the paper on mutations in the *American Naturalist* (vol. 61, Oct. 1927) will be read with interest. Prof. Gates points out that while organic evolution is now generally accepted as a historical fact, there never has been greater difference of opinion concerning the causes of the vast diversification of forms of life we now know. The problem of specific diversity is certainly not a problem with a single solution, although many biologists still try to explain all specific differences and all phylogenies in terms of one evolutionary factor, or on one pet hypothesis. Prof. Gates dismisses the Lamarckian factor as having so far no satisfactory experimental evidence; he is of opinion that the melanic variations of *Tephrosia bistortata* obtained by feeding the larvæ on smoke contaminated foliage cannot be given a Lamarckian setting. These variations are in fact due to actual germinal changes induced in certain of the germ nuclei. In recent years our increased knowledge of the structure of gametes of organisms, and the way in which differences arise in the germ-plasm and are transmitted by inheritance, has thrown much light on problems connected with mutations. Mutants show visible gametic differences—differences in arrangement and structure of the chromosomes. These discrete changes in the germ-plasm are of many kinds, some 'spontaneous,' some connected with crossing, some induced by environmental factors. Of whatever kind, they must have played an important rôle in the production of species and varieties. In the tracing of phylogenies an increasing amount of importance is attached to parallel mutations and convergences, and the tendency of modern phylogenies is to deal less with divergences and more with parallelisms and convergences, a tendency shown in the recent conclusions of Bower on the phylogeny of the ferns.

CHIMERAS IN POTATOES.—Bud mutations in potatoes, involving changes in colour or shape of the tuber, are well known, but a 'kostroma' mutant from the Russian variety *Imperator* differs from the normal only in having more dissected leaves and corollas. As described by Miss T. Asseyeva (*Jour. of Genetics*, vol. 19, No. 1), this mutant remains nearly constant when propagated from tubers, but occasional leaflets revert. Removal of the 'eyes' from a tuber leads to the regeneration of fresh buds which usually show reversion to the normal parent form. In this way

the 'kostroma' mutant was shown to be a chimera. Similar experiments with several other potato varieties lead to the conclusion that many of them are periclinal chimeras in which the outer layer of the tuber differs in its genetical capacities from the inner ones. This may account for some of the phenomena of pollen sterility in potatoes, as well as for the fact that forms produced from seeds frequently have tubers different from the parent clone. It may also have an important bearing on the question of 'running out' in potato varieties. Several of the common varieties are indicated as chimeras, though they may also be hybrid in the ordinary sense. The author suggests that bud mutations are usually of a chimerical nature, but there is no indication as to how the potato chimeras may have arisen.

FOREST AND PRAIRIE.—At the last meeting of the National Academy of Sciences at Washington, Prof. Henry C. Cowles, of the University of Chicago, discussed the probable fate of the great stretches of rolling grassland beginning in Illinois and stretching across Iowa and Minnesota into Kansas and Nebraska, if they had not been ploughed into corn and wheat lands. A brief account of the paper has been issued by Science Service, of Washington. Prof. Cowles distinguished two types of prairies, edaphic and climatic. The former, occurring as interruptions in otherwise forested areas, are due to peculiar conditions of soil, soil water, soil chemistry or other soil conditions where they occur. This type is by no means permanent, but exists as a stage in the development of some more stable type of vegetation. The trees that surround the edaphic prairie modify soil conditions along the border until they are able to creep over it and establish themselves on the grassland. Climatic prairie is typified by the unbroken stretches of grassland in the west, and its existence is determined by general climatic conditions, regardless of local differences in soil. It is a permanent type, to which all kinds of plant assemblies in the region gradually revert if left to themselves, for the climatic conditions under which it develops are unfavourable to tree growth. 'Tension line' prairies also, which occupy an intermediate position between edaphic and climatic prairie, will in the end become forest under a state of Nature.

GEOGRAPHICAL FACTORS IN THE COTTON INDUSTRY.—The dependence of the cotton industry of Lancashire on imported raw material makes its location and growth at some distance from a seaport not a little remarkable, and especially was this the case in its early days, in the sixteenth and seventeenth centuries, when land transport was bad. In a paper in the *Journal of the Textile Institute* for November, Mr. H. W. Ogden discusses the geographical basis of the industry. His paper is particularly valuable for the number of old and modern maps with which it is illustrated. He takes into account only the geographical factors, without denying that historical causes have also played their part. The cotton port was originally Chester, and it was not until the Dee lost its usefulness by silting that, early in the eighteenth century, Liverpool began to displace it. Mr. Ogden goes at length into the distribution of weaving and spinning in the cotton manufacturing area, and shows that the important geographical factors were the upland area to the east, with abundant rainfall, giving an even supply of soft water throughout the year. Soft water in abundance is required for all the processes of manufacture, while the application of steam power to the industry caused a further demand for it. Details are given of the distribution of rainfall.

OCEAN WEATHER.—A useful series of data is collected and tabulated from various sources by the Koninklijk Nederlandsch Meteorologisch Institut bearing on the weather of the Atlantic, Pacific, and Indian Oceans. The pamphlet (*Publication* of the Institute, 107 B) giving the data for 1925 has now appeared. There is no map, but the ocean is divided into ten-degree squares from lat. 25° N. to 30° S. in the Atlantic, from lat. 10° N. to 20° S. in the Indian, and from 30° N. to 30° S. in the Pacific Ocean. For each month, in each square, is given the force and direction of the wind, pressure, temperature of the air, and water, cloud, and percentage of hours of rain. A few squares in the Pacific are blank, and the figures in some squares, especially in the Pacific and Indian Oceans, are based on few observations. Others in the northern Indian Ocean are the result of several hundred records. The publication is considerably interesting, especially after the data have been plotted on charts.

RIFT VALLEYS.—An important paper on fault troughs, both superficial and profound, appears in the *Journal of Geology*, p. 577, 1927, from the pen of Stephen Taber. He reviews the evidence bearing on the origin of the greater features of this kind, such as the rift valleys of Africa and the Rhine, and concludes that they have not been formed by thrust faulting. Of the responsible factors he favours tension as the most important, and shows that normal faulting should be accompanied by an uptilting of the plateaux along the rims of the trough. It is realised also that extrusion of lavas and increase of density of the material in depth—due in part to expulsion of gases and crystallisation—must be contributory causes in many places. There appears to be some confusion between oceanic deeps and rift valleys, but the author is wise in advocating a complete investigation of the Bartlett trough by the co-operation of geodesist, geologist, seismologist, and oceanographer.

PHOTO-ELASTICITY.—Volume 7 of *Scientific Papers* from the Institute of Physical and Chemical Research of Tokyo contains three papers by Mr. Z. Tuzi on the properties and applications of a new material, 'phenolite,' intended for photo-elastic research. It is made from phenol and formalin by the catalytic action of ammonia and is baked at 150° C. It is easily worked, takes a fine polish, is very transparent, and light yellow in colour. It breaks in tension at 300 kilograms per sq. cm., its extension being proportional to the load up to the breaking point. When examined in polarised light under stress, about 10 equal stress bands are visible before the breaking point is reached, so that it admits of a much more accurate estimate of stress than does celluloid. Its coefficient of volume expansion is 0·000564 and its heat conductivity 0·00044 at 35° C. Photographs of the stress bands are given for beams of both uniform and varying thickness when loaded and when heated to 140° C. and plunged into cold water.

LIGHT QUANTA AND INTERFERENCE.—Some interference experiments with weak sources of light, which are described by A. J. Dempster and H. F. Batho in the November issue of the *Physical Review*, show in a conclusive way that a single quantum of radiation has sufficient extent to produce fringes. The helium line at 4471 A was employed, as its decay constant is known from the experiments of Prof. Wien with positive rays, and its intensity was determined in each instance by comparison with the radiation from a black body. Using an echelon grating, the characteristic double order patterns which could be photographed showed that the quantum retained its

coherence after simultaneous passage through several steps, whilst with an air film between parallel plates, an even more stringent test could be imposed, which showed that a quantum follows the classical laws of reflection and transmission, and recombines afterwards with the difference in phase required by the wave theory of light.

ETHER DRIFT.—The latest repetition of the Michelson-Morley experiment, which is described by K. K. Illingworth in a recent issue of the *Physical Review* (p. 692), has yielded a null result, no ether drift being recorded greater than one kilometre per second, the probable error of the measurements. An interferometer was used of the modified type in which one of the totally reflecting mirrors is interrupted by a small step of about one-twentieth the wave-length of green light, upon which the fringes are formed and viewed. The half-shade appearance of the line of dislocation gives an accurate means of detecting small differences in path, so that a careful untrained observer can notice a shift of less than a thousandth of a fringe. The experiments were performed in the California Institute of Technology at various times during the summer of 1927, and included runs made both under isothermal conditions and with slow progressive changes of temperature, the effect of which could be eliminated in the final analysis of the observations.

A NOVEL ELECTRIC FURNACE.—A new form of electric furnace is described in the *Chemiker-Zeitung* of Nov. 9, which is suitable for heating quartz or porcelain combustion tubes to a temperature of 1300° C. It is mounted on rails in such a way that movements of ten to forty centimetres are possible in four directions. This enables one to remove the furnace from the hot tube and to keep it hot while the tube is cooling. The furnace is supplied by the firm Laboratoriumsbedarf Gesellschaft, Essen.

THE CRYSTAL STRUCTURES OF MERCURIC AND MERCUROUS IODIDES.—An investigation of the crystal structures of the mercury iodides carried out by M. L. Huggins and P. L. Magill, and published in the October number of the *Journal of the American Chemical Society*, confirms the previous results of other workers. Crystals of both compounds are tetragonal and the required data for the analysis were obtained from Laue and spectral photographs. In the case of mercuric iodide, HgI_2, each mercury atom is surrounded tetrahedrally by four iodine atoms each at a distance of 2·77 A., and each iodine atom by two equidistant mercury atoms. The molecules appear to be arranged in layers, and the shortest distance between two iodine atoms in different layers is 4·10 A. The crystals readily cleave parallel to the (001) faces and this is probably accounted for by the fact that the attractive forces between the layers are much weaker than those between the atoms in any one layer. Mercurous iodide, Hg_2I_2, is an aggregate of IHgHgI molecules, each mercury atom being surrounded by four iodine atoms and vice versa. The shortest interatomic distances are: Hg – Hg, 2·72 A.; I – I, 3·42 A.; Hg – I (on same tetragonal axis), 2·75 A.

ALUMINO-SILICATES AND OXALATES. — Alumino-silicates are of considerable variety and of abundant occurrence in the mineral kingdom, and many views have been expressed as to their constitution. Recently, Prof. Walter Wahl, of Helsingfors, in a series of papers published in Finnish journals and summarised in the *Zeitschrift für Kristallographie* (vol. 66), has worked out a complete analogy between these and the alumino-oxalates. He had found that certain alkali aluminium trioxalates can be split up into optically-active enantiomorphous isomers. It therefore becomes necessary to write a co-ordination formula with a central sexavalent (co-ordination number of 6) aluminium atom surrounded by six (C_2O_4) groups, giving a complex tervalent anion. In some of these complex compounds the central aluminium atom is quadrivalent (co-ordination number of 4). Replacing the oxalate groups by 'silicyl' (SiO_3) and 'disilicyl' (Si_2O_5) groups, co-ordination formulæ on the same lines are written for a large number of minerals. For example, orthoclase is written shortly as $[Al_2(SiO_3)_2(Si_2O_5)_2]K_2$ and leucite as $[Al_2(SiO_3)_4]K_2$; these formulæ suggesting an explanation of the breaking down of orthoclase into leucite and silica at a high temperature. Polymerised formulæ for the micas occupy almost a page of print. Silica also is not always quadrivalent in the silicates, as suggested by analogy with the fluosilicates $[SiF_6]R'_2$, and there may thus be isomorphous replacement of silica with co-ordination number of 6 by aluminium also with co-ordination number of 6. Such a replacement had indeed been suggested by P. A. von Bonsdorff in 1821, but this was acceptable only before the current views of valency had developed, and these it seems must now be modified.

THE 'ISOMERIC' CHLORIDES OF RUTHENIUM. The results of work carried out by J. L. Howe and described in the October issue of the *Journal of the American Chemical Society*, seem to dispose of two of the problems connected with the chemistry of ruthenium, namely, the apparent existence of two isomers in the K_2RuCl_5 series and the valency of ruthenium in the blue compound formed when ruthenium solutions are treated with a strong reducing agent. It is shown that the series previously considered to be $M_2Ru^{iii}Cl_5$ is really $M_2Ru^{iv}Cl_5OH$ containing quadrivalent, instead of tervalent, ruthenium, and that the so-called 'aquo' series is actually an ordinary series of tervalent ruthenium crystallising as $M_2Ru^{iii}Cl_5 . H_2O$. There are, therefore, no isomeric ruthenium chlorides, and since K_2RuCl_5 does not exist, a possible co-ordination number of five can no longer be claimed for ruthenium. In all the above salts the co-ordination number is six. Hydrated ruthenium oxide is usually considered to be $Ru_2O_3 . xH_2O$, but is more probably $RuO_2 . xH_2O$, since in solution it always gives H_2RuCl_5OH. When the latter substance is reduced by two units, it gives the blue solution referred to above, which, therefore, contains bivalent ruthenium, as Claus supposed.

VARIATION OF ENGINE POWER WITH HEIGHT.—The manner of variation of the power of an engine with height has been the subject of much discussion in certain scientific circles for some time. It is of fundamental importance in the reduction of aeroplane performance to a standard basis of comparison. Many investigations have been pursued to determine whether it is more accurate to regard the engine power at a definite rate of revolution as a function of the density only or of the pressure only. Recently Mr. Capon (R. and M. 1080, Aero. Research Committee. London: H.M. Stationery Office. 4*d.* net) has suggested that the power is more precisely represented as a function of $(\text{pressure})^{2/3} \times (\text{density})^{1/3}$. In a memorandum (R. and M. 1099, Aero. Research Committee. London: H.M. Stationery Office. 4*d.* net) entitled, "A Discussion of the Law of Variation of Engine Power with Height," Mr. Glauert reviews this whole subject and shows that the simple pressure law is undoubtedly better than the simple density law, but for greater refinement, Mr. Capon's suggestion certainly gives a very close approximation to the truth.

A Recent Modification of the Species-Idea.[1]

By Dr. A. B. DROOGLEEVER FORTUYN.

IN view of the necessity of naming every organism, and from the fact that such a name often must be corrected when new biological facts become known, it follows that taxonomic systems are always changing. Even the species-idea, which is the basis of taxonomy, is changing. The question which group of organisms has a right to be called a species has been answered in different manners in different times. It seems to me that the question is always answered in agreement with the development of biology in general.

Lamarck and Darwin founded the species-idea upon organs and their changes as revealed by morphology and physiology. Mendel was the first to discover a means of analysing the organism through other than morphological and physiological concepts. He detected the now well-known hereditary units or genes, these being the more natural units than organs.

Because genes represented a new principle in the analysis of the organism they also came to be used as a new basis for the species-idea. This was done by Hugo de Vries in his mutation-theory, in which the existing species-idea of Lamarck and Darwin was partly changed and partly consolidated. A species from the point of view of de Vries—and I believe I may say that this is the prevalent species-idea at the present time—is a group of organisms possessing the same hereditary qualities, the same set of genes, and thought to be genetically pure. In recent years the work of Johannsen and others has given us more insight into the question of what really constitutes a group of organisms that is pure in respect to heredity. Johannsen has termed groups of genetically identical organisms pure lines and a mixture of them a population. Pure lines are not the species of Nature, though they can be isolated from the latter.

We cannot define a species as a group of organisms having the same genotype,[2] for it is known that often the male and the female of one species differ in the number of their chromosomes and in the number of their genes. Thus our idea of species must be wide enough to include organisms with genetical differences, as Dr. Hagedoorn and his wife, Dr. Vorstheuvel la Brand, have so ably shown in their book, "The relative Value of the Processes causing Evolution," The Hague, Martinus Nijhoff, 1921.

The Hagedoorns urge us to remember that a species is a natural phenomenon and not a theoretical conception. Species, as found in Nature, are mixtures of genotypes, so if we follow Johannsen and term such a mixture of genotypes a population, a species is a population, but not every population is a species. In order to be a species the individuals of a group must interbreed. Groups of organisms unable to propagate with one another do not belong to the same species. Therefore a species is a mixture of genotypes freely interbreeding and containing some types of homozygotes as well as several types of heterozygotes or hybrids.

Just because there is free interbreeding the group as a whole will have more or less constant composition and features, the type of the species. The absence of complete constancy in the character of a species doubtless renders it sometimes difficult to define, but on the other hand, as we know that species in Nature are changing and unstable, our definition must take this fact into consideration.

Independent of the work of the Hagedoorns such ideas are rising in the minds of several investigators to-day. E. S. Goodrich, for example ("Living Organisms," Oxford, Clarendon Press, 1924, p. 151), called a species "an assemblage of closely allied and interbreeding races, differing from each other by small factorial differences, and representing as a whole its present phase of evolution." The great plasticity of such a definition of the species is obvious.

So far as I know, no one has worked out this new idea of inconstant and impure species more in detail than the Hagedoorns, who have done so with much success. Although a species is inconstant and genetically impure (that is, composed of many genotypes and their hybrids), it always tends to become more constant and more pure because in the struggle for existence an elimination of ill-adapted genotypes takes place, and because new genotypes may only be introduced through rare cases of mutation or of crossing with other species. Therefore in accordance with the Hagedoorns we may call a species "a population which is so situated and constituted that it tends automatically to reduce its variability."

Under domestication so-called varieties exist side by side with the species to which they belong, though in Nature this is not the case. Among the sparrows, for example, we find now and then a white specimen; but these albinos propagate with gray sparrows and return in their offspring to the species. According to the Hagedoorns varieties do not exist outside a species, but within it. They call a variety "those individuals together which differ in some marked way from the common type, when there is nothing in the circumstances which isolates these organisms and prevents them from crossing freely with typical ones."

If a species be composed of many genotypes, the addition of one new genotype will not much alter the species. Therefore even a mutation will not always obviously change a species, but mutation remains a source for new genes and consequently for new genotypes, so it remains in this way one of the origins of species. On the other hand, new species may arise, apart from mutation and hybridisation, by mere isolation.

If a continental peninsula be transformed into an island and some members of a species originally continental thus become isolated, then the mixture of genotypes represented by the individuals on the island may be different from that obtaining among the individuals remaining on the continent. Both mixtures will move towards their own equilibrium, and therefore so long as they are isolated the island and the continent will each have its own species. These species would have arisen suddenly and without adaptation. In this way the fact may be explained that islands like the Galapagos having similar climate and conditions but being isolated from one another by deep seas have each their own closely related species of many types of animals and plants, a fact which Darwin failed to explain.

This new species-idea is of importance because it shows that there is no reason for specific discrimination among the individuals of a group freely interbreeding. Take, for example, the house-rat. Be it presumed that from Norway to Manchuria, through Europe and Asia, all house-rats are freely inter-

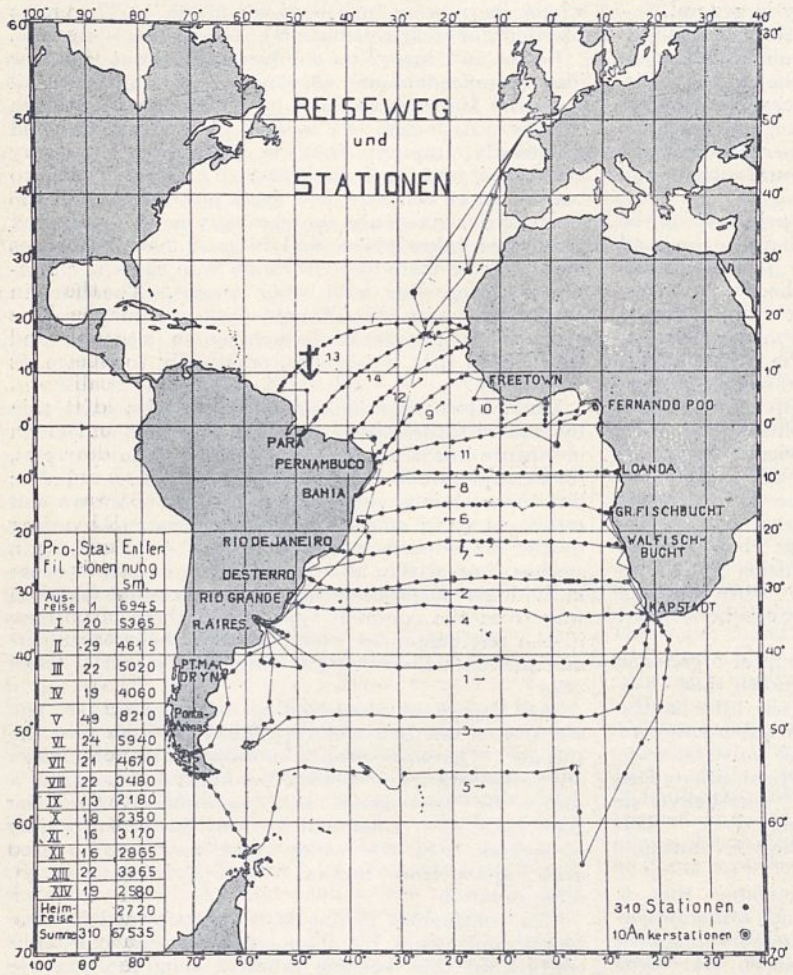
[1] From the Department of Anatomy, Peking Union Medical College, Peking, China. Substance of a communication read before the Anatomical and Anthropological Section of the China Medical Association in Peking, September 1926.

[2] Genotype here means type of a set of genes, not the type of a genus.

breeding. In that case they belong to one species, *Mus decumanus* or *Mus norvegicus*. There is no reason to call the rat of Manchuria, even if it differs from the European rat, a sub-species (*Epimys norvegicus caraco*) or even a different species (*Mus caraco*) as has been done. Variation is found everywhere, for the very reason that a species is a population of many genotypes. If one wants a pure genotype one will not find it in Nature, but one may isolate it from the natural stock by breeding the rats scientifically. Therefore in research work it is often advisable either to use the impure species as such or to work with material which has been artifically and thoroughly purified, but not with an arbitrary impure portion of the whole impure species.

A taxonomic name represents a phenotype, although it always suggests a genotype. In how far it really represents a genotype may only be detected after scientific breeding. Whether it represents a species may only be decided after a careful study in Nature of the life of the individuals indicated by the name. For these reasons palæontological names can never be proved to indicate more than phenotypes.

This new species-idea is also of significance in the field of anthropology, for if mankind as a whole be freely interbreeding, then biologically speaking, mankind is only one species. It is a species so much the more because it tends to reduce its own variability by the extinction of some minor races and by other means. Pure lines are absent in man, while hybrids, on the other hand, are numerous, because even the children of a man with brown and a woman with blue eyes must be called hybrids. The groups recognised by anthropology as races certainly are heterogeneous portions of a heterogeneous whole, and their true nature cannot be fully understood without a thorough genotypical analysis.



Profil	Stationen	Entfernung sm
Ausreise	1	6945
I	20	5365
II	29	4615
III	22	5020
IV	19	4060
V	49	8210
VI	24	5940
VII	21	4670
VIII	22	0480
IX	13	2180
X	18	2350
XI	16	3170
XII	16	2865
XIII	22	3365
XIV	19	2580
Heimreise		2720
Summe	310	67535

FIG. 1.—Track and hydrographic stations of the *Meteor*. From "Die Deutsche Atlantische Expedition auf dem *Meteor*."

Hydrography of the South Atlantic.

THE cruise of the ex-gunboat *Meteor* terminated at Wilhelmshaven at the end of May last, after traversing 67,535 sea miles and crossing the South Atlantic thirteen times between Africa and the South American continent. This is the only survey of the physical and chemical conditions of an ocean on such an extensive scale.

The fourth and final report of the expedition[1] shows that the programme of work, drawn up by the late Dr. Mertz, has been very completely carried out, in spite of difficulties incidental to work of this nature. When the results of the observations are worked up and finally published, they will form a considerable addition to our knowledge of physical oceanography, and in all probability fundamental principles will emerge having applications of practical value. Whether this happens or not, scientific exploration of this nature is an effective way of 'showing the flag,' an exceptional experience for the naval officers employed, and sound training for apprentices and seamen.

Since H.M.S. *Challenger* was sent in 1872 on a voyage of exploration of the conditions and life within the oceans, Germany has added much to our knowledge through the expeditions of the *Valdivia*, *National*, *Planet*, *Deutschland*, and now of the *Meteor*. After the voyage of the *Challenger*, interest in the physical conditions of the oceans centred mainly in the drift of warm Atlantic water towards the north-west seaboard of Europe. Observations, mostly by the Scandinavians, led to the inference that this moved slowly towards the Norwegian coast, the drift being stronger in some years and weaker in others, and that these fluctuations in strength of the drift ran hand in hand with fluctuations in general weather conditions and affected the fisheries, most of which are seasonal and sometimes fail. It is to be hoped that an investigation, on a scale commensurate with the German South Atlantic Expedition, may sometime be possible in the North Atlantic, and particularly in the area to the westward of France and Ireland. A wide field for inquiry still remains open.

The report deals mostly with the programme of work carried out rather than with the results obtained. Undulatory movements in the water layers below the surface were found by A. Defant, most marked at and below the thermocline. Similar

[1] "Die Deutsche Atlantische Expedition auf dem *Meteor*." IV. Bericht. *Zeit. des Gesells. für Erdkunde*, Berlin, 1927, Nr. 5/6.

undulations have been observed by Helland-Hansen (see NATURE, Jan. 1, 1927, p. 18) in the North Atlantic. A rise and fall of both temperature and salinity was very marked at depths between 100 and 250 metres at a position shown by an anchor on the track chart (Fig. 1) where the depth was 4350 metres. These undulations appeared to be composed of waves having a period of about 12½ hours and of shorter waves with a period of 2¼ hours, as a gross result of which the temperature at 100 metres varied between *circa* 22°·2 C. and 24°·6 C.

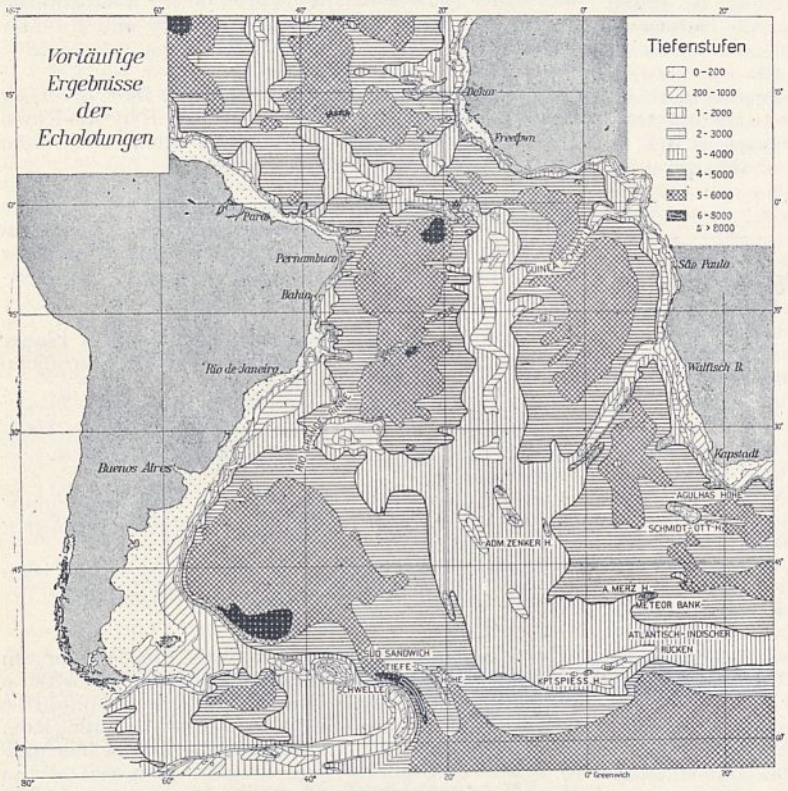


FIG. 2.—Depths of the South Atlantic Ocean from the preliminary results of sonic soundings by the *Meteor*. From "Die Lotungen des *Meteor* und die Nautik."

A separate contribution by H. Maurer[2] deals with the preliminary results of the bathymetric survey in which sonic and direct sounding was employed (Fig. 2).

[2] "Die Lotungen des *Meteor* und die Nautik." *Ibid.* Nr. 7/8.

Larch Canker in Britain.

THERE is probably no more striking example of the assistance which the botanist, and more especially the forest botanist, can render the forester than that afforded by the history of the larch canker in Britain. The introduction of the European species of larch (*Larix europœa*) in the eighteenth century was followed by plantings, for the time, on a considerable scale. The fact that, owing to the durability and value of the wood, all sizes from an early age (*e.g.* for sheep-net stakes) are utilisable, resulted in the species being planted without reference to the kinds of soil it required, or, as important, in the absence of any working knowledge of the necessary thinnings which the young plantations required. Old ideas and opinions, founded on premises which lack the necessary scientific study of facts upon the ground, are difficult to eradicate.

The appearance of the larch canker (*Dasyscypha calycina* Fuckel) in Britain and the devastation caused by this fungus in larch woods led to a scare in the later years of the nineteenth century. In some cases woods were so seriously infested as to justify their removal *en bloc*. Many others which with the knowledge of the disease now available could have been left standing, the seriously attacked trees only being felled, were cut down. Worse still, larch grown in mixture with Scots pine and spruce were ruthlessly cut out under the mistaken idea that the fungus infection would spread. In other words, that most disastrous occurrence in forestry, a 'species scare,' took place. A much saner view of the position was taken during the early years of the present century. The disease was studied out in the woods, and with the fuller knowledge obtained, many owners ruefully recognised that some of their older standing woods had been reduced in value by 50 per cent. or more owing to the wholesale removal of the larch a score of years or so earlier.

Two primary causes for the widespread attack to which the larch was subjected were established: the unsuitability to the species of many of the soils or localities in which it was planted, and the excessive density of the unthinned plantations. Both were undoubtedly contributory causes to the universal spread of the disease. It was established at the same period, however, that infected trees did not necessarily succumb to the attack; and that a young plantation of a few years' standing in which a considerable portion of the trees were infested would not die. The removal of the worst of the diseased trees should be carried out, the rest being left and kept under observation. There are instances where such plantations have completely recovered.

A description of this fungus and suggestions for its control are discussed in a *Leaflet* (No. 16) recently issued by the Forestry Commission. It is pointed out that the European larch is chiefly affected, the more recently introduced Japanese larch (*Larix leptolepsis*) being seldom attacked; on the other hand, the West American larch (*Larix occidentalis*) appears to suffer even more than the European.

Under methods of control, the author of the *Leaflet* lays down, quite correctly, the necessity of not planting larch upon unsuitable soils. The dictum applies equally to many species, but is especially necessary in cases where a serious disease has made its appearance in the country: since the planter not only risks losing his own plantation, but his mistake also leads to the infection of neighbouring ones. On the subject of spacing, the author perhaps follows unconsciously the present policy of the Forestry Commission and advocates, in order to reduce the possibilities of attack, wide spacing in the formation of the plantations: "Never less than four and a half feet, or on the better sites five and a half to six feet." This opinion is widely held in Great Britain at the present day. But it appears to be based on two fallacies. First, owing to the fact that the correct mode of thinning larch was not understood as practised in the

past, the plantations became congested, damp, and airless, and bad attacks of canker followed. Secondly, the larch has always been raised in plantations from planted-out plants. Saving one or two instances only, no larch wood has originated from natural regeneration or from sown seed in Great Britain. The *Leaflet* in question, and many other writers, appear to assume that larch will never be raised in dense natural woods in Britain. It appears at least doubtful that this assumption is likely to prove justified. As the *Leaflet* shows, the life history of the fungus and the conditions it requires to thrive in are now available to all. Many of the mistakes of the past are thus avoidable. Once the correct methods of thinning are applied, it is reasonable to surmise that it may be possible to raise larch in Britain as well as other species in dense young woods and thus produce a finer quality of timber.

Activities of Czechoslovak Engineers.

THE magnitude of engineering undertakings in Czechoslovakia is not generally realised. The publication of the "Almanac" of the seventh conference of Czechoslovak Engineers and Architects (a profusely illustrated quarto volume of 432 pages) directs attention to the achievements of its members. The greatest Czechoslovak engineering concern, the Skoda works at Pilsen, occupies an enormous area, and the history of its precursor, the firm of Laurin and Klement, shows what rapid strides have been made in the construction of engines and motors for various purposes.

In the conference proceedings three authors dwell upon the extension of the use of power alcohol, whilst other chemical engineers foreshadow the use of both old and new poison gases in future warfare.

Sugar is an important item in their export trade, and an account is given of the latest practice at a number of well-known factories. The report from the Semčice Experimental Beet-growing Station also gives an idea of the progress made in improving both the crop and the sugar content of the beets.

Mladá Boleslav, in north-east Bohemia, where the conference met, is near the centre of the gem, glass, and textile industries. Reference is made to all these in the "Almanac," which gives descriptions of the garnet-cutting industry at Turnov, the glass-making at Jablonec, and the textile trade of Liberec (Reichenberg).

Another subject which received attention is long-distance telephony. The construction and equipment of stations for this work and the essentials for good transmission of speech by cable or radio were described, together with an account of the transmission stations of Prague, Brno, and Bratislava.

Technical education has not been neglected in Czechoslovakia, and the principals of a number of special schools indicated to the conference the lines upon which their work is carried on, and make mention of the good results that have accrued.

An interesting feature of the conference was that prominent industrialists and statesmen were invited to suggest in which directions they considered there was scope for improvement and further development in engineering activities and to indicate where engineers had neglected to make the necessary developments in the past. Several instructive replies are printed in the proceedings, and it may be added that they are applicable to other countries besides Czechoslovakia.

University and Educational Intelligence.

CAMBRIDGE.—Dr. M. Dixon, Emmanuel College, has been appointed University lecturer in biochemistry.

Under the will of the Rev. J. H. Ellis a sum of about £65,000 will shortly pass to the University. The Council announces that it has given preliminary consideration to the possibility of finding from this and other sources means to provide for a substantial portion of the new University Library and for new lecture rooms for the literary faculties. A detailed report will be made next term.

Sir Humphry Rolleston will represent the University next May at the tercentenary celebration by the Royal College of Physicians of the publication of William Harvey's book, "De motu cordis."

LONDON.—An offer by the joint committee of the Paviors' Company and of the Institution of Municipal and County Engineers to establish a part-time chair of highway engineering in the University for post-graduate students has been accepted.

OXFORD.—Cecil Graham Traquair Morison, reader in agricultural chemistry, has been elected to an official studentship at Christ Church.

John Carew Eccles, Rhodes Scholar from Melbourne, has been awarded the Francis Gotch Memorial Prize and has been elected to a junior research fellowship at Exeter College.

John Hulton Wolfenden, Procter Travelling Fellow of 1924–5, has been appointed lecturer in chemistry at Exeter College.

Stanley Carson, Fellow of New College, has been elected a member of the Committee of Geography.

NEW science laboratories at the City of London School were formally opened on Dec. 20 with a reception by the chairman of the school committee (Mr. Cecil F. J. Jennings) and the headmaster (Rev. Dr. Prebendary Chilton), followed by a conversazione to which 1500 guests were invited. The site of the school on the Victoria Embankment is probably as fine, and certainly as valuable, as that of any school in the kingdom. The penalty of eminence in this case is the difficulty of extension. The present alterations have been carried out at a cost of £22,000, and include four class rooms, a large lecture hall, a new dining-room, an armoury, and the remodelling and refurnishing of the whole of the top floor for the teaching of science. All this has been accomplished without encroaching to any appreciable extent on the playground space. The new extensions were rendered necessary by recent movements in the direction of teaching science on a broader basis and to larger numbers of non-specialists. The school was one of the first to introduce natural science into its curriculum. This teaching was by 'block' lectures covering a wide range and taking in the whole school, but with very little opportunity for practical work. It has been the fashion of late to depreciate this kind of teaching; nevertheless, the fact remains that many old citizens who became famous in after life had their enthusiasm aroused and their imaginations stirred by these lectures. This, rightly or wrongly, was followed by a period of increasing specialisation for the comparative few and concurrent limitation of opportunity for the rest. The new movement is towards a broadening of the basis for all. General science, including biology, will be taught on the classical side, physics-with-chemistry on the modern side, while on the science side limited specialisation in physics, chemistry, and biology will be possible.

Calendar of Discovery and Invention.

December 25, 1758.—Newton having stated the principles by which the orbit of a comet could be determined, Halley traced the paths of twenty-four comets which had appeared between 1337 and 1698. Finding three tracks closely resembling one another, he was led to the conclusion that the so-called three comets were but different appearances of the same comet at intervals of about 75 or 76 years. Further investigation, in which he allowed for the retarding influence of Jupiter on the comet, led to the prediction of this comet's return. He knew he could not live to see it, but he wrote, "If it should return, according to our predictions, about the year 1758, impartial posterity will not refuse to acknowledge that this was first discovered by an Englishman." As the time for its reappearance drew near, its orbit was recalculated and the comet was recognised on Christmas Day, 1758.

December 27, 1831. — Recommended by Prof. Henslow to Captain Fitzroy, who was about to set out in H.M.S. *Beagle* to survey Patagonia, Terra del Fuego, Chile, Peru, and some of the Pacific Islands, Darwin, then twenty-two years of age, joined the expedition as naturalist, and the *Beagle*, after being driven back twice by gales, finally left Devonport on her famous voyage on Dec. 27, 1831. The trip lasted nearly five years, the vessel reaching Falmouth on Oct. 2, 1836.

December 28, 1814.—It was while serving as a government civil engineer in the Corps des Ponts et Chaussées that Fresnel, on Dec. 28, 1814, wrote to a friend inquiring what was meant by the polarisation of light. The information obtained was quickly mastered, and from that time dates the beginning of his valuable studies in optics.

December 28, 1895.—On a building, at 14 Boulevard des Capucines, Paris, is a tablet commemorating the first public display of a kinematograph film by the Brothers Lumière on Dec. 28, 1895.

December 29, 1566.—Few men of science have been called upon to fight a duel, but Tycho Brahe's fight at Rostock must always remain of interest to astronomers. Tycho's quarrel with his adversary, Manderupius Pasbergius, is said to have originated in a difference of opinion respecting their mathematical acquirements. The duel took place on the dark evening of Dec. 29, 1566, Tycho then being twenty years of age. In the fight Tycho lost his nose, but, as Brewster remarked, "it was fortunate for astronomy that his more valuable organs were defended by so faithful an outpost."

December 31, 1839.—Weld's "History of the Royal Society" contains some interesting notes on Herschel's great telescope, and includes "The Herschelian Telescope Song," the "Requiem of the Forty-feet Reflector at Slough," written by Sir John Herschel, "to be sung on the New Year's Eve, 1839–40, by Papa, Mama, Madame, and all the Little Bodies in the tube thereof assembled." Three of the verses ran:

Full fifty years did he laugh at the storm,
And the blast could not shake his majestic form;
Now prone he lies, where he once stood high,
And search'd the deep Heavens with his broad bright eye.

There are wonders no living wight hath seen,
Which within this hollow have pictured been;
Which mortal record can ne'er recall,
And are known to Him only who makes them all.

Here watched our father in wintry night,
And his gaze hath been fed with pre-Adamite light;
While planets above him, in circular dance,
Sent down on his toils a propitious glance.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, Dec. 8 (*continued from p.* 902).—F. H. **Constable**: Spectrophotometric observations on the growth of oxide films on iron, nickel, and copper. The reflecting power of the metallic films increased considerably on activation; this explains the brightening of the oxidation colours consequent on the oxidation of the metal. The phenomenon was imitated by oxidising a cylinder of metallic copper divided into four portions, burnished, sandpapered, and two electrolytically deposited. The brightness of the respective colour sequences were in the same order as the brightness of the metal surface on which they were produced. The colour sequence on copper showed strong reds and weak blues. This is attributed to the strong specific reflection of red light by metallic copper. The sequence of nickel was remarkable for the absence of red colour, only browns being visible, while the dark blue was of remarkable intensity. The effect is attributed to the specific absorption of nickelous oxide. The colours on iron are normal to blue, after which the absorption becomes so strong as to distort the sequence.

J. W. **Lewis**: An experimental study of the motion of a viscous liquid contained between two coaxial cylinders. Mathematical laws deduced by G. I. Taylor for the case when ratio of interspace (d) to radius (R_1) of the inner cylinder is small have been confirmed. When the outer cylinder is fixed, the expression for the critical velocity at which the laminar motion gives place to vortex motion holds for values of the ratio d/R_1 as high as 0·71, and for liquids the coefficient of viscosity of which varies from 0·006 to 0·018 C.G.S. The determination of the critical speed can be used for the measurement of viscosities. When $R_1 = 0{\cdot}26$ cm., and $R_2 = 0{\cdot}45$ cm., viscosities from 0·008 to 0·012 C.G.S. can be measured with certainty to within 1 per cent.

C. E. **Inglis**: Oscillations of a bridge caused by the passage of a locomotive. Mathematical methods are developed for predicting the state of oscillation set up when a given locomotive crosses a bridge at a specified speed. The author, as a member of a committee appointed in 1923 by the Department of Scientific and Industrial Research to investigate impact effects in railway bridges, had the results of practical experiment to point the way. Analysis is applied in the first instance to a long-span bridge where the state of oscillation is not sufficiently violent to stimulate spring movement in the locomotive. A more comprehensive analysis, in which bridge damping and inertia effects of the moving load are taken into account, is applied to the case of an actual bridge of 262½ feet span. Laboratory experiments with a model bridge and locomotive were also described.

G. R. **Goldsbrough**: Tides in oceans on a rotating globe. A method is developed by which it is possible to calculate the forced tidal oscillations in an ocean, bounded by two meridians, on a rotating globe. When the ocean depth is proportional to the square of the cosine of the latitude, the determination of the semi-diurnal tide is slightly simpler, and it is with this particular case that the paper is largely concerned. The method, in the case of the stated law of depth, permits of the determination of the critical depths at which synchronism with the semi-diurnal tide takes place. In an ocean bounded by two meridians 60° apart (which may be regarded as a representation of the Atlantic Ocean) the critical depth is not far from the mean depth of the Atlantic Ocean. The tides of that ocean may then be considered as arising from approximate synchronism.

W. F. Sheppard: The fit of a formula for discrepant observations. For testing whether a set of observations is consistent with a particular hypothesis, the accepted method is Pearson's 'χ^2' method. The discrepancies between calculated and observed values being found in the usual way, the extent of agreement is summarised in a ratio P, which is, broadly speaking, the relative frequency of occurrence of similar or greater discrepancies in cases of the kind considered. When the hypothesis involves unknown constants which have to be determined from the observations themselves, the formula is not exact. The important theorem is that, whatever (correct) method we use for finding the constants and thence deducing the discrepancies, we arrive always at the same value for P. This is the result of linear relations between sets of discrepancies found by different methods.

J. Taylor: On a photoelectric theory of sparking potentials. The sparking potential is a function of the photoelectric emissivity of the cathode for the radiations accompanying the neutralisation of the positive ions at the cathode surface. It is assumed that no ionisation by collision is produced by the positive ions in the gas. The validity of the theory is examined for the case of helium and good quantitative agreement is obtained.

C. G. Darwin: Free motion in the wave mechanics. Whereas previously the wave mechanics has mostly been applied to a study of stationary states, the present paper discusses its application to cases where there is a *progress* of events. The following problems are solved: Free motion of an electron under no forces; motions of an electron in uniform electric and magnetic fields; motion of an electron in an atom; motion of an atom in a uniform magnetic field; Stern-Gerlach effect; motion of the spinning electron.

A. Fowler: The spectrum of doubly ionised oxygen (O III). The paper includes a catalogue of more than 300 lines attributed to O III, of which about one-half have been classified by the author and others. As was expected, the spectrum is generally similar to that of N II, and the terms so far determined are in complete agreement with Hund's theory. The assigned term values are based upon a sequence of three singlet D terms. The deepest term is of the type $^3P_0$, and for this the value 444661 has been determined by adopting Bowen's suggestion that the well-known green lines, λ5006·8, λ4958·9, in the spectra of gaseous nebulæ are due to irregular combinations of deep terms of O III. The corresponding ionisation potential of O III is 54·88 volts.

H. Dingle: The spectrum of fluorine (F I). The spectrum F I has been investigated in the region λ7600 - λ8400, and the wave-lengths of 16 lines have been measured. The analysis of the spectrum previously made has been slightly modified and extended, and an approximate ionisation potential of 18·6 volts calculated. Relative term values of F I, based on the two metastable states of the core, have been deduced.

Lord Rayleigh: The line spectrum of mercury in absorption. Occurrence of the 'forbidden' line λ2270, $1^1S_0 - 1^3P_2$. This line can be observed as a sharp absorption line in the unexcited vapour. The quantity of mercury required appears to be of the order 10^7 times as much as for the resonance line λ2537.

Lord Rayleigh: Series of emission and absorption bands in the mercury spectrum. (1) The less refrangible group is situated between λ3000 and λ2600 and consists of 42 emission bands and 48 absorption bands. The emission bands are diffuse and symmetrical, without heads, and the initial spacing is 250 cm.$^{-1}$ and point of convergence is near λ2537. The initial spacing of the absorption bands is 148 cm.$^{-1}$ and the convergence point about λ2645. (2) The more refrangible group between λ2350 and λ2290. Under this we have: (*a*) A series of emission bands, symmetrical, without heads, which merge into an apparently continuous spectrum ending exactly at the forbidden line λ2270; spacing about 70 cm.$^{-1}$; (*b*) a series of four bands, in absorption, without heads; (*c*) a series of absorption bands, of finer spacing than (*b*) and in part superposed on the latter. The convergence point seems to be about λ2264. The spacing of these bands is initially only 18 cm.$^{-1}$.

W. H. Taylor and J. West: The crystal structure of the chondrodite series. Chondrodite, humite, and clinohumite have been examined by the rotating crystal method and by the ionisation spectrometer. Humite is based on a simple orthorhombic lattice, space group V^{h16}, the unit cell containing four molecules. Chondrodite and clinohumite are each based on a simple monoclinic lattice, space group C_{2h}^5, the unit cell containing two molecules. The crystals bear a strong crystallographic resemblance to each other and to olivine, based on a hexagonal close-packed arrangement (somewhat expanded) of O atoms and OH groups, amongst which are distributed Mg and Si atoms, in such a way that whilst Mg atoms lie within groups of 6 atoms (O or OH) each Si atom is surrounded by 4 O atoms. The Mg_2SiO_4 portion of each crystal possesses the olivine structure. All three structures may in effect be regarded as built up of alternate layers (parallel to the *c* face) of $Mg(OH)_2$ and olivine. The cementing layer of $Mg(OH)_2$ has the same thickness in all, whereas the thickness of the olivine layer differs for each, the ratio of the thicknesses being that of the Mg_2SiO_4 content of each molecule.

Physical Society, Nov. 25.—A. E. Knowler: On the measurement of the electrical resistance of porous materials. The resistance of a material is measured independently of that at the surfaces in contact with it. The method is specially suited to the measurement of the resistance of ceramic, refractory, and building materials. Results show that the conductivity of a building stone is nearly proportional to its moisture content.—P. K. Kichlu: Regularities in the spectrum of ionised neon. The theory of Hund is applied in tracing doublet terms and intercombinations between doublets and quartets. Almost all the lines between 2500 and 3800 have been accounted for, with a few discrepancies.—Ezer Griffiths: A calorimeter for the determination of the heat developed by fruit. A differential arrangement is used, one container being filled with apples and the other with dummy apples of the same thermal capacity, made of thin-walled glass spheres filled with moistened glass wool. Resistance thermometers composed of 80 yards of nickel wire in glass tubes are disposed among the apples and the dummies. They are connected differentially to a slide wire, on which a difference of one thousandth of a degree causes a movement of the contact maker of 3 millimetres. The air circulation is controlled so as to maintain at will atmospheres containing from 2 to 10 per cent. of carbon dioxide around the apples. The moisture content of the air before and after circulation is determined by a dew-point apparatus, and a correction applied for the heat absorbed in evaporating water from the apples. At a temperature of 20° C., sound apples generate heat at the rate of about 0·012 calorie per second per kilogram of apples; or for an apple of average size (2½ inches in diameter) the rate of heat generation per second is one and a half thousandth calories.

Geological Society, Nov. 30.—C. W. Osman: The granites of the Scilly Isles, and their relation to the Dartmoor granites. Assuming that the whole of the granites of Devon and Cornwall are due to the same cause, late adjustments of the post-Carboniferous revolution; it is shown, by comparing the two ends of the series, that the isostatic correction-sequence of intrusions is similar in both areas. Previous to the intrusion of the granites the south-west of England had been subjected to three separate foldings, and the positions of the granite-laccolites are directly related to the intersection of the ridges of these folds: (*a*) Post-Silurian, Caledonian folding; (*b*) Post-Middle Coal-Measures, Malvernian folding; and (*c*) Post-Carboniferous, Armorican folding. The granite-magma crystallisation shrinkage-jointing, in regard to the production of pseudo-anticlines and synclines, is significant of direct roof-cooling influence. The deeper into the laccolite the jointing is observed, the flatter the bed-joints become, as the roof-cooling influence is exhausted, until in the centre of the islands the bedding-joints are horizontal. Petrological differences between the granites of Bodmin Moor and the Scilly Isles and the remainder of the south-western granites indicate a different source. These two granite-laccolites were supplied from a great Caledonian direction-fault or series of faults parallel with, but some miles off, the north-western coast of Cornwall; only from such great faults could the allied Lundy Island granite have been intruded, all the other granite-laccolites being intruded from the Start-Lizard series of faults. The pre-granitic xenolithic inclusions in the Scilly granites indicate a great difference in age between the floor and the roof of this laccolite.

PARIS.

Academy of Sciences, Nov. 21.—Charles Moureu, Charles Dufraisse, and Gérard Berchet: Researches on rubrene: pseudorubrene. By the action of hydriodic acid on rubrene, iodine is set free, which suggested that a hydrogenation product of rubrene had been formed. No such product could be isolated, but a substance isomeric with rubrene was obtained, named pseudorubrene. The cause of the liberation of iodine has not been elucidated.—Jean Baptiste Senderens and Jean Aboulenc: The decomposition of the fatty acids by sulphuric acid. All the fatty acids, starting with propionic acid, are attacked by sulphuric acid at temperatures above 160° C. Details of the velocity of gas formation and analyses of the gases produced are given for various acids. It was found that the presence of a lateral chain favoured the attack by sulphuric acid.—E. Bataillon: Polyspermia in the triton and the simultaneous cleavage into four obtained by centrifugation.—Louis Roy was elected a *correspondant* for the section of mechanics.—Félix Leprince-Ringuet: The application of the method of least squares to a system of unknowns susceptible of variation.—J. A. Schouten: Some remarks on the geodesic deviation and similar problems.—S. Mandelbrojt: Suites of holomorph functions. Integral functions.—W. Gontcharoff: Integral functions.—F. Leja: A property of double integral series.—George Alexits: Remarks on the divergence of Fourier's series of continued functions.—Krawtchouk: Analytical functions with real singularities.—G. Polya: The coefficients of Taylor's series.—Henri Bénard: Cellular vortices and the theory of Rayleigh.—M. Aubert, A. Pignot, and J. Villey: The action of antidetonants on the adiabatic inflammability of hydrocarbons. Measurements of the initial temperatures necessary to obtain inflammation by adiabatic compression for mixtures of lead tetraethyl with cyclohexane, normal hexane and normal heptane.—R. Wavre: An extension of Stokes's theorem relating to figures of equilibrium.—Thadée Banachiewicz: The fundamental relations of spherical polygonometry and the systems of Gauss and Delambre of spherical trigonometry.—Louis de Broglie: Corpuscles and Ψ waves.—J. F. Saffy: The prediction of the expansibility of invar in pieces obtained by hot or cold transformation.—C. Raveau: The theory of electrostriction. Criticism of a recent paper by Rocart.—G. Simon: Superposition rings obtained with two Fabry and Perot half-silvered plates.—Henri Chrétien: The aplanatic telescope and its applications.—Fred Vlès, Paul Reiss, and Mlle. Madeleine Gex: Colouring matters changing colour in the presence of neutral salts, and the constitution of a scale of indicators with indices of variable massivity permitting the comparison of saline solutions.—Pierre Chevenard: The influence of the addition of chromium on the internal friction of reversible ferronickels.—Pierre Brun: The dehydration of aqueous alcoholic liquids. Experimental study of mixtures of water, ethyl alcohol, and isoamyl alcohol.—Auguste Le Thomas: The suppression of the internal strains in cast iron. The method suggested is to reheat the castings slowly to 650° C. and allow them to cool slowly.—M. Wilmet: The estimation of the constituents of a gas mixture containing sulphuretted hydrogen, carbon dioxide, hydrogen arsenide, hydrogen phosphide, and acetylene.—Paul Baud: The use of gypsum for the manufacture of ammonium sulphate. Experimental studies on the conversion of gypsum into ammonium sulphate by treating a suspension of the gypsum in ammoniacal solution with a current of carbon dioxide.—J. Orcel: The use of the photo-electric cell for the measurement of the reflecting power of opaque minerals. The method consists in the comparison under the microscope of the mineral to be examined with another mineral (galena, or zinc blende) taken as a standard. The objective method of R. Toussaint is preferable to ocular comparison, since it is free from the personal factor. Bournonite and famatinite can be readily distinguished by this apparatus.—B. Dimitrievitch: A case of pseudo-polychroism of calcite.—Paul Corbin and Nicolas Oulianoff: A series of rocks of supposed Carboniferous age near the Paradis des Praz, Chamonix (Aiguilles Rouges). These rocks belong entirely to the Mesozoic: there are no Carboniferous strata in this locality.—Devaux: The measurement of the density of snow-fields and glaciers.—R. G. Werner: The influence of the medium on the growth of the fungi of lichens.—Em. Miège: Several special and endemic forms of *Triticum dicoccum*.—Louis Emberger: The vegetation of the mountains of Central Morocco.—Antonin Nemec: The proportion of resins in forest humus and its influence on the humification of organic materials.—R. Legendre: Application of the idea of *p*H to the preservation of seeds and the offals of cereals. An increase in the alkalinity reduces the liability to fermentation or germination.—E. Roubaud: The trophic preferences of *Pyrausta nubilalis*. The importance of the common wormwood (*Artemisia vulgaris*) as a plant for the protection of cultures. The Pyralis chooses wormwood in preference to maize and the former is not killed by the pest. It is suggested that this fact may be useful in restraining the ravages of the parasite on maize.—F. Henrijean: The cardiac systole.—Fernand Mercier: The influence of sparteine on the cardiac action of adrenaline: the adrenalino-sparteinic syncope.—A. Vila and R. Ancelle: The differentiation of the proteids of the blood serum. The determination of the sulphur affords useful information for the definition of the separated fractions of the proteids. It allows the purification of the two

principal proteids of the serum to be followed.—Mme. **Heldt**: The copepods of the lake of Tunis.—P. I. **Mezernitzky**: A new method for the quantitative measurement of the effects of sun baths.—**Paternot, Maillet, and Rehm**: An automatic ventilator for the permanent natural ventilation of rooms. A simple thermostat is connected with a damper so that the movement of the latter is a function of the temperature.

Official Publications Received.

BRITISH.

Memoirs of the Department of Agriculture in India. Chemical Series. Vol. 9, No. 5: Experiments on the Feeding of Sorghum Silage and Concentrate to Scindi Calves. By F. J. Worth and Shari Kant Misra. Pp. 125-153. (Calcutta: Government of India Central Publication Branch.) 9 annas; 10*d*.

Memoirs of the Asiatic Society of Bengal. Vol. 10, No. 2: Studies in Santal Medicine and connected Folklore. By Rev. P. O. Bodding. Part 2: Santal Medicine. Pp. 131-426. (Calcutta.) 10.11 rupees.

Annual Report for the Year 1926 of the South African Institute for Medical Research, Johannesburg. Pp. 53+2 plates. (Johannesburg.)

City of Leicester Museum and Art Gallery. Twenty-third Report to the City Council, 1st April 1926 to 31st March 1927. Pp. 28. (Leicester.)

Aeronautical Research Committee: Reports and Memoranda. No. 1072 (Ae. 254): The Characteristics of certain Aerofoil Sections for Infinite Aspect Ratio. By A. S. Hartshorn. (A.3.a. Aerofoils-General, 172.—T. 2378.) Pp. 9+12 plates. 9*d*. net. No. 1102 (M. 50): The Undercooling of some Aluminium Alloys. By Dr. Marie L. V. Gayler. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (A. 21.) Pp. 24+15 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1926–27. Pp. 35. (Aberdeen.)

Report of the Department of National Defence (Naval Service), Canada, for the Fiscal Year ended March 31, 1927. Pp. 28. (Ottawa: F. A. Acland.) 10 cents.

The Chemist and Druggist Diary, 1928. Pp. 488+Diary. (London: 42 Cannon Street.)

Journal of the Royal Microscopical Society. Series 3, Vol. 47, Part 4, December. Pp. xv+319-406. (London.) 10*s*. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 372, December. Pp. 88+xxxiv. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*. net.

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 2, No. 21: The Tholeiites and Dolerites of the Dalmahoy Syncline. By Dr. Robert Campbell and Dr. James W. Lunn. Pp. 489-505+2 plates. 3*s*. Vol. 55, Part 2, No. 22: The Peripheral Innervation of the Uterus. By Dr. Amy S. Fleming. Pp. 507-529. 3*s*. Vol. 55, Part 2, No. 23: The Expedition to the South Pacific of the S.Y. *St. George*. Marine Ecology and Coral Formations in the Panama Region, the Galapagos and Marquesas Islands, and the Atoll of Napuka. By Dr. Cyril Crossland. Pp. 531-554+1 plate. 3*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Report of an Inquiry into the Relationships of Technical Education to other Forms of Education and to Industry and Commerce. Pp. 50. (London: 29 Gordon Square.) 1*s*.

Report on the Teaching of the Life Sciences in the Education of Boys and Girls of Ages 10-18. Pp. 22. (York: Friends' Guild of Teachers, Bootham School.) 7*d*.

The Mineral Resources of Manitoba. By R. C. Wallace. Second edition. Pp. 58. (Winnipeg: Industrial Development Board of Manitoba.)

Memoirs of the Department of Agriculture in India. Entomological Series, Vol. 10, Nos. 1, 2: Four new Indian Gall Midges, by Dr. E. P. Felt; The Citrus Psylla (*Diaphorina citri*, Kuw.) [Psyllidae: Homoptera], by Mohammad Afzal Hussain and Dina Nath. Pp. 4+27+4 plates. 1.2 rupees; 2*s*. Entomological Series, Vol. 10, No. 4: Some new Indian Miridæ (Capsidæ). By E. Ballard. Pp. 61-68+plates 15-21. 6 annas; 8*d*. Bacteriological Series, Vol. 11, No. 2: A Bacterial Soft Rot of Garden Poppy. By C. S. Ram Ayyar. Pp. 29-33+3 plates. 5 annas; 6*d*. (Calcutta: Government of India Central Publication Branch.)

Annals of Eugenics: a Journal for the Scientific Study of Racial Problems. Edited by Karl Pearson, assisted by Ethel M. Elderton. Vol. 2, Parts 3 and 4, October. Pp. iv+245-404+12 plates. (London: Francis Galton Laboratory for National Eugenics, University College.) 35*s*. net.

Diary of Societies.

THURSDAY, DECEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. N. da C. Andrade: Engines: Rules which all Engines must obey (Juvenile Christmas Lectures) (I.).

FRIDAY, DECEMBER 30.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—A. P. Morris: The Burmese Lacquer Industry.

SATURDAY, DECEMBER 31.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. N. da C. Andrade: Engines: Learning about Steam (Juvenile Christmas Lectures) (II.).

CONFERENCES.

DECEMBER 29 TO JANUARY 6.

CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Thursday, Dec. 29, at 3.—Sir Michael E. Sadler: The Educational Outlook (Presidential Address).

Friday, Dec. 30, at 10 A.M.—Eugenics Society.

At 10.30 A.M.—Education Guild of Great Britain and Ireland.—Sir Robert Blair: The Finance of Education (Presidential Address).

At 2.30.—Joint Conference.—Linking-up in Adolescent Education. *Speakers*—Miss M. H. Meade, Mrs. Millington, G. R. Parker, and T. B. Tilley.

At 5.30.—Order of Woodcraft Chivalry.—H. D. Jennings-White: The Biological Principles of Education.

At 6.—International Language (Ido) Society.—G. H. Richardson: Ido Versification.—E. M. Turle: Radio and Ido.

Saturday, Dec. 31, at 3.—Educational Handwork Association.—A. F. Collins: The Place of Craft in Education.

At 3.—Association of Head Mistresses of Recognised Private Schools.—Prof. Winifred Cullis: Education and Health.

Monday, Jan. 2, at 11.30.—League of Nations Union (Education Committee).—Prof. P. M. Roxby: Geography and the League of Nations.

At 3.—School Nature Study Union.—Dr. F. A. Bather: The Use of Museums.

At 5.—Leplay House.—Sociology in Education.

At 5.—National League for Health, Maternity, and Child Welfare.—Discussion: School Meals and the Nutritional Requirements of School Children.

At 5.30.—British Psychological Society (Education Section).—Dr. D. Forsyth: Those First Five Years.

Tuesday, Jan. 3, at 11 A.M.—Society for Experiment and Research in Education.—J. H. Whitehouse and others: Some Needed Reforms in Education.

At 11 A.M.—British Broadcasting Corporation.—Demonstration of Educational Broadcasting.

Wednesday, Jan. 4, at 2.30.—Joint Conference.—The Equipment of Schools. *Speakers*—T. T. Rees, H. G. Wood, and others.

At 5.30.—Child Study Society.—Dr. D. Forsyth: The Effects of Bodily Infirmity on Character Formation in Childhood.

At 5.30.—British Association for Physical Training.—Dr. G. P. Crowden: Physiology and Muscular Exercise.

Thursday, Jan. 5, at 2.30.—Association for Education in Industry and Commerce.—Some Recent Educational Experiments in Industry.

At 5.30.—London Head Teachers' Association.—Rev. Hon. Dr. E. Lyttelton: The Growth of the Human Mind.

Friday, Jan. 6, at 5.—King Alfred School Society.—Dr. Leonard Hill: Sunshine, Open Air, and Health.

JANUARY 4 TO JANUARY 9.

GEOGRAPHICAL ASSOCIATION (at London School of Economics).

Wednesday, Jan. 4.—Meetings of Standing Committees.

Thursday, Jan. 5, at 11.30 A.M.—Dr. Marion I. Newbigin: The Geographer and the Study of Climate (Lecture).

At 5.—Sir John Russell: Palestine and its Agricultural Possibilities (Lecture).

At 6.15.—Prof. J. F. Unstead: What should a Geography Teacher know—and be?

Friday, Jan. 6, at 10 A.M.—E. J. Orford and others: Discussion on The Use of Ordnance Survey Maps in Primary Schools.

At 10 A.M.—W. E. P. Betts and others: Discussion on Tha Geography is the Pivotal Subject in a Central School with a Commercial Bias.

At 10 A.M.—V. C. Spary and others: Discussion on Post-Matriculation Work.

At 11.45 A.M.—Dr. Vaughan Cornish: Harmonies of Scenery (Presidential Address).

At 2.30.—Prof. Rodwell Jones: The Prairie Provinces of Canada: Geographical Factors in their Economic Development (Lecture).

Saturday, Jan. 7, at 10.30 A.M.—Major Sir E. Humphrey Leggett: Economics and Administration in British East Africa (Lecture).

Sunday, Jan. 8 (at Westminster Abbey), at 3.—Rev. Canon C. S. Woodward: International Relations in the Light of Geographical Science.

JANUARY 5 AND 6.

MATHEMATICAL ASSOCIATION (at London Day Training College).

Thursday, Jan. 5, at 5.30.—Prof. S. Brodetsky: Gravitation.

Friday, Jan. 6, at 10.30 A.M.—President's Address: The Logical Eye and the Mathematical Eye: their Outlook on Euclid's Theory of Proportion.

At 11.30 A.M.—Dr. W. F. Sheppard: What is a Partial Differential Coefficient?

At 11.45 A.M.—W. Hope-Jones: Sound-Ranging.

At 2.30.—P. Bolton: The Organisation of School Mathematics.—A. W. Siddons: The Best Method of Examining School Mathematics, with special reference to the School Certificate Examination of the Oxford and Cambridge Schools Examination Board.—A. J. Taylor and others: Discussion.

JANUARY 4, 5, and 6.

SCIENCE MASTERS' ASSOCIATION (in Chemistry Department, Imperial College of Science, with Evening Meetings at Household and Social Science Department, King's College for Women).

Wednesday, Jan. 4, at 8.15 P.M.—Sir Richard Gregory: Presidential Address.

Thursday, Jan. 5, at 10.45 A.M.—Sir J. B. Farmer and Capt. Irby: Discussion—The Need of Scientific Investigators for the Agricultural Industries Overseas.

At 12.—Dr. J. W. T. Walsh: Some Modern Methods in Photometry (Lecture).

Friday, Jan. 6, at 10.15 A.M.—Prof. J. C. Philip: Charcoal and its Activation (Lecture).

At 11.30 A.M.—Prof. W. A. Bone: Discussion—Industrial Openings in Scientific Technology.