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Science in Non-Self-Governing Dependencies.

GOVERNORS and other official representatives of the non-self-governing dependencies of the Crown, recently gathered together at the Colonial Office Conference, devoted no little attention to a consideration of the function of scientific research in the development of the territories for which they are responsible, and the means by which this research is to be promoted. The outcome of their deliberations is the report on Colonial Scientific and Research Services which they approved and adopted on May 27, and is now available to the public in the published proceedings of the conference—the first of its kind.

From the point of view of research, no more favourable time could have been chosen for this first conference. It has followed closely upon the visit of the Parliamentary Commission to East Africa in the latter part of 1924, the personal visit of the Under-Secretary of State for the Colonies to West Africa in 1926, the tour of Mr. Roy Wilson and Mr. Harry Snell to British Guiana this year, and the reports which were presented to Parliament at their conclusion, in all of which the dependence of economic development upon the creation of new knowledge and the application of existing scientific and technical knowledge was emphasised. Furthermore, it is only a few months since the Premiers and other representatives of the self-governing Dominions met, and were led to consider similar problems and approved a report of a sub-committee which they appointed on Empire research.

The changed attitude of the Dominion premiers towards scientific research as manifested in that report was the subject of comment in these columns at the time. At the Imperial Conference in 1923 they sought for a solution of their economic problems in political expedients; three years later they decided to give science a trial. Upon this result the present political heads of the Colonial Office can be congratulated, for they have assiduously preached the gospel of science for the past two years.

Under influence of the same stimulus, the representatives of the non-self-governing dependencies have reacted in the same way as the Dominion representatives. One of their first acts in conference was to appoint a committee under the chairmanship of Lord Lovat "to frame and submit a scheme, based on contributions to a common pool, for the creation of a Colonial Scientific and Research Service available for the requirements of the whole

Colonial Empire, for the support of institutions required for that purpose, and for the increase of research and study facilities in connexion with the specialist services of the Colonies generally."

In the general statement of the problem the Committee has drawn largely upon the information contained in the report of the Committee on Agricultural Research and Administration in the Non-Self-Governing Dependencies, of which Lord Lovat was also chairman. Its recommendations are almost identical with those put forward in that report, and follow the general principles enunciated in the report of the East Africa Parliamentary Commission for the effective prosecution and co-ordination of research. The modesty of its proposals, however, will be gauged from the fact that the scheme proposed for the reorganisation of the colonial agricultural services involves an annual expenditure of £175,000 in all, a considerable proportion of which is at present a charge on colonial revenues. This is a very small sum when regarded from the point of view of the needs of colonies covering a total area of roughly 2,000,000 square miles, the populations of which—mainly agricultural—number 50,000,000, controlled by thirty distinct administrations. It is illuminating to relate the cost of such a service to the exports from the colonies to the United Kingdom. These exports, mainly agricultural, have quadrupled in the last twenty years and amounted to £81,000,000 in 1925. In that year "they were greater than those from the whole of India, or from any single one of the self-governing Dominions." If the total agricultural exports of the colonials are taken into account, including rubber, the cost of the proposed service works out to $\frac{1}{5}$ of a penny in the pound. The Committee states that so far "the aid of science has been but half-heartedly invoked," but it is difficult to see how this state of affairs is to be remedied with such meagre financial provision.

The committee is well aware of the needs of research. It appreciates the fact that "there is severe and growing competition between the sources of raw materials and food-stuffs for the supply of the world's markets"; that "the ravages of diseases, particularly among the luxuriant conditions of tropical life, are ever increasing"; and that "science, and science alone, can enable us to increase production by improved methods, and, at the same time, combat successfully the diseases which these new methods bring in their train." It notes that the "United States, the area of which is one-third larger, and the population a little more than double that of our

Colonial Empire, spends more than £4,000,000 annually on agricultural research"; and that Egypt spends nearly twice as much annually on agricultural entomology as the whole of the British colonial governments, most of which are faced with far graver problems than Egypt. Unfortunately, the committee gives no indication of the expenditure of France, Belgium, or Holland on agricultural research in their respective colonies; but we know that the Dutch maintain Buitenzorg splendidly while the Amani Institute is still lying derelict, untenanted, unstaffed; we know that the French are devoting much attention to the investigation of nagana (tsetse-fly disease in cattle), and are attempting to breed immune types, while we continue to starve the veterinary research stations in East Africa, and to expect the research staffs to devote a considerable proportion of their time to the preparation of sera for inoculating cattle against the various diseases which decimate the natives' herds.

In view of the condition of affairs regarding research and research institutions and the scientific services generally, as disclosed in the various reports to which we have referred above, in fact, to the complacent indifference to science which characterises our colonial administration, and the statement of Lord Lovat's Committee that "there is no organisation whatsoever in the colonies which views the problems of science as a whole," we can but admire the forbearance of the committee in stating that it is anxious not to give the impression that it is trying to be dictatorial to the colonial governments. It is well, however, that it has obtained general consent to the establishment of a central fund maintained by contributions from the various colonies. This should ensure continuity of research, and safeguard the individual scientific officer against the excessive zeal of colonial governments to reduce their scientific staffs in times of financial stringency. The evident purpose of the committee's recommendations is to make the research services of the colonies attractive to the best type of worker, and this is certainly a great step forward.

The committee felt itself unequal to the task, in the short time available, of formulating proposals for the creation of a unified research service, postulating as it does modifications in the organisations (existing and proposed), the creation of links between various sciences not only in the colonies but also through research organisations at home and in the Dominions. That task is left for another committee, which will have the advantage of making

its proposals after the Colonial Medical Research Committee, the Empire Forestry Conference, and other bodies have examined the problems confronting them.

The Lovat Committee, however, is quite definite as regards the organisation of a colonial agricultural research service. It recommends that a central council should be constituted with a chairman (who should be a layman), a director (who should be a recognised man of science), and a deputy-director (who should have had administrative experience in the tropics). The formal channel of communication between the council and the Secretary of State should be through the chairman. The members of the Council should be the directors of the Royal Botanic Gardens at Kew, of the Imperial Bureau of Entomology, and of the Imperial Bureau of Mycology, a chemist, and representatives of veterinary science, of the Imperial Institute, of the Colonial Office, and of the Empire Marketing Board. Liaison with the Medical Research Committee and any other research committee should be maintained either by co-opting a member of that committee as occasion required, or by creating an *ad hoc* committee of members of the bodies concerned to deal with borderline questions.

The proposed constitution of the council is open to criticism. No reasons are given for the choice of chairman. What precisely is meant by a layman? Is he to be a man whose impartiality and sound judgment are to be guaranteed by his complete ignorance of science? Exception might be taken also to the selection of the scientific representatives. Presumably botany, mycology, entomology, and chemistry are regarded by the committee as the four sciences of most importance to agriculture. Two of them are mainly concerned with the pathological aspects of agricultural research, admittedly of importance, but certainly not so important as research in genetics aiming at the production of new varieties of plant and animal types resistant to disease. At least one geneticist should be added to the council. The claims of physicists to representation on the council are also strong. A physicist would be able to advise on most problems in connexion with the relationship of soil and climate to plant life as well as those concerned with the transport and storage of agricultural produce. If there is a fear that the council would be too unwieldy, the substitution of an agriculturist—say the director of Rothamsted Experimental Station—for the four scientific members proposed by the committee, would preserve its balance and not diminish its effectiveness

as a council. Perhaps it is not too late, also, to suggest that an ex-member of the Indian agricultural services should be given a seat on the council. Many of the difficulties which beset agriculturists in the colonies are identical with those which have already been successfully surmounted in India by the application of research, and it would be well for the council to have the advice of some one thoroughly familiar with the methods already successfully adopted there. A further point might also be considered. The principle of automatic retirement of members of advisory councils after a short term of years has already been applied to membership of the Medical Research Council and the Advisory Council for Scientific and Industrial Research. If the Colonial Agricultural Research Council is constituted as proposed, this principle could not be applied.

The observations of the committee on the need for attracting the best talent to the colonial agricultural services will commend themselves to scientific workers as a whole. It must provide a career. "It must be well paid, and the financial prospects held out must be better than those which obtain at present." An officer entering the unified service must be liable to transfer, but he must be safeguarded against any loss on transfer. It is recommended that retiring benefits for the members of this service should be provided by a provident fund scheme. Transfers of research officers to the administrative side of agriculture would not then present any difficulties in this regard. Before the recommendations of the conference can be translated into facts, however, the committee which has just been appointed by the Secretary of State for the Colonies has to go fully into the question of finance and submit its proposals to the colonial governments. This procedure involves vexatious delay and might have been obviated.

The tentative proposals of the committee on the unification of the various colonial research services need not be considered at this juncture. It will be time enough to deal with the matter when it is made the subject of a report by the further committee which is to be set up. The progress made in connexion with the agricultural research services will be studied with interest, and once the recommendation of the conference is made operative, that the poorer colonies will be entitled to command the services of first-class men from the central pool—equally with those colonies with greater financial resources—provided their problems are of sufficient importance, no excuse will remain for their starving these essential services.

The Gentle Art of Chemical Controversy.

Essays on the Art and Principles of Chemistry: including the First Messel Memorial Lecture.

By Prof. Henry E. Armstrong. Pp. xxxi + 276. (London: Ernest Benn, Ltd., 1927.) 15s. net.

WHILE we regard parts of this book as beneath the dignity of the science the art and the principles of which it professes to expound, we cannot repress some feeling of sympathy with the author for the courage he shows in resisting superior forces. We can admire Prof. Armstrong's defence of the name of 'oxygen,' we can appreciate his insistence that water acts chemically when dissolving salts: but is anything gained by crude lampoons on van 't Hoff, Arrhenius, and Ostwald—and indeed on the whole school of modern physical chemistry founded on their work?

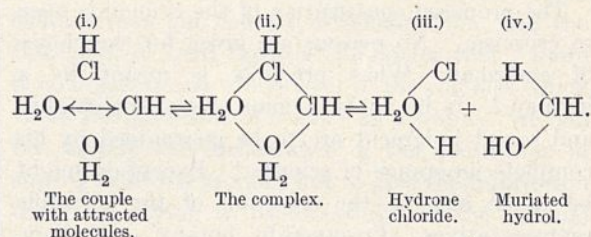
The *motif* of the book appears to be that chemists are not only a perverse and unthinking crowd, easily hypnotised by any 'Nordic' magician who can work the spell of the integral calculus, but also, having been inoculated with the *ionic virus*, are unable to see the clear facts which Prof. Armstrong has been putting before their eyes for the last forty years. Why should this be? Probably the force of prejudice and of dictated belief has blinded them: they have not understood. The case must be presented again in a more comprehensive and definite way.

The root of the trouble is twofold: people have never grasped that water is not the simple, neutral, self-satisfied body made up of an oxygen atom holding a hydrogen atom in each of its two hands—it is a far more complicated affair, a mixture of 'polyhydrones' of various orders of complexity holding in solution simple 'hydrones' (H_2O), the capture of which by molecules of dissolved salt or acid alters the physical properties of the solvent; and, secondly, no chemical action can take place unless there is a *tertium quid*—usually conducting water—to form an electrolytic system through which the change occurs.

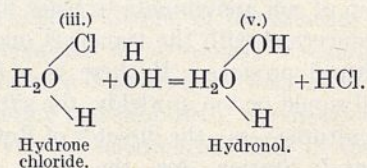
The year 1885 must still be sodden with the tears of things. In that year Prof. Armstrong first preached the true doctrine to the Chemical Section of the British Association; in that year the conception of the dissociation of salts in dilute solution became known—to use Prof. Armstrong's phrase, "Arrhenius came forward as a Whole-Hogger"; and "in 1885 van 't Hoff, assuming the character of the Hatter, invited us to a scientific Mad Tea Party, at which he out-hatted the Hatter." But even this combination of 'genius' and 'youthful

enthusiasm' would not have prevailed alone to spread the 'joke'; it was carried far and wide by "floods of Ostwaldian ink." Is not this language a little reminiscent of a celebrated criticism of the Hallucinations and the 'Phantasiespielereien' of a certain Dr. J. H. van 't Hoff, and does not our modern Censor rather out-Kolbe Kolbe?

Chemists can understand the protest against the idea that water, acting as a solvent, is a mere material vacuum-chamber affording room for the salt to dissociate; they can believe it is an active chemical substance, and that the action between salt and water is reciprocal. Here is a strong position to hold, but Prof. Armstrong is not content to hold it. The salt, or the acid, cannot react with water without an intervening electrolyte. "Take," he says, "pure non-conducting water and pure non-conducting hydrogen chloride: they cannot react chemically, but they can form a couple by some mechanical 'attraction' or process of 'distribution.' This couple (being an electrolyte?) can now bring about union between it and another pair of molecules to form a complex which splits up into two bodies—one, 'muriated hydrol,' the other, 'hydrone chloride.'" We are given a picture of the process, which we partly reproduce:

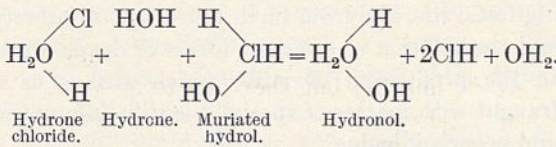


So far the conception seems clear, but afterwards it is harder to follow. The two hydrogen chloride molecules have each incorporated a volatile hydrone molecule, and by so doing have altered the physical properties of the solvent; but one has to account for each molecule of hydrogen chloride producing *double* the effect of a neutral non-conducting molecule. It seemed at first sight that Prof. Armstrong considered the 'hydrone chloride' molecule to be more readily acted on by hydrone than its sister hydrol, and we pictured a further process taking place:

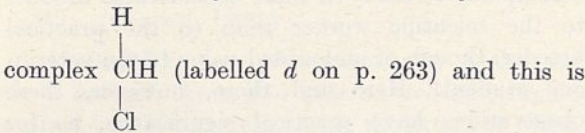


The hydrogen chloride liberated in the last equation would presumably repeat the cycle, so that finally

for every HCl molecule dissolved, *one* hydrone would be captured and held bound as 'muriated hydrol,' while *two* hydrones would be incorporated as hydronol which is represented as a stable molecule. That this is the interpretation meant by Prof. Armstrong seemed confirmed by his statement (p. 266) that the osmotic activity is to be attributed, in a dilute solution of hydrogen chloride, to the molecules of muriated hydrol and of hydronol. It will be noticed that in this interpretation every HCl molecule dissolved affects *three*, and not *two*, hydronic molecules: but in the equation suggested on page 264 to account for the production of hydronol both the hydrone chloride and the muriated hydrol react with hydrone and *all the hydrogen chloride is liberated*:

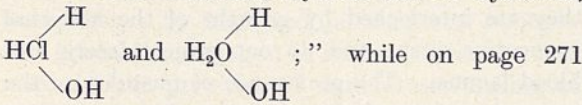


If the two HCl molecules liberated in this equation are free they would, presumably, repeat the original cycle until *all* the free hydrone was converted into 'hydronol.' But if they form the



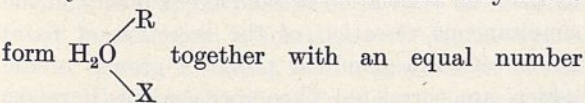
unacted on by hydrone, then each HCl molecule has only anchored *one* hydrone.

Probably Prof. Armstrong can devise some way out of the difficulty which eludes us, or possibly we have been caught by a snag somewhere. When a man prides himself on his clear and forcible English, what are we to make of the following statements? On page 266 he writes: "This osmotic activity is to be attributed . . . in a dilute solution of hydrogen chloride, for example, to the molecules of muriated hydrol and of hydronol,



while on page 271 he says: "As the concentration is lowered, under the influence of hydrone, the complex RX

is more and more converted into hydronol. Ultimately the solution contains the solute only in the



of molecules of hydronol." The difficulties of

following the hypothesis of electrolytic dissociation seem small in comparison.

Similarly in all cases of oxidation, whether it be a solid or a gaseous fuel that is burnt, hydrone is the *sine qua non*. Take that peculiar gas carbonic oxide. "It is commonly recognised," Prof. Armstrong writes, "that this gas cannot be burnt dry, but that the rate of combustion rises as the amount of hydrone in admixture with it is increased, up to a certain point; hydrone apparently plays a peculiarly active part in its combustion, primarily through incorporation into its being. In fact, it is difficult to think of hydrone as active in conjunction with carbonic oxide except by giving rise to formic acid; the two molecules cannot well grip each other at all with any other result." That carbonic oxide can directly 'grip' with hydrone to form formic acid seems to be an advance on the doctrine that no chemical action can take place between two molecules unless there is a third and conducting body to act as go-between; but obviously in this instance, as with hydrogen chloride, the hydrone plays a double part. It can 'grip' or 'disperse itself over' carbonic oxide, and then "given the initial production of formic acid, all else in the behaviour of carbonic oxide is clear."

Prof. Armstrong complains that his work has not been appreciated, his explanations not heeded. "Since 1885," he writes, "my voice has been that of one crying in the wilderness." But the voice of one crying in the wilderness—as prophesied by Isaiah—surely was listened to. Are we not told that not only Jerusalem went out to hear, but "all Judæa, and all the region round about Jordan"? The voice has been heard, but is not the answer more nearly that pagan rejoinder, 'Credat Judæus'?

Scientific Research and the Veterinary Profession.

The Physiology of Reproduction in the Cow. By John Hammond. Pp. xvi + 226 + 33 plates. (Cambridge: At the University Press, 1927.) 21s. net.

IN the modest preface to this book, the author expresses his hope that it will be of use to those who engage in research on the subject he deals with, and at the same time form a reference book for advanced students in agriculture and veterinary science. We have confidence that his hopes will be fulfilled.

Those who have learnt to value the care and

accuracy which characterise all Mr. Hammond's work will find in this book increased reason for appreciation of those qualities in the author. It is not only a masterly exposition of the physiology of reproduction in the cow; it also deals in a truly scientific spirit with gynaecological problems of the first importance to members of the veterinary profession, and therefore to their clients, the practical breeders.

The volume is divided into (1) a short account of the breeding season; (2) the œstrous cycle, which occupies the bulk of the book; (3) pregnancy; and (4) sterility. The method of investigation the author adopts will be best disclosed by a brief survey of the section on the œstrous cycle.

Mr. Hammond examines the periodicity and rhythm of the œstrous cycle in relation to the time of year, the age, the state of fatness, the effect of drugs, the psychological effect of proximity of the bull, the effect of service of the bull, and the result of artificial removal of the corpus luteum; and wherever possible supports the conclusions he arrives at with elaborate tables of figures. The duration of œstrus he treats in a similar elaborate manner, and comes to the conclusion, which we think is justified by his records, that the length of the cycle and the duration of œstrus are correlated phenomena. But the main portion of this section is devoted to a detailed account of the physiological, anatomical, and histological changes which take place throughout the whole of the organs concerned with reproduction during the œstrous cycle, and with the mammary gland; a most painstaking and valuable piece of work.

It is impossible to do justice, in a critical sense, in the space at our disposal, to what may be described as a monograph of more than eighty pages containing fourteen elaborate tables and illustrated by a prodigious number of drawings and photographs contained in nineteen admirably executed plates. Much of it, of course, consists of a critical examination of work done by others, and when we add that the author's bibliography contains references to four hundred books and papers, some idea may be gained of the labour involved in the work. A welcome feature of this portion of the author's duties is his generous appreciation of the work of others and his judicial tolerance in criticism. We would assure him that the weight of his judgment is not decreased thereby.

Mr. Hammond's account of the anatomical and histological changes which take place in the ovaries during the œstrous cycle are specially worthy of

note, more particularly, perhaps, in relation to the Graafian follicle and to the corpus luteum. Much of this is new, and in some ways highly suggestive, while the tables and figures he gives are illuminating. With some of his general conclusions we are in entire accord, as, for example, in his refusal to accept the theory that the ripening of the Graafian follicle is the direct cause of menstruation. On the other hand, we have failed to convince ourselves of the truth of the view that the duration of the corpus luteum solely controls the length of the œstrous cycle, a view which he finds reason to accept.

If we must particularise, however, it is Mr. Hammond's original work on the mammary gland, on its growth, the histology of its development during foetal life, and from birth to the age of puberty, and the relation of different forms of development to the production of milk, which strikes us as fraught with matter of special scientific importance and economic value.

The section concerned with pregnancy contains a valuable résumé of the work of a host of observers on a variety of domesticated animals; it is, in fact, a comparative study of more considerable interest to the scientific worker than to the practical breeder, though of undoubted value to the veterinary student. Here and there, however, these observations have practical significance, as for example the correlation between the time when the proportion of foetus exceeds that of the foetal fluids, and the liability to infection with *Bacillus abortus*.

The changes which take place in the uterine tissues during pregnancy are very fully described and of much interest; especially in regard to the destructive action of the foetal membranes on the cotyledons, and the attachment of the foetal placenta thereto by finger-like growths which eat their way into the tissues of the cotyledons, where they are interlocked by growths of the maternal connective tissue and do not project freely into blood lacunæ. The occurrence of pustules on the internal surface of the amnion and their relation to the amount of mucus in the amniotic fluid is recorded, but beyond the fact that they are said to contain large quantities of glycogen and that they are temporary structures, nothing seems to be known of their metabolic function. It occurs to us that the association of their breakdown and the simultaneous cessation of the secretion of foetal fluids with the glandular phase of growth of the udder, are correlated phenomena which it might be worth while to investigate. In this section also

the work done on the histological changes which take place in the udder, and the nature of its secretions at different stages of pregnancy, is of marked value.

It is to be hoped that the brief concluding chapter on sterility may be extended when a call is made for the next edition of the book. There is no subject associated with the breeding industry, especially the breeding of thoroughbred stock, of greater importance than this, and there is no subject of which both the man of science and the veterinary profession are more profoundly ignorant.

W. H.

Scientific Studies in a Swiss Nature Reserve.

- (1) *Der schweizerische National-Park*. 50 künstlerische Aufnahmen von J. Feuerstein. Pp. iv + 48 Tafeln. (Zürich: Brunner und Co. A.-G., n.d.) n.p.
- (2) *Vegetationsentwicklung und Bodenbildung in der alpinen Stufe der Zentralalpen*. Von J. Braun-Blanquet unter Mitwirkung von Hans Jenny. (*Mém. de la Soc. Helvétique des Sci. Nat.* Vol. 63, *Mém.* 2, 1926.) Pp. viii + 181-349. (Geneva, 1926.)

PROBABLY few whose pursuits have not brought them into wide as well as intimate contact with Nature, can realise the extent to which the face of the globe has been modified by the restless activities of the human race. The modifying influence of man is more particularly experienced by the organic film which tends to cover, now thickly, now thinly, those portions of the surface of the earth which are capable of supporting life. Nowhere, perhaps, is this influence more noticeable than in the case of vegetation. For this reason plant ecologists have up to the present tended where possible to select for study the more 'natural' types of vegetation, *i.e.* those least altered by man and his domestic animals. It is gradually coming to be realised, however, that many of the problems of agriculture, dealing as it does with 'semi-natural' vegetation such as pastures, as well as with vegetation in its most 'artificial' aspect, the crops of arable land, are really ecological problems.

Though, however, no doubt ecology in the future will occupy a not unimportant position amongst the applied sciences, in this, as in other cases, pure science is fundamental. Such experiments, therefore, as that now in progress on a large scale in the Swiss National Park, are being watched by ecologists with considerable interest. The

Swiss "Commission for Nature Protection" is to be congratulated on its decision to allow natural processes to operate in this area of upwards of fifty square miles, entirely free from the disturbing influence of man.¹ Here man is content to stand aside, and merely to observe and record. The two works reviewed below deal with this great Nature reserve, but from very different points of view.

(1) The first is merely a 'Nationalparkalbum' of some fifty photographs by J. Feuerstein, with forewords by Prof. Schröter and H. Federer. Yet the album is worthy of its subject, for Herr Feuerstein is at once a skilled photographer and an enthusiast thoroughly familiar with the Park and its inhabitants. Artistically and technically the photographs reach a high standard; they are well reproduced, and most of them are of whole plate size. The photographs themselves possess considerable scientific interest. The landscapes give a good idea of the ecological character of the district, especially of the coniferous forests on the mountain slopes and the alpine zone above. There are some excellent photographs of a few well-known plants such as *Ranunculus alpestris* and *Crocus albiflorus*, and of a number of animals. The latter include the marmot, chamois, roe deer, ibex, foxes, and the kite and other birds. One particularly attractive photograph shows an alpine hare seated on the snow.

(2) The second of the two works under consideration is an important contribution towards the scientific exploration of the Swiss National Park, dealing with the development of both soil and vegetation above the tree limit. The vegetation in question is well seen in several photographs in the 'Album.' Dr. Braun-Blanquet is responsible for the vegetational portion of the memoir, and Dr. Jenny, of the Agricultural-Chemical Laboratory, Zürich, for that devoted to soils. The work has gained greatly by this co-operation.

The underlying thesis, well established by convincing evidence, is that soil and vegetation undergo a parallel genetic development. Both exhibit initial and transitional stages, and both tend towards a more or less stable ultimate condition, the soil climax and the vegetation climax respectively. Soil development is primarily conditioned by climatic factors, especially temperature, precipitation, and evaporation. The combined action of these factors ultimately produces a definite soil type which occurs, under similar climatic conditions, on every geological or petrographical substratum where soil formation

¹ See article by Prof. C. Schröter, *NATURE*, Sept. 29, 1923; vol. 112, p. 478.

has progressed to the final stage. The soil type then is a function of climate, and it should be possible therefore to speak of a 'climatic climax' in the case of soils, as we already do in the case of vegetation. In the humid climate of the alpine zone in the Central Alps the progression, owing to leaching and the accumulation of humus, is invariably from basic or weakly acid soils towards a strongly acid climax—the alpine humus soil. This order of development is irreversible. So far as plant succession is concerned, the gradual changes in soil reaction are accompanied by a struggle between the pioneer species characteristic of basic or less acid soils, and invaders capable of flourishing in increasingly acid soils. The climax community, on the strongly acid alpine humus soil, is dominated by *Carex curvula*. There is thus a very close parallel between soil succession and plant succession. The authors regard the progressive changes occurring in the soil as the immediate cause of plant succession, the climate mainly affecting this succession indirectly through the soil.

Another point of general interest is the apparently great importance of wind-borne dust. This dust aids in the building of soils; compensates to some extent for the leaching out of soluble salts—thereby, in the case under consideration, retarding plant succession; is a source of mineral nutriment for plants—indeed the chief source, according to the authors, in the case of shallow-rooted plants growing in acid humus soil; and finally, serves to infect the soil with spores and seeds. The authors quote the opinion of Treitz, expressed at the International Soil Conference at Prague (1924), to the effect that "the most important soil-forming and plant-forming climatic factor is the annually deposited amount of wind-borne dust." At first frankly sceptical regarding this somewhat sweeping generalisation, the authors investigated the matter for themselves, by collecting and therefore immobilising blown dust in 'rain totalisators,' placed at two elevations in the Val Cluozza. The results obtained were truly remarkable. At the upper station, for example, above the tree limit at an altitude of 2340 m., the dust was collected continuously for two years. The average deposition over this period worked out at about 6.46 tons of dust per acre per annum, of which about 1.63 tons were CaCO_3 . Such heavy manuring by wind action alone seems almost incredible, but if true would justify the authors' opinion that alpine vegetation depends for its supply of mineral salts to a great extent on wind-borne dust. Similar

experiments would be well worth carrying out in Great Britain. Hitherto, with the obvious exception of accumulations of wind-blown sand, little or no attention has been paid by ecologists to what seems likely to prove an important factor of the plant environment.

The memoir contains a mass of careful detailed work which cannot be dealt with here, beyond saying that Dr. Braun-Blanquet has described and analysed a large number of plant associations forming the complex of communities leading to that dominated by *Carex curvula*. He has, moreover, attempted to group these associations into alliances, according to their floristic relationships. On the whole, the monograph is certainly one of the best that has so far emanated from the Zürich school.

R. H. Y.

Psychopathology.

An Outline of Abnormal Psychology. By Prof. William McDougall. Pp. xvi + 572. (London: Methuen and Co., Ltd., 1926.) 15s. net.

MEDICAL psychology has had a long and varied history. In its earliest stages it dealt with magical and pseudo-religious phenomena, which it took at their face value. Even within the last century it remained mainly anecdotal, with a complacent acceptance of the miraculous and the supernormal. With the earlier investigations and writings of scientists still among us, such as Dr. Pierre Janet and Dr. Morton Prince, it passed into the stage of detailed descriptions of outstanding cases of mental abnormality, especially of hysterical cases with their startling characteristics of dissociation and susceptibility to hypnotism. Only within the last thirty years has it taken on the characteristics of a definite science—that of psychopathology—with a systematic classification of its subject matter and a set of general principles genuinely explanatory in nature. In the course of its development it has profited greatly by the advance of normal psychology, but is now reacting strongly upon the latter science, deepening its conceptions and revealing the presence of dynamic factors in the normal mind which would otherwise have remained unobserved and unsuspected.

In Prof. W. McDougall's "Outline of Abnormal Psychology" we have the first serious attempt at a systematic and detailed text-book on the subject. It is a sequel to his already well-known "Outline of Psychology," and is written on the lines of general

psychological theory there set forth. In a series of thirty-four chapters, all the main aspects and problems of the science are fully dealt with. Throughout the volume detailed descriptions of typical cases, to the number of sixty in all, are given, which furnish a solid empirical foundation to the theoretical superstructure. Although full accounts are given of the chief schools of thought in modern psychopathology, such as those of Janet, Morton Prince, Freud, Jung, and Adler, these are successfully pressed into service to illustrate the author's own systematic psychological theory, the vitality of which is shown by its power to assimilate much that is characteristic of each of them. In this respect McDougall is representative of a flourishing school of psychopathology and psychotherapy especially prominent in England at the present time.

Certain minor points may be singled out for qualified criticism. The theory of causation of exaltation and depression (manic-depressive insanity), in terms of the instincts of self-assertion and self-abasement, would seem to be too simple. It does not allow for the large part played by 'disappointment in love,' understood in the widest sense, often found in these cases when deeply investigated. Again, the author unduly minimises the correlation of pronounced hypnotic phenomena with those of hysterical dissociation. This is no doubt not unconnected with his readiness to accept at their face value the manifestations of alternating and multiple personality. This, in its turn, involves him in the necessity of producing an ingenious but singular theory of 'monads' in telepathic relation with one another to explain the forms of internal communication and lack of communication within these split personalities. Such monads are different from their Leibnizian prototypes, since the latter 'had no windows.' Moreover, to bring in telepathy as a thorough-going explanatory factor in this way seems perilously near explaining *ignotum per ignotius*.

We should bear in mind the alternative possibility that the phenomena of multiple personality may be in the main artefacts, due to the hypnotic methods of investigation and treatment employed by their observers. This would fit in with the fact that during the recent European War, in which severe forms of functional nervous derangement were produced by the thousand, no well-marked cases of multiple personality were reported or observed. Cases of extensive amnesia, fugues, etc., were numerous; but the first aim of the army doctors in the battle areas was to remove these

amnesias and re-associate the patients as quickly as possible, so that the latter might be either returned to the line or sent down to the base with the minimum of delay. Moreover, we should not overlook the part played by drama, or rather melodrama, in producing well-marked phenomena of multiple personality.

Finally, Prof. McDougall makes a vigorous onslaught upon the theory of 'abreaction' or psychocatharsis as a working off of pent-up emotion leading to recovery. But in explaining the beneficial results of this method as due to a re-association of the mind, he is only restating the theory of his selected opponent, set out in publications already some years old. The essence of his opponent's theory was that the re-arousal of disturbing emotional experiences with sensorial vividness was in certain cases alone adequate to produce a re-association of the mind with the requisite degree of completeness. The re-association must be an emotional one as well as an intellectual one.

These matters are, however, of subsidiary importance. In its powerful sweep, firm grasp of detail, and vivid and lucid style, the book stands out as one of the most important contributions to psychopathology of the present time.

WILLIAM BROWN.

Our Bookshelf.

- (1) *The Food of some British Wild Birds: a Study in Economic Ornithology.* By Dr. Walter E. Collinge. Second revised and enlarged edition. Pp. xix + 427 + 9 plates. (York: Published by the Author, Yorkshire Museum, 1927.) n.p.
- (2) *The Birds of the British Isles.* By T. A. Coward. (The Wayside and Woodland Series.) Third Series: Comprising their Migration and Habits and Observations on our rarer Visitants. Pp. xi + 308 + 127 plates. (London and New York: Frederick Warne and Co., Ltd., 1926.) 10s. 6d. net.
- (3) *British Birds.* Written and Illustrated by Archibald Thorburn. New edition. In 4 vols. Vol. 4. Pp. x + 154 + plates 145-192. (London: Longmans, Green and Co., Ltd., 1926.) 16s. net.

(1) ALTHOUGH Dr. Collinge modestly calls this a revised edition of his work of 1913, it is virtually a new book. In place of the twenty-nine species formerly considered, the feeding habits of seventy are now discussed in detail, a considerable number being sea-birds, which had no place in the earlier work. The data for most of the species have been extended, the volumetric system of analysis, now universally adopted in the United States of America, has been superimposed upon the numerical

system, and the useful chapters dealing with general aspects of the economic relationships of birds have been added to and expanded. On the whole, it is surprising in how many cases an analysis of the food stuffs taken over a long period tells in favour of birds usually condemned as unmitigated pests, even although the statistics here given reckon against the bird much in the food content which can be of no agricultural value. The statistical methods adopted in such investigations still fall far short of scientific precision and leave the final judgment to personal interpretation with wide margins, but until better methods are evolved, Dr. Collinge's book will remain the standard British work on the subject.

(2) For the average naturalist this third volume completes the most attractive and useful of the lesser books on British birds. As a practical guide to species it is less essential than its forerunners, since it deals mainly with rare and casual visitors. It is illustrated by many fine coloured drawings reduced from Lord Lilford's standard work. But it breaks new ground by introducing several chapters dealing with general aspects of British bird life, including a lengthy and excellent account of migration, and descriptions, family by family, of characteristic migratory and other habits. The sixteen 'sub species' added to the British list since the earlier volumes appeared are here described, as well as two species since recorded for the first time from Great Britain.

(3) The appeal of Mr. Thorburn's work rests largely upon the beautiful and accurate coloured plates, the finest of their kind, which make identification of species a pleasure and a matter of comparative simplicity. Since, except for a number of rare and closely related species, all the British birds appear in these 192 plates, descriptive matter has been reduced to a minimum, and the text is confined to short accounts of range and characteristic habits.

(1) *Civilisation or Civilisations: an Essay in the Spenglerian Philosophy of History.* By E. H. Goddard and P. A. Gibbons. Pp. xvi+231. (London: Constable and Co., Ltd., 1926.) 7s. 6d. net.

(2) *Sunrise in the West: a Modern Interpretation of Past and Present.* By Adrian Stokes. Pp. xvi+168. (London: Kegan Paul and Co., Ltd., n.d.) 7s. 6d. net.

(1) In a preface to "Civilisation or Civilisations," Dr. F. C. S. Schiller, with a characteristic and mildly cynical humour, discusses the reasons for teaching history and briefly expounds the philosophy of that subject as an attempt to formulate a 'law.' The book itself is intended to familiarise English readers with the ideas of Spengler's book, "Der Untergang des Abendlandes," in which the belief in progress was challenged. Holding that civilisation does not show any steady arithmetical progression, Spengler propounds a 'law of civilisations' to account for their rise and fall. Human achievements are divided into nine groups or eras, each constituting a distinct civilisation capable of

high achievement in art, in science, in thought, in religion, and in social organisation. Each of these passes through a course of progress covering about 1400 years, after which the society ceases to be artistic, social, or scientific in any but the crudest sense. Western civilisation, beginning about A.D. 900, is expected to come to an end about A.D. 2300. It will be seen that this theory of history involves a return to the schematisation of progress, and indeed the authors will have nothing to do with the archæologist who traces cultural phenomena back to their origins or with the diffusionist and his migrations of culture from an original centre in Egypt. Either school may perhaps be content to await the verdict of the facts—when we know them.

(2) "Sunrise in the West" is essentially modern in outlook and in language—both to the plain man a little obscure. The culture of the west is reviewed as a progress in the relation to one another of the 'poetry' and 'prose' of human expression. Our present position is a stage before the apotheosis of western civilisation, and the flame of the Western Spirit is a 'blue vision' which the author himself characterises as "an unsatisfactory expression, no doubt"!

The Riddle of the Tsangpo Gorges. By Capt. F. Kingdon Ward. Pp. xv + 328 + 16 plates. (London: Edward Arnold and Co., 1926.) 21s. net.

THE Tsangpo River, the main source of the Brahmaputra, flows placidly, from west to east, across Tibet until it reaches the eastern end of the Himalayan range, and vanishes into a terrific gorge. The bottom of the gorge is 9680 feet above sea-level, and the peaks that hem it in on each side rise to more than 21,000 feet. The river emerges from the mountains some 35 miles away, and is then flowing south and west at an elevation of less than 2000 feet. There was, therefore, a chance that the gorge might conceal the most stupendous waterfall. Part of the gorge was explored by Bailey and Morshead in 1913, and most of the remainder by Captain Kingdon Ward and Lord Cawdor in 1924. No large falls were found, and it is now clear that none exists.

The main purpose, however, of Captain Kingdon Ward's expedition was not the exploration of the gorge, but the collection of plants and seeds. In this corner of Tibet the climate varies from tropical to arctic, and from humid to arid, within a range of a few miles, and the flora varies with the climate. It is a wild garden stocked with countless species and varieties of flowers and flowering shrubs; hillsides blazing with rhododendrons; fields of lilies; meadows of primulas; giant snowpeaks above, and below the abyss, echoing with the thunder of the hidden river.

The book is very modestly written, and the dangers and difficulties that were faced and surmounted in the gorge are mostly left to the reader's imagination. It is probable that they will not be fully realised until some other explorer attempts to follow in the footsteps of Captain Kingdon Ward

and Lord Cawdor. The expedition owed much to the hospitality of the Tibetans, and to the courage and endurance of the men and women who, at the risk of life and limb, carried their loads up and down the almost vertical cliffs of the gorge. The book is illustrated by excellent photographs, some of which must have been taken from very perilous positions. The last two chapters of the book are by Lord Cawdor, and give a short account of the natives of Eastern Tibet and their customs.

Reports of the Progress of Applied Chemistry, issued by the Society of Chemical Industry. Vol. 11, 1926. Pp. 742. (London: The Society of Chemical Industry, 46 Finsbury Square, E.C.2, 1927.) 12s. 6d.; 10s. to Fellows of the Chemical Society, or 7s. 6d. to members of the Society of Chemical Industry.

ONE is accustomed to anticipate with some eagerness the publication of the annual reports on pure and applied chemistry by the Chemical Society and the Society of Chemical Industry, respectively. The eleventh volume (1926) of the latter series will occasion no disappointment. In fact, it is unusually comprehensive; it is readable and yet as full as ever of catalogued information, and, moreover, it has appeared promptly. It is not surprising that constant reference is made to the impression left by last year's dispute in the coal-mining industry on the progress of applied chemistry; however, the difficulties of that period have at least focussed attention on fuel economy, on more fruitful ways of using coal, and on the possibility of meeting future demands for liquid fuel.

It is noteworthy that the period under review saw the establishment of the Institution of Fuel Technology and the Fuel Section of the Society of Chemical Industry. The fermentation industries, also, continue to grow in importance; the butyl alcohol—acetone fermentation is now being harnessed to the commercial production of hydrogen. Harington's work on thyroxin is recorded as the most notable advance in the chemistry of the hormones. A. A. E.

Wireless Loud-Speakers: a Practical Manual describing the Principles of Operation, Performance, and Design. By Dr. N. W. McLachlan. Pp. viii + 139. (London: Iliffe and Sons, Ltd., 1927.) 2s. 6d. net.

THIS book describes in a simple way the main principles used in the design of various modern types of loud-speaker. Both the amateur and the expert will find in it much that is instructive. The musician who judges from the average loud-speaker reproduction of to-day is forced to conclude that at the best it is only fair. The performance of even the best loud-speakers is far from ideal. The musical ear soon detects resonances in the reproduction, and sometimes it soon ceases to give pleasure. It is also necessary that there should be no falling off in the reproduction of notes in the scale having frequencies between 40 and 400 cycles and also in the scale from 2000 to 4000 cycles. In

the former case the bass, and in the latter the upper harmonics, are almost lost. In practice the ear finds a great difficulty in judging which of several imperfect instruments is the best. It seems to be a matter of taste. It has to be remembered that the radiation of sound from a horn loud-speaker is in the form of a divergent beam, the best quality being obtained when the aperture of the horn points directly to the listener. With a cone diaphragm the radiant beam is wider and extends on both sides of the diaphragm. Owing to the focussing effect the reproduction is best with the concave face to the front. In certain cases, however, this is somewhat modified by reflection from the walls of the room.

Entwicklungsgeschichte der mineralogischen Wissenschaften. Von P. Groth. Pp. v + 262. (Berlin: Julius Springer, 1926.) 18 gold marks.

THIS essay on the historical development of the mineralogical sciences is especially interesting in being from Prof. Groth, who has been a leader in these subjects for half a century and has now reached the age of eighty-three years. It is divided into two sections—"Krystallkunde" and "Mineralkunde"—and the period covered is up to the end of the nineteenth century; that is, previous to the recent developments in crystallography due to X-ray methods.

The early history of mineralogy and crystallography are closely interwoven, but now they must be regarded as distinct sciences. Crystallography is no longer an aid only to mineralogy, but also to chemistry and physics—a fact that is well brought out in the present sketch. Besides chapters on geometrical crystallography there are others on physical and chemical crystallography, and on the recognition of the connexion between the form of crystals and their optical properties. The mineral section contains chapters on the crystallography of minerals and the optical determination of rock-forming minerals, and on the chemistry of minerals, including the study of their alteration and artificial reproduction. Some account is given of the more important mineral collections in various countries and of the work that has been done on the material so collected. An appendix gives an interesting series of biographical sketches of the more prominent past workers.

The Story of Reckoning in the Middle Ages. By Florence A. Yeldham. With an Introduction by Dr. Charles Singer. Pp. 96. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., 1926.) 4s. 6d. net.

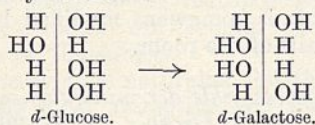
THE increasing number of teachers who are becoming interested in the history of mathematics will welcome this little book, which is divided into two parts, treating respectively of the abacus and algorism. Admirable diagrams enable the reader to perform simple calculations with the abacus, and the chapters on algorism throw considerable light on the evolution of our modern methods of computation.

Letters to the Editor.

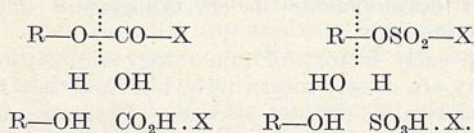
[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

An Aspect of the Biochemistry of the Sugars.

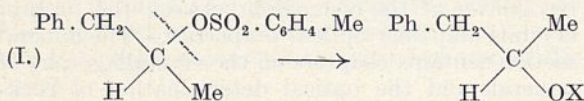
As is well known, the *d*-galactose configuration may be derived from that of *d*-glucose by a simple optical inversion at position 4 as shown in the annexed conventional symbols:



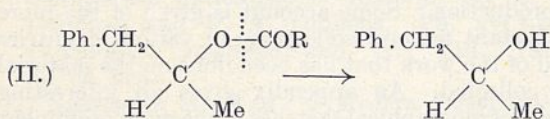
Although no suggestions as to a probable mechanism of this important transformation have hitherto been advanced, the explanation becomes obvious when certain developments in the theory of the Walden inversion and related simple optical inversions are taken into account. Lapworth, in the course of his studies of the mechanism of the formation and hydrolysis of esters, has pointed out that carboxylic esters and sulphonic esters are normally hydrolysed, and suffer fission generally, at the points shown by the dotted lines:



In harmony with the requirements of this theory, Phillips has found that optical inversion occurs in the fission, for example, the acetolysis of *d*-benzylmethylcarbinyl *p*-toluenesulphonate. The results are summarised by the scheme:



with inversion;



without inversion.

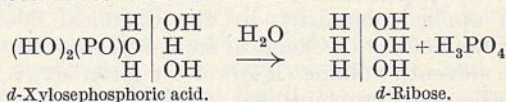
In reactions of type I., inversion is normal but not inevitable, since special conditions may induce a direct replacement. Thus there is little doubt that inversions in the carbohydrate group, though not occurring in the hydrolysis of acetates, carbonates, acetone compounds, etc., could be brought about by the formation and hydrolysis of sulphato or arylsulphonyl compounds. The theory which applies to derivatives of sulphuric acid applies also to derivatives of phosphoric acid since, putting it crudely, phosphorus has much affinity for oxygen, and having once acquired the element will be difficult to part from it. Therefore hydrolysis of phosphoric esters will be in

accordance with the scheme $\text{R} \cdots \text{O}(\text{PO})(\text{OH})_2$, and if

the oxygen atom is directly attached to an asymmetric carbon atom, optical inversion should be observed.

Bearing in mind, then, the occurrence of hexose-phosphates in Nature, it seems certain that the galactose configuration results from the hydrolysis of a glucosephosphoric acid which may occur as such or form part of a larger molecule. An interesting side-issue is the indication of the probable constitution of the glucosephosphoric acid, and the fact that the present hypothesis, permissible on the basis of Haworth's six-ring glucose formula, would be excluded if glucose contained the butylene oxide ring. The reverse change from galactose to glucose will naturally have the same mechanism.

In discussing the matter recently with Prof. W. N. Haworth and Dr. E. L. Hirst, it was pointed out that the above suggestion throws an interesting light on the nature of the pentose in the nucleic acid derived from vegetable nucleo-proteins. Levene has obtained from this source a pentose-phosphoric acid which on hydrolysis yields *d*-ribose and phosphoric acid and is therefore considered to be a ribosephosphoric acid. It is much more likely to be *d*-xylosephosphoric acid, the ribose being produced in accordance with the scheme:



The circumstance that we are able in this way to regard nucleic acid as a derivative of the relatively widely distributed xylose instead of the rare or unique ribose must undoubtedly be regarded as strongly supporting the thesis advanced. The *d*-ribose could also be obtained from a *d*-arabinose-phosphoric acid or from *l*-lyxosephosphoric acid, but *d*-arabinose and *l*-lyxose do not appear to occur naturally, and consequently the assumption of the origin from *d*-xylose is preferable. Finally, without going into detail, it may be pointed out that a consideration of the facts in relation to the theory of hydrolysis and optical inversion indicates that the first stage, involving fission of a bond, in the hydrolysis of a glucoside is the opening of the oxide ring.

R. ROBINSON.

The University,
Manchester, June 24.

Friction of Solids.

THERE seems to be but very little published information regarding the subject of solid friction, and such as there is is chiefly concerned with the effects of lubrication at considerable velocities and at comparatively low pressures.

I think, therefore, it is worth while to contribute a short note on some experiments which I have recently made, in which the pressure between the solids range from those ordinarily met with in mechanical practice up to the highest which the material can withstand¹ and in which the velocities are almost vanishingly small. A list of the materials tried and of their coefficients of friction is given below.

The point worthy of remark is the small difference which exists between the coefficients for the various metals notwithstanding their strong contrasts in other respects. Another point which seems remarkable is that when the pressure is high, the presence of a lubricant nearly always increases instead of diminishing the coefficient of friction.²

¹ An example of friction at destructive pressures is presented by the driving-band on the projectiles of large guns. The great volume of smoke which 'smokeless' powder produces when such guns are fired consists almost entirely of powdered driving-band, i.e. of finely divided copper.

² The effect of a 'drop' in the saucer in preventing a cup from slipping is very generally known.

In these experiments a small plate of sapphire was always used as one of the pair of substances the mutual friction of which was to be determined, because, as was found after many trials, where one of the pair was so hard as to be free from any chance of being

The tray *A* was supported on three steel balls rolling on steel guides, and it was found that the resistance offered to the travel of the tray was less than a ten-thousandth of the load carried by it.

In making an experiment the tray was brought to

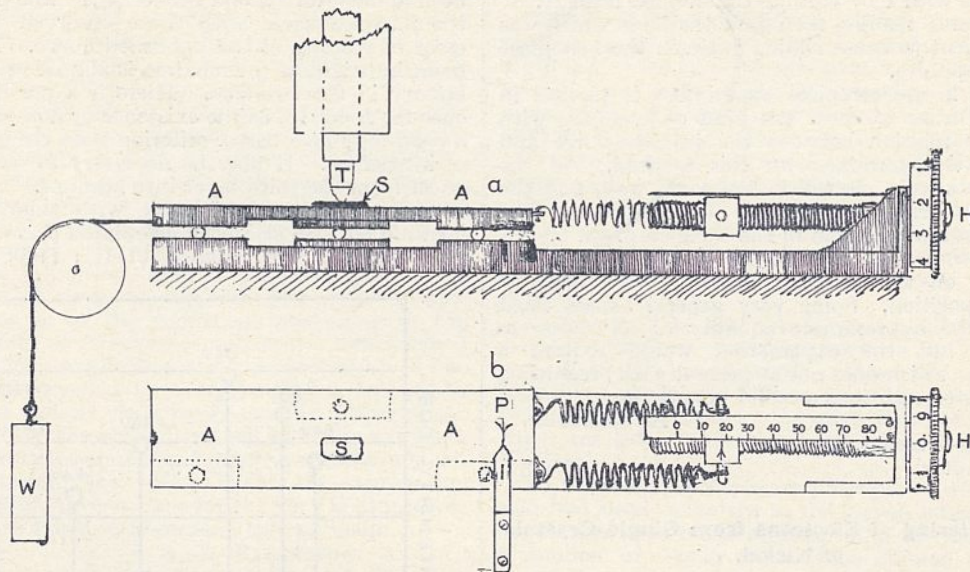


FIG. 1.—Apparatus used in the measurement coefficient of friction. *a*, side elevation; *b*, plan; *A*, tray rolling on steel balls; *S*, sapphire plate; *T*, test piece; *P*, zero mark on tray; *I*, index; *H*, divided head, controlling spring balance.

scratched, the coefficient depended solely on the properties of the softer material.

As mentioned in my letter published in NATURE of May 7, the sapphire plate was carried on a tray

the zero position by turning the adjusting screw *H* of the spring balance until the mark *P* on the tray coincided with the index *I*.

COEFFICIENT OF FRICTION BETWEEN METAL AND SAPPHIRE.

Metal.	Coefficient of Friction.	Load.	Pressure.
Steel	{ D 0.10	The loads were increased by quarter lb. from 0 to 1 lb., half lb. from 1 lb. to 4 lb., lb. from 4 lb. to 9 lb.	Pressure = load by measured area of contact. This ranged up to 300 tons per square unit for steel. limiting pressure for the other metals.
	{ L 0.11		
Copper	{ D 0.11		
	{ L 0.105		
Antimony	{ D 0.105		
	{ L 0.14		
Zinc	{ D 0.105		
	{ L 0.115		
Cadmium	{ D 0.10		
	{ L 0.125		
Tin	{ D 0.115		
	{ L 0.135		
Aluminium	{ D 0.10		
	{ L 0.11		
Bismuth	{ D 0.095		
	{ L 0.075		
Lead	{ D 0.10		
	{ L 0.135		
Zinc-copper	{ D 0.85		
	{ L 0.95		
Tin-copper	{ D 0.115		
	{ L 0.125		
Antimony-copper	{ D 0.09		
	{ L 0.108		
Cadmium-copper	{ D 0.09		
	{ L 0.115		
Aluminium-copper	{ D 0.095		
	{ L 0.10		

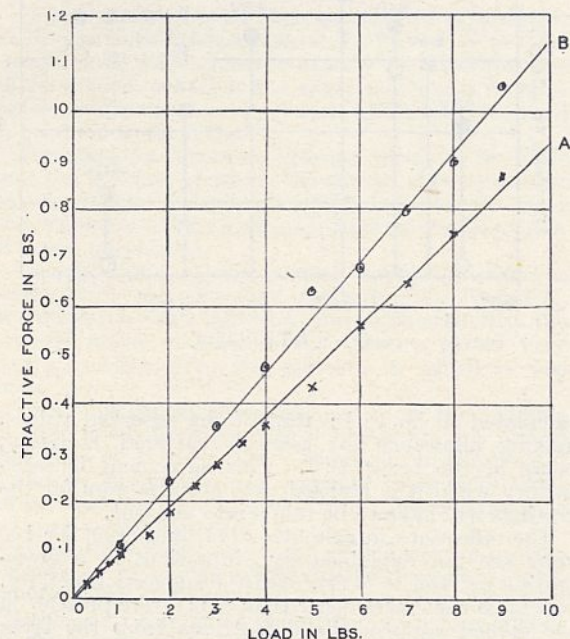


FIG. 2.—Diagram showing the results of two sets of experiments on the coefficient of friction of steel on sapphire.

x Individual observations when the surfaces are dry.
 o " " " " in oil.
 The ratio ordinate/abscissa = coefficient of friction.

which could be dragged literally under the loaded test piece by the action of a spring balance. The apparatus, somewhat improved, is shown in Fig. 1, *a* and *b*.

D indicates that the surfaces were clean and dry.
 L " " " " lubricated.

To make the zero definite a counter weight *W* was added to give an initial tension to the springs. The

test piece with its appropriate load was then allowed to press on the sapphire and the tray (by means of a screw nut shown in the sketch) was shifted slightly in the direction to extend the balance spring. This screw was slacked back and the mark *P* again brought to coincide with *I* by turning the divided head *H*.

The balance reading then gave the force which was just sufficient to cause sliding between the test piece and the sapphire.

In Fig. 2 one complete experiment is plotted in detail, in order to show the kind of accuracy with which the relation between the tractive force and the load is determined by this method. All the experiments were plotted in the same way, and the order of accuracy is much the same on each. The average results are given in the table on p. 45.

Lubrication was effected by putting a drop of heavy oil on the sapphire before placing the test piece in position. Some very general causes must underlie the approximate equality of all these coefficients, but the explanation would require a knowledge (which does not at present exist) regarding the intimate conditions at solid boundaries.

A. MALLOCK.

9 Baring Crescent,
Exeter.

The Scattering of Electrons from Single Crystals of Nickel.

In a letter to *NATURE* (vol. 119, p. 558; April 16, 1927, hereafter cited as *loc. cit.*), Messrs. Davisson and Germer have communicated the results of some very interesting experiments on the scattering of electrons from single crystals of nickel. They show that the distribution of scattered electrons, which have only lost a small fraction of their energy, depends on the voltage, and is in accordance with the symmetry of the crystal. The authors explain their results approximately on the basis of the Einstein - de Broglie theory of the wave electron, in a similar manner to that suggested by Elsasser (*Naturwiss.*, 13, p. 711, 1925) in explanation of earlier experiments of Davisson and Kunsman (*Phys. Rev.*, 22, p. 243, 1923). In particular, the explanation given is that electrons of velocity *v* are scattered by the nickel crystal in very nearly the same directions as those in which an electromagnetic wave of wave-length $\lambda_e = h/mv$ would be diffracted by the cross grating formed by the uppermost layer of atoms in the face of the crystal—in this case, a {111} face which has been etched by vaporisation.

The alteration in intensity (with varying voltage) of the reflection with maximum at 50° in the {111} azimuth for 54 volt electrons [*loc. cit.*, Fig. 1] is not explained by diffraction at a cross grating. There is another control which brings out the one reflection as a maximum with the partial suppression of the neighbouring ones. The control is not the complete one which would be exercised by a space lattice. This would entirely suppress all reflections but the maximum. The necessary degree of control would be provided by the influence of a second cross grating lying beneath the first. The observed position of the maximum (*i.e.* at 54 volts, 50°) can then, however, be explained only by the assumption of a spacing between the two gratings equal to $Ka/\sqrt{3}$, where $K = 0.66$ or 1.16 and $a/\sqrt{3}$ is the normal spacing of the {111} planes of a face-centred cubic lattice of constant *a*. At these distances the diffracted beams from the two layers are in phase for 54 volts. The two factors differ from one another in corresponding path length by one wave-length.

It must be pointed out that the factor *K* is not quite

the same for all reflections. The calculated maximum intensities for the various voltages in the neighbourhood of 54 volts for the above values of *K* are shown in the figure, compared with the observed maximum intensities [*loc. cit.* Fig. 1]. (No corrections have been applied for general scattering.) The positions of the maxima agree with those observed within the error of reading of the published curve. The agreement in height of the maxima is almost equally satisfactory in the two sets. There is a possible preference for $K = 1.16$, as the existence or non-existence of a peak may be a better criterion than the comparison of intensities. It may be necessary to take a slight effect from the third layer into account.

The variation of intensity with azimuth in co-latitude 50° has also been calculated [*loc. cit.* Fig. 2]. The ratio of the maxima {111} : {100} has been

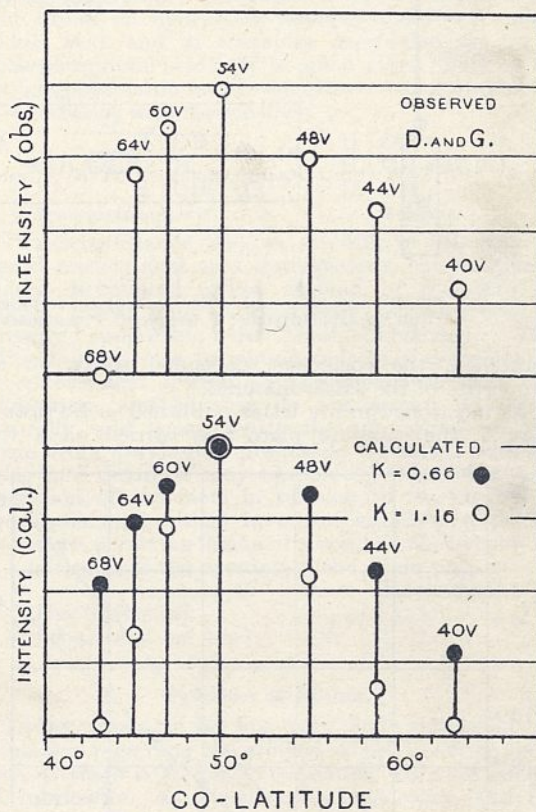


FIG. 1.

calculated to be 4 : 1; that of the observed values, making allowance for general scattered radiation, being of the order 2 : 1. This agreement is satisfactory when it is realised that atom factors for the gratings will have to be taken into account.

The reflections in azimuths {111} and {100} for 110 volts are not explained by diffractions in a cross-grating parallel to (111). On the suggestion of Prof. von Laue that faces other than (111) were present on the etched surface, the diffractions from the cross gratings parallel to a few of the most probable subsidiary faces were calculated. The assumption of the existence of faces $\{\bar{1}11\}$ would explain the reflection in the {111} azimuth, giving a value of $n(\lambda mv/h) = 2(1.06)$. The reflection in the {100} azimuth can possibly be explained as a diffraction of the same type in the $\{\bar{1}11\}$ faces of minute twin crystals, which are rotated through 60° on the surface of the main crystal.

It is reasonable to assume that an alteration in the

lattice is to be found near the surface of a crystal. Whether an increase or a decrease takes place seems to be an open question. An application of the electron lattice theory of Haber would suggest that the nickel atoms would be repelled, and the spacing increase (*cf.* Madelung, *Phys. Zeits.*, 20, p. 494, 1919). The point is, however, not very clear. That the surface of an etched crystal is not perfectly plane, and that many faces of the order of ten to a few hundred atoms in extent are present, is also to be expected.

It is not profitable to carry the discussion further on the basis of the results which could be communicated in the scope of a letter to NATURE. The agreement of these results with calculation seems to indicate that the phenomenon can be explained as a diffraction of waves in the *outermost layers* of the crystal surface. It also appears, which may be even more important, that a complete analysis of the results of such experiments will give valuable information as to the conditions prevailing in the actual surface of the crystal, and that a new method has been made available for the investigation of the structure of crystals in a region which has up to the present almost completely escaped observation. Calculations on the above lines will be continued when a more detailed account of the experiments is available.

In conclusion, the writer wishes to express his thanks to Prof. M. von Laue for the very kind interest which he has taken in discussing this problem.

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May 26.

The Origin of Speech.

It is well known that the gestures of articulation which produce the consonants *L*, *T*, and *K* are not always made respectively in exactly the same position in the mouth, and that the exact position is more or less dependent on the vowel with which the consonant in question is associated.

Actually, the consonant gesture tends to be made near the position at which the tongue approaches the palate to form the central orifice between the front and back resonators which produce the required pair of vowel resonances.

Examination of the actual resonance-changes produced by the consonant gestures of *L*, *T*, and *K*, in association with different vowels, showed that the acoustic effect of a consonant gesture varied very greatly according to the position in which it was made.

Thus the initial resonance of *L* in the syllable *Li* (lee) is about 4 semitones higher (in my voice) than that of *L* in *lu* (loo). Similarly, in the case of *ti* and *tu* the difference of resonant pitch is 14 semitones, while between *ki* and *ku* the difference may be so much as 20 semitones.

These differences of resonant pitch are much greater than those by which we normally distinguish such vowel sounds as *i* (eat) and *ei* (hay), or *æ* (hat) and *ɜ* (earth), or *ʌ* (up) and *a* (calm); yet we normally hear all these consonants as the same—whatever be the vowel with which they are respectively associated.

The conclusion which was drawn from these (and other) observations was that, in appreciating speech, the human mind is not primarily interested in the sounds—which are due to changes of resonance—but rather in the gestures of articulation by which these changes are produced.

We therefore normally accept, as identical, speech

sounds which may be very different in pitch or in change of pitch, if we recognise that they are made by the same gesture of the tongue—even though that gesture may, for convenience, be made in different positions in the mouth when associated with different vowels.

To test the assumption that speech is essentially a matter of gesture, the attempt was made to 'fabricate' a number of words symbolising such simple actions as to dig, wave aloft, shake (like shaking a mat), stab, scrape, etc. The method of formation was to imitate, with the tongue, a pantomimic gesture, such as might also have been made by hand, and to phonate or grunt *while* making the tongue-gesture.

The phonetic results of these combined gestures and grunts were submitted to Dr. Neville Whymant, who kindly undertook to compare them with early Polynesian, Melanesian, and Japanese words of similar meaning.

As the result he was able to produce close phonetic counterparts from these languages in the case of 11 out of 12 fabricated words. Thus, for to dig, the fabricated word was *tadi* or *tari*—the actual Protopolynesian word is *tari*; for wave aloft the fabricated word was *ledhl-ledhl* or *ledl-ledl*—the actual word is *lete-lete*.

To test whether the same principle of word formation had been operative in the Aryan languages, the experiment was made of comparing the meanings of a number of Aryan roots which differed only by a single consonant sound—as, for example, the roots *LA*, *LAS*, *LAGH*, and *LAK*.

It was found that, in the case of about 130 words thus compared, each separate consonant imported a characteristic element of meaning, and that this meaning was pantomimically related to the gesture by which the consonant was produced.

Thus *LA*—which is due to the sudden lowering of the tongue from contact with the palate—has the meaning 'to be low.'

The consonant *S* is produced by pressure of the tip of the tongue against the back of the front teeth, so as to make a constriction in the front of the mouth.

S consequently denotes a grip or a bringing to a point in a forward position.

Actually, *LAS* means 'to glean,' that is, to be low and grip or pick in front of one.

GH is due to a partial closure of the back of the tongue against the back of the throat—the sensation being that of flattening the tongue out in the mouth.

Actually, *LAGH* means to lie down.

K is due to a complete closure (and release) of the back of the tongue against the soft palate.

Actually, *LAK* means to bend or depress—the forcible *K* closure importing the idea of stress.

Similarly, *R* (made apparently with a reflexed tongue as in Wessex and very generally in the United States) commonly denotes a bending back or surrounding, while *L* symbolises vertical movement, up or down.

Besides the roots which form comparable series, there were found a large number of isolated words—like **DHIGH* to smear, *WID* to see, *DU*, *DUK*, or *TUH* to lead—which give similar evidence of gestural origin. In the case of *WID* the lips and tongue appear to imitate the human eye, while in *DU*, *DUK*, and *TUH* the lips make a pointing gesture.

Altogether some 320 roots have been found which show signs of pantomimic origin.

It would appear, therefore, that human speech began by the performance of sequences of simple pantomimic gestures of the tongue, lips, etc., comparable with the natural gestures (of hands, etc.) which are still made by deaf mutes, and that these

gestures were made audible by breathing or grunting.

In this way a single polysyllabic 'word' would denote a sequence of actions (or of actions and related objects), in other words, a 'sentence.'

Since these results were formulated I have learnt that a practically identical theory was put forward in Sept.-Oct. 1862 by Dr. J. Rae of Honolulu, in three articles published by *The Polynesian*, copies of which I have now seen in the British Museum Library (Press Mark—General Catalogue—P.P. 9899. 6).

Dr. Rae's conclusions were drawn from a study of Polynesian word-formation.

It is remarkable that, though Prof. Max Müller was acquainted with Dr. Rae's articles (see his "Science of Language," Second Series, 1864, pp. 10 and 89), he did not appreciate their importance, or see the light which they threw on the origin of the Aryan roots and of human speech in general.

R. A. S. PAGET.

1 Devonshire Terrace, W.2,
June 6.

Preliminary Note on a Glow in Hydrogen at High Pressure.

DURING an experiment in which an attempt was being made to get atomic hydrogen by means of an incandescent tungsten filament in wet hydrogen, a quite unexpected glow was discovered. The apparatus consisted of a three-litre bulb in the bottom of which there was sealed a tungsten filament from a 300-watt electric-light bulb. The pressures varied from 2 cm. to 35 cm., the hydrogen being generated by the electrolysis of potassium hydroxide. No care was taken to dry the hydrogen or to purify it.

The glow was observed as follows: The filament was allowed to come to incandescence, the observer very carefully shielding his eye from the direct light of the filament. On extinguishing the filament and then opening the eyes, it was possible to see a weakly luminous ball of vapour, blue in colour, rising from the filament and spreading out into an umbrella-shaped cloud at the top of the bulb. This glow persisted for about a second and then disappeared. The act of disappearance was a characteristic one, the glow appearing to collapse from the wall of the bulb to its centre. The speed with which the glow shot up from the filament increased with increased pressures. Below 2 cm. and above 30 cm. the glow was no longer observed.

It was found that after the filament had been run steadily for about thirty minutes it was no longer possible to observe the glow. However, on letting the filament stand for about ten minutes it recovered its former power to give the glow. We suspect from this that the glow is caused by something which is liberated from the incandescent tungsten filament, the fatigue of the filament being due to the filament's having given up all the carriers of the glow.

When fresh hydrogen was allowed to enter the bulb the filament did not give the glow until it had been flashed about ten or twelve times, after which it recovered its former ability to give the glow.

In order to eliminate the possibility that the glow may have been due to excitation of the hydrogen by electrons from the filament which had been accelerated due to the potential drop along the filament, a filament was used which became incandescent and gave the glow on only 5.5 volts. This immediately eliminated the above possibility, because the lowest excitation potential of H_2 is at 11.4 volts.

Several attempts were made to photograph the

spectrum of the glow, all with no success. However, by the use of colour filters it was possible to show definitely that the glow extended at least from 5000 Å.U. to 4400 Å.U. Therefore, although there are as yet no photographs, there is very little doubt in our mind as to the nature of the spectrum. We think that the spectrum is continuous because it is hard to see how such a weak spectrum can extend over a range of more than 600 Å.U. and be anything else. An attempt is now being made to determine the nature of the carriers of this glow.

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Anomalies in the Properties of Long-Chain Compounds.

DURING the course of an investigation into the nature of adhesion (on which I have been engaged with Prof. J. W. McBain on behalf of the Adhesives Research Committee of the Department of Scientific and Industrial Research), it has become evident that many of the properties of certain long-chain compounds become anomalous at (or in the immediate neighbourhood of) the 5th, 10th, and 15th carbon atoms in the chain. This is of theoretical interest in connexion with the form which the carbon spiral assumes in particular homologous series.

As is well known, the combined X-ray data of various investigators lend support to the idea that some form of carbon spiral or zigzag exists in certain long-chain compounds; and on certain assumptions the disposition of the carbon atoms in the chain has been more precisely defined. It is desirable, however, that data other than those of X-ray spacings should be considered in this connexion; for example, properties relating to the *molten state* or to *solution*.

According to the stereochemical view, a continuous chain of five carbon atoms would be expected almost to return on itself; and it is reasonable to suppose that a similar disposition of the carbon atoms would recur at the 10th, 15th, etc., carbon atoms. In this event the properties of similarly constituted compounds might be expected to show at least a tendency to periodicity with increase of molecular weight. Evidence of such a periodicity in the molecular rotatory power of the ethyl-R-carbinols ($R = \text{alkyl}$) was obtained by Pickard and Kenyon (*Jour. Chem. Soc.*, p. 1924; 1923).

From a consideration of such properties as static friction, adhesion, cohesion, surface tension, density of packing and electrical properties of monomolecular films on water, optical activity, magnetic rotation, dissociation constants, toxicity, together with other data, it appears that cumulative evidence can now be adduced indicating that anomalies or turning points exist in many of the properties of certain long-chain compounds at (or near) the 5th, 10th, and 15th carbon atoms of the chain. (It is intended to publish the detailed evidence shortly.) The abnormality is usually most pronounced at or near C_{15} , the anomalies being smaller in the neighbourhood of C_5 and C_{10} . It is considered that publication of the data may stimulate research into the question of periodicity in the properties of long-chain compounds, quite independently of the various X-ray investigations now in progress.

W. B. LEE.

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June 20.

Observations of the Total Eclipse of the Sun, June 29.

THE sense of personal disappointment of the astronomers who were prevented by clouds from observing the total eclipse on June 29 gives place readily to feelings of relief that in spite of persistently bad weather the spectacle was witnessed by many expectant people. As Prof. Turner rightly commented in the *Times* of June 28, the possible technical gains to astronomers on this occasion would take second place beside the general advantage of the public. On account of the uncertainty of favourable weather, the shortness of the duration of totality, and the low elevation of the sun at the time, this eclipse was not a favourable one for the specialists in eclipse problems. As a possible opportunity, however, for many people to see the various phenomena of a total eclipse for the first and only time of their lives, the occasion justified all the careful preparations made on every side for its occurrence.

Three months ago the railway companies regarded the suggestion that a special train might be run to a place in the eclipse track as scarcely a business proposition. One company replied that, though the event might be of interest to a few astronomers, the public was not likely to pay much attention to it. Within a few weeks of the eclipse, however, it became evident that a very large number of people intended to get within the zone of totality on June 29; and the railway companies with lines in or near the eclipse track found that they could fill all the trains they could run, or for which convenient stations or sidings were available. In addition to the thousands who travelled by rail, very many more journeyed to the track by motor-cars, and during the night of June 28 there was an almost unending procession of cars driving to the main roads within the track.

Such a great pilgrimage to view an astronomical

phenomenon was in itself most remarkable, and though only perhaps about a quarter of a million people actually saw the glorious shrine of the sun's corona, yet every one within the zone of totality was impressed by the accuracy of the timing of the eclipse (the difference between prediction and observation was less than three seconds) and the eerie darkness of the total phase. There was a sigh of relief in the watching crowds when the sky began to light up again after the sudden gloom.

Those of us who are familiar with celestial move-

ments can scarcely understand how completely wonderful the prediction of eclipses appears to be to the mind of the general public. Most people have only the vaguest ideas as to the sizes, distances, or motions of the sun, moon, and earth, and to many of them the dark body of the moon seemed to be actually a disc touching the sun. One lady was heard to say that she was afraid the thing would stick upon the sun instead of passing right across. It is true that the periodical press

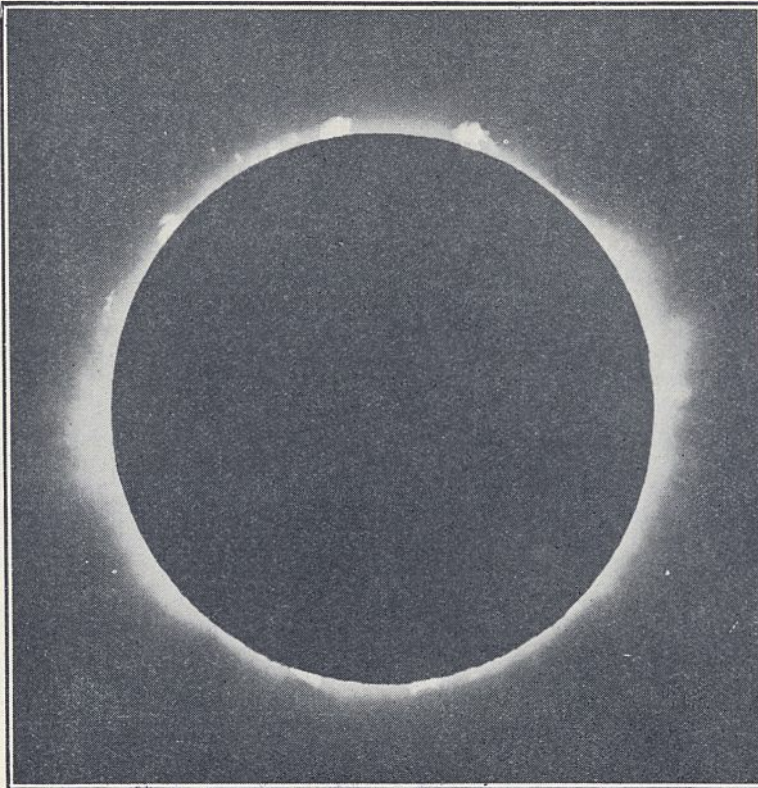


FIG. 1.—Photograph of solar prominences and inner corona taken at the Astronomer Royal's observing station at Giggleswick, Yorks, during totality on June 29. Exposure 20 sec., using a 6-in. lens of 45-ft. focus by Alvan Clark, kindly lent by Mr. James H. Worthington.

has done much to enlighten the public by means of descriptive and illustrated articles as to the nature and cause of eclipses, and never in the lifetime of any of us has so much space been devoted to an astronomical subject. The *Daily Mail* in particular took the lead months before the event, and near the day of the eclipse, as well as a day or two later, every daily newspaper made it a leading feature. Reporters and press photographers invaded every station where astronomical instruments were set up, and opinions as to promise or performance were eagerly sought and copiously printed. It is stated in the *Times* of July 4 that 22,000 press telegrams on the eclipse were dispatched from Settle on June 27-29. The London *Evening News* may be congratulated upon a remarkable achievement in this connexion. The Astronomer Royal's

photograph of the corona taken at Giggleswick was developed by ten o'clock on the Wednesday morning, and a representative of the *Evening News* was permitted to copy the negative. He went at once to Leeds by motor-car, and from there his photograph was taken to London by aeroplane, with the result that a reproduction appeared in the *Evening News* of the same day. By the courtesy of that journal we are able to reproduce the same photograph in NATURE (Fig. 1). The original negative at the Royal Observatory, Greenwich, shows, of course, more detail, yet the picture here reproduced illustrates how successfully the Astronomer Royal's party took advantage of the good fortune given it during the fine moments of totality.

Though glimpses of the corona were obtained at a few other places, no photographs comparable with that secured at Giggleswick were obtained elsewhere in England or Wales. At Gilling, near Richmond, Yorks, Sir Francis McClean had erected a camera with a lens aperture of 6 inches and focal length of 31.5 feet for the photography of the corona, but he and his brother, Capt. W. N. McClean, as well as Dr. Lockyer, Director of the Norman Lockyer Observatory, who hoped to obtain a photograph of the coronal spectrum, were prevented by thick clouds from doing anything useful during totality. Similar depressing weather conditions prevailed at most places and prevented observational work, either visual or photographic, by Prof. Fowler at South Kensington, Prof. Newall and the Cambridge party at Aal, Norway, and Prof. Mitchell at Fagerness. It is reported, however, in the *Times* of June 30 that at Ringeby, in Gudbrandsdal, and at Nyborgmon, in Finmark, weather conditions were perfect and excellent observations were made and photographs taken by Profs. Säland and Vegard at the former, and by Prof. Linke and M. Krogness, Director of the Geophysical Institute of Tromsö, at the latter.

Whilst sympathising with the many disappointed astronomers who had prepared and hoped for successful observation, it cannot but be felt that the combination of circumstances, such as they were, could not have been happier. In the first place, the Astronomer Royal's party was able to carry through successfully its intended programme, in spite of a serious handicap to the adjustments of instruments imposed by continuous bad weather for a fortnight before the event. Only those who have at least seen something of the preparations required in setting up an eclipse camp can appreciate the skill, concentration, and anxiety involved, and all will rejoice at the Astronomer Royal's good fortune in being at the most favoured place on June 29. At Southport also, a town at which the largest number of people had congregated, a satisfying, although not perfect, view of the eclipse was afforded. Prof. Turner, who has done so much to forward public interest in the eclipse, must feel highly gratified at his happy selection of Southport for his observing station, to which people gravitated in such large numbers.

An account of the intended programmes of

work proposed at various eclipse stations was given in the Supplement to NATURE for June 18. Work was practicable, however, at three only of these stations. At the Astronomer Royal's camp at Giggleswick, the very successful large-scale photograph of the corona already mentioned was taken with an exposure of 20 sec. Photographs of the flash spectrum, whilst not completely successful, on account of the lightly-veiled sky, should give useful information. At Southport, the site of the joint expedition from the University and Radcliffe Observatories, Oxford, two photographs were obtained with the astrographic telescope. One of these photographs developed during the following afternoon gave a moderately good image of the corona, the other plate being reserved for special treatment at Oxford. A pair of polariscopic plates, taken with the similar components of the Abney lens, showed that qualitatively, at any rate, the method employed was successful. At Stonyhurst, where the vagaries of the weather were especially evident, the programme arranged by the director could not be carried out owing to cloud, but a visiting astronomer, the director of the Coimbra Observatory, Portugal, was able, in another part of the grounds, to complete two kinematograph films, which it is hoped will show the formation of Baily's Beads. In an aeroplane (kindly placed at the disposal of the Astronomer Royal by the *Daily Mail*) at a height of 11,000 feet over Darlington, two members of the staff of the Royal Observatory, Greenwich, secured three small-scale photographs showing the corona and its extensions. These photographs would have been of special use in defining the type of corona and tracing its extensions if the sun had been completely hidden at all land stations.

The most interesting features of the eclipse appear to be as follows:

THE MOON'S SHADOW.—The approach and retreat of the moon's shadow as a definite boundary were clearly seen by Dr. Gerald Stoney from a ridge a few miles north of Richmond, Yorks. To most observers, however, the shadow was simply an increasing darkness. It was noted generally that the increase of light after totality was *apparently* more rapid than the decrease before totality. The progressive changes of colour as totality approached and passed have been fully described by eye-witnesses in and adjacent to the zone of totality. The most remarkable effects were evidently seen from the air.

BAILY'S BEADS.—Several people reported having seen this phenomenon, which occurs immediately before and after complete totality. It is possible, however, that in some cases this may have been confused with the appearance of bright prominences. An account of a spectroscopic observation of Baily's Beads, succeeded by the appearance of the flash spectrum, is given by a correspondent in the *Yorkshire Post* for June 30.

SOLAR PROMINENCES AND CHROMOSPHERE.—The prominences were a striking feature at totality, four or five being visible to the naked eye. The largest of these, near the sun's north pole, was easily seen

by most people; its height was estimated to be 50,000 miles. The day previous to the eclipse, Prof. Fowler, observing at South Kensington, detected this prominence spectroscopically. The only sunspots near the sun's limb at the time of the eclipse were placed at position angles 70° and 257° respectively, measured from the north point of the image. The colour ascribed to the chromosphere and prominences by the majority of observers was pink, red, or scarlet. It is of interest that the Greenwich observers and their associates in the aeroplane agree in the statement that at a height of 11,000 feet, where the sky was so clear as to be a deep Oxford blue, the colour was a lustrous silver white. This divergence of colour estimate might well be a point for observation at future eclipses.

THE CORONA.—The type of the 1927 corona is that previously found associated with maximum sunspot activity. In shape it resembles that of the 1905 corona. (An article dealing with the forms of the corona and their origin was contributed by Dr. W. J. S. Lockyer to *NATURE* for June 18, p. 93.) A remarkable feature of the 1927 corona was the brightness of the inner zone. One or more extensions were seen, the estimated length for the longest being about $1\frac{1}{2}$ solar diameters.

We are glad to be able to publish the subjoined details of observations made at various stations.

GIGGLESWICK.

The Royal Observatory observers at Giggleswick were Messrs. Davidson, Jackson, Melotte, and Woodman. They arrived a fortnight beforehand in time to meet their instruments, which had been sent from Greenwich by Admiralty lorry. They were joined later by Messrs. Greaves and Horrocks, and on June 24 by the Astronomer Royal. The site kindly placed at their disposal by the governors and headmaster of Giggleswick School was a field behind the chapel, from which the morning sun was seen over a hill rising to an altitude of 4° to 6° . On the morning of the observers' arrival, the sun was seen in a perfectly clear sky at the time of the eclipse, but for thirteen successive days was invisible at this time. During this fortnight rain and wind hampered the observers, but the greatest trouble was the absence of any continuous spells of sunshine. This made the final adjustments of the spectroscopes very difficult and somewhat uncertain.

On the day of the eclipse the observers were kept on tenter-hooks, but the sun was visible in a slightly hazy sky for 10 minutes before the total phase. Mr. Horrocks had a chronometer and called out, from the calculated times, $10^m : 5^m : 2^m : 1^m : 50^s : 40^s : 30^s : 20^s : 10^s$ before totality. The commencement of totality was 3^s before the revised predicted time. This was observed by the Astronomer Royal and coincided with the time when Mr. Davidson, watching the image, cried 'Go.' Mr. Horrocks from this zero counted seconds. The duration was 23^s .

Dr. Jackson exposed a plate in the 45-foot camera from 1^s to 21^s . A very sharply defined picture of the inner corona on the large scale of 5 inches to the sun's diameter was obtained. The extension is not great, but the detail is very fine.

The spectra of the 'flash' were only partially successful.

The observers in the aeroplane provided by the *Daily Mail* were Messrs. Greaves and Witchell of the Observatory staff and Mr. Hargreaves, an amateur astronomer who has been very successful in photographing faint comets. On his advice, hyper-sensitised panchromatic plates were used. With these, three photographs were taken with exposures of $\frac{1}{15}^s$, $\frac{1}{30}^s$, $\frac{1}{50}^s$. The plates show the extension of the corona well, but the longer exposures are affected by shake. The success of this party was due in great part to the magnificent piloting of Capt. Barnard. He found a hole in the high alto-stratus clouds and kept the aeroplane in it at the critical time.

The third Greenwich expedition was not so fortunate. The Hydrographer kindly arranged for the survey ship H.M.S. *Fitzroy* to be in the belt of totality during the eclipse. Messrs. Edney and Chamberlain took cameras of 27 in. and 20 in. focal length working at $F/4.5$ and $F/5.6$ respectively. But the sky was completely covered and nothing could be done.

There were no less than 100,000 visitors to the Settle and Giggleswick district who obtained a magnificent view of the eclipse. Among them were a number of boys and girls from West Riding towns like Huddersfield and Keighley. The educational effect of this unforgettable sight is not the least valuable result of the eclipse. F. W. DYSON.

I observed the eclipse at Giggleswick from a point in the Chapel Field a few yards to the west of the Royal Observatory party. With me were Messrs. R. W. H. and J. Davies, who assisted me greatly in the erection and adjustment of my instruments. The only photographic work attempted was with a small home-made slitless spectograph fitted with a transmission grating mounted on a prism. The clear aperture was $1\frac{1}{2}$ inches, and the spectrum was focussed by a spectacle lens of 32 inches focal length. The scale of the spectrum thus formed on the plate was about 500 Å.U. to the inch. The plate used was a super-speed panchromatic, made and kindly presented by the Imperial Dry Plate Company. The speed was estimated by the makers at about 1250 H. & D., and the sensitiveness extends well down into the red, to about $\lambda 7500$. A half-plate was used, and this included about 5 inches of the red end of the spectrum, from $\lambda 5000$ to the limit above stated. Fairly satisfactory photographs of the flash spectrum were secured at both second and third contacts, exposure at the latter being made by Mr. J. Davies. H_α and D_3 are shown as large arcs, the former more than 180° in extent, and there are about a score of reversed metallic lines, mostly in the green; but the plate has not yet been examined in detail.

The majority of totality was devoted to a simple visual scrutiny of the corona with a 3-inch Merz comet-seeker having a power of 17 and a field of $3^\circ 10'$. With this instrument the intense brilliance of the lower corona was very striking. It certainly

greatly exceeded the intrinsic brightness of the full moon and seemed to approximate to that of an incandescent mantle. The colour was pure silver-white, while that of the prominences was rose-pink, or perhaps more nearly cerise. The four principal rays of the outer corona seemed to be arranged fairly symmetrically round the disc, and the general appearance was that of a typical maximum corona. These rays were very much fainter than any part of the lower corona, but could be traced out to at least a full diameter of the moon. More than one was observed to exhibit a double curvature of outline, and in all there was a marked tendency to radial striation or subdivision. The rays seemed scarcely so white as the lower corona. Instead, they appeared slightly cream coloured, but the somewhat hazy sky may have had something to do with this.

At third contact I moved the telescope so as to place the reappearing crescent just outside the field of view. The lower corona and prominences were then still conspicuously visible and remained so for at least half a minute. After this, as the light increased, the corona became gradually fainter, besides growing narrower through the encroachment of the moon's disc, but it could be clearly held until 3 minutes and 5 seconds after third contact. This moment corresponded to a 94 per cent. obscuration of the sun. There was much absorption and scattering of the sunlight by haze, and the sky against or through which the corona was seen was very bright. Had the atmosphere been transparent and a somewhat higher power been used, I feel fairly confident that I could have seen the corona for at least another minute, and possibly a little longer still. In any event, my observation seems to lead to the interesting conclusion that, given clear weather and a suitable instrument, the lower corona could have been seen at this eclipse from practically every part of the British Isles. Certainly from places near the zone of totality, such as Manchester, Leeds, and Newcastle, it would have been a conspicuous object.

W. H. STEAVENSON.

SOUTHPORT.

The members of the Oxford expedition, Prof. H. H. Turner from the University Observatory, and Dr. H. Knox-Shaw and Mr. H. G. S. Barret from the Radcliffe Observatory, arrived at Southport on June 22, and immediately commenced setting up their instruments in a cycle shed of the King George V. School, which with the ready assistance of the Southport Director of Works was quickly converted into a comfortable observatory. As mentioned in NATURE of June 18, the instruments consisted of the astrographic object-glass of the University Observatory with a portable tube, fed by a 16-in. cœlostatt, for direct photography of the corona; and the two components of a 4-in. Dallmeyer doublet (the Abney lens), each of 5 ft. focal length, with two cameras containing plates of plate-glass, blackened at the back, just within the focus, reflection off which polarised the

light in two directions at right angles. These cameras were fixed on an equatorial mounting.

The weather was almost uniformly bad during the week of preparation. The instruments were set up approximately in azimuth by means of an excellent plan of the shed prepared by boys of the school, and accuracy to within about a degree was secured in this way. The cœlostatt commanded only the morning sky, and a glimpse of the sun on the morning of June 25 provided the means of its final adjustment in azimuth. Intermittent sights of the sun on June 28 enabled the cœlostatt clock to be rated. As there were no clear nights, the focus of the three telescopes was determined in the school dark-room by a photographic autocollimation method.

On the night before the eclipse there was a short interval when the stars were clearly visible, but it clouded up before dawn and there were no patches of clear sky again until the following afternoon. Throughout the period of the eclipse there was a uniform sheet of thin cloud over the sky and considerable lower cloud as well, from which the sun was fortunately clear from 5 h. 10 m. (summer time) until about a quarter of an hour after totality, except for a few anxious minutes after six o'clock, when it was almost entirely absorbed. Through this thin cloud exposures of 5 sec. and 2 sec. were made with the astrographic telescope, and a plate was exposed in each of the polariscopic cameras simultaneously for 18 sec.

The latter plates, on which photometric wedges had been impressed at the Clarendon Laboratory, with the kind co-operation of Mr. I. O. Griffith and Dr. G. M. B. Dobson, have been developed, and show differences which seem definitely to be due to polarisation in the corona. It is doubtful whether they will prove of any photometric value owing to the presence of cloud, but it is gratifying to find that this simple and inexpensive method of obtaining photographs of the corona in polarised light, which should be within the reach of amateurs, promises to be successful. The 2 sec. exposure with the astrographic telescope was also developed at the school. Although weak, it shows a narrow corona and several prominences, one of them showing a distinct arch. The 5 sec. exposure with this camera was taken back to Oxford to have a wedge impressed on it before development. All the plates show absorption by cloud over the lower limb of the sun.

The observation of the time of second contact indicates a correction to the predicted time of *minus* 2 or 3 seconds, but this, as in the case of the observation made at Giggleswick, will require confirmation, when the accurate position of the station is determined. A number of persons saw several prominences quite distinctly with the naked eye.

The headmaster (Mr. G. A. Millward) and the staff of the school, and the Mayor and Corporation of Southport, gave every assistance in their power. For the observations at totality the expedition was assisted by Mrs. Turner and Mr. E. B. Knobel, who with fans made the exposures at the two

instruments; by Mr. J. H. Reynolds, who attempted without success, as did Mr. Barrett, to observe the flash spectrum with a direct-vision spectroscope; by Messrs. D. C. Leech, R. Thompson, and C. Woodham, masters at the school, who worked the apparatus which provided the wireless time signals from Greenwich and called out the seconds of totality; and by several boys of the school, who booked the times of the various exposures.

Meteorological Observations.

The maximum of wind velocity occurred at 5.28 or 5.29 G.M.T., and the maximum 'backing' of wind direction at 5.30. The reduction in velocity was only 2 or 3 miles per hour, namely, from about 6 to about a 4 miles per hour wind, the recovery being the same. The backing of direction was 28° (from a point 146° from north through east to 118°), and the recovery afterwards practically as much.

Temperature fell only $0^\circ.4$ F. by the M.O. thermograph in the Stevenson screen, but $0^\circ.9$ by the dry bulb of the Assmann aspirated psychrometer. The minimum occurred at 5.34.

The wet bulb fall was $0^\circ.6$ by the Assmann. At 5.35 the dry and wet bulbs were only $0^\circ.9$ apart (dry = $47^\circ.9$ and wet = $47^\circ.0$).

The open-scale barogram shows nothing whatever that can with any certainty be associated with the eclipse.

The grass minimum temperature (by a special thermometer as sensitive as a mercurial one) was $44^\circ.8$.

Not the slightest char was made on the card of the sunshine recorder all the morning.

JOSEPH BAXENDELL.

DARLINGTON.

As I was one of the fortunate few who saw the eclipse on June 29, a brief account of my experience may be of some interest. I spent the previous night at Darlington with my party, and a little before 5.30 we went out into the streets in a quiet part of the town. The eastern sky was cloudy, and it was some ten minutes before we could locate the sun, but at last, about 5.45, there was a break in the clouds and it was seen that the moon had already bitten, so to speak, a fairly large crescent into the disc. Clouds were continually passing, but at intervals we saw the gradual progress of the moon across the sun's face. As the time of totality approached, a mass of cloud advanced and completely obscured the sun, and after 6.20 an extraordinary pall of darkness fell upon us, which we took to mean that totality had begun. We had all but given up hope of seeing what we had gone so far to see, when suddenly the sun disengaged itself, and we saw the black disc of the moon with a fiery belt all around it, and then bursting out from the top right-hand corner came a flash of blinding light which seemed to take the form of two ovoid excrescences. Immediately afterwards, more cloud came up through which we could just make out a

thin sickle of light on the right of the moon, and then we saw no more. But our effort had been well rewarded.

GEORGE A. MACMILLAN.

EDINBURGH.

Preparations were made at the Royal Observatory, Edinburgh, for observing the 'flash' during the partial phase. The great solar spectrograph with 40-ft. focus O.G. and Rowland concave grating of $21\frac{1}{2}$ ft. radius was adapted for the purpose by introducing a right-angled prism in the beam so that the tip of the cusp could be rotated tangentially to the slit. The weather, however, proved unfavourable. The crescent of the sun was glimpsed at maximum phase (0.98) through low, rainy cloud, but not for long enough to turn the spectroscope upon it, even visually.

R. A. SAMPSON.

STONYHURST COLLEGE.

At Stonyhurst, owing to a small cloud covering the sun at time of totality, the plates, which were all exposed according to programme, show nothing with the exception of that on the Dallmeyer portrait lens camera attached to the 15-in. equatorial. The eclipsed sun was slowly emerging from the small cloud mentioned above during the last 4 or 5 seconds of totality, and the result on the plate was a fairly complete ring of the chromosphere, the prominences on the west limb, and a trace of the corona to about one-third of a solar diameter beyond the prominences.

TIMES OF CONTACT.—At time of first contact the sun was partially immersed in cloud and no observation was possible.

The time of second contact, 5 h. 23 m. 58.9 s. G.M.T., was well determined by Father Rowland observing through a prismatic monocular magnifying 8 diameters, the Rev. J. Lawrence, S.J., timing with the Frodsham half-seconds chronometer, of which the correction had been determined from the Greenwich radio signals at 4 h. G.M.T. The rapidly diminishing solar crescent was distinctly though faintly seen through the cloud, until its quite sudden disappearance.

The third contact was unfortunately not so well determined. When the crescent disappeared, there was absolutely nothing left to hold in the field of view, and though the observer tried to keep the instrument directed to the assumed position of the sun, it actually drifted off, and the first intimation of the end of totality was the appearance of the emerging crescent, seen with the other eye, without instrumental aid, and immediately the signal 'stop' was called. The time was clearly late, the observer estimating the error as about $1\frac{1}{2}$ sec. Father O'Connor, who was operating the 19-ft. prismatic camera, and was carefully observing for the first reappearance of a Baily Bead, with the view of obtaining the second 'flash,' closed down just one second before the signal 'stop' was given. Applying a correction of $1\frac{1}{2}$ sec., the time of third contact works out as 5 h. 24 m. 20.9 s., giving a duration of totality of 22 sec.

The times of second contact and of duration had

been worked out by Dr. Crommelin as 5 h. 24 m. 0 s., and 22 sec. respectively.

MAGNETIC RECORDS.—In accordance with the request of the Permanent Joint Eclipse Committee, quick runs of 4 hours' duration were made on the magnetographs from 4 h. to 8 h. G.M.T. on June 28, 29, and 30. The curves obtained are beautifully clear, and throughout the periods of the quick runs on all three days the magnetic conditions were exceptionally quiet, and so were well suited to bring out any deviations from the *normal* effect of solar radiations as affecting magnetic conditions. As the curves show that there was not the slightest variation at or near the time of eclipse, it appears to be clearly established that the screening action of the moon is without magnetic effect under these conditions. Whether it would produce any diminution of disturbed conditions remains an open question.

METEOROLOGICAL.—The barometer was steadily falling all the time from 29.342 in. at 4.15 G.M.T. to 29.326 in. at 6.0 G.M.T.

Readings of the thermometer were taken at every 15 minutes, starting at 4.15 G.M.T. The readings were: 54°·3, 54°·5, 54°·6, 54°·4, 54°·3, 54°·3, 54°·7, 56°·5. The thermograph showed practically no variation.

Further to my earlier communication, it may be of interest to note that the time of second contact was confirmed by an independent observation made by the Rev. J. O'Hea, S.J., working with a second chronometer at a station 23 chains due south of the first station, who obtained the time of second contact as 5^h 23^m 58·5^s G.M.T. By interpolation from the data on the B.A.A. Eclipse Map, the time at the second station should be 0·36^s earlier than at the first station, and applying this correction the time reduced to the first station becomes 5^h 23^m 58·86^s, which is in striking agreement with that actually observed there.

It had been intended to observe the times of contact by noting the instant of the reversal of the Fraunhofer lines of the spectrum as the moon covered and uncovered the photosphere. For this purpose a transparent Thorp replica grating of about 14,000 lines to the inch was fitted in front of the objective of the prismatic monocular. With this instrument a beautiful spectrum was obtained, and as the solar crescent waned the principal Fraunhofer lines could be distinctly seen as curved arcs, but as totality approached the spectrum became so faint owing to the interposition of the small cloud mentioned in my previous communication, that it was realised the method might fail from lack of light, and the instrument was therefore turned direct on to the diminishing crescent.

E. D. O'CONNOR.

RICHMOND, YORKS.

The expedition from the Norman Lockyer Observatory took up its position at Olliver Duckett, near Richmond, on June 19, and commenced operations in setting up the instruments; and the

work was completed and all in order two days before the eclipse. For the first few days the weather was fairly fine, but after that it became very wet and windy and made it very difficult to erect the tube of the 30-ft. coronagraph. Very little work could be done on June 21 owing to a gale, which necessitated everything being anchored down securely.

Observation of the sky every morning at the time and in the direction of the eclipse showed that on three occasions it was perfectly clear, two days thin clouds were present, and for the rest totally overcast. Three mornings previous to eclipse day thick cloud intervened.

Sir Francis McClean and Capt. W. N. McClean with their staffs were each operating three instruments, and the writer with his staff four instruments. Three members of the Observatory Corporation were also located on our site and were employing one instrument each.

On the morning of the eclipse the sun when just above the horizon appeared as a red disc, but soon became hidden by clouds. At 5^h 10^m the clouds seemed to be breaking up and patches of blue sky appeared in the south, from which direction the light wind was coming. The valley mists appeared to be rising and dissipating, and the prospects looked hopeful at about 5^h 35^m.

At 5^h 50^m the conditions seemed to be more promising, and at 6^h 0^m the partial phase was well seen in clear sky for a few minutes. At 6^h 7^m heavy clouds obliterated the sun from view, and I then thought that we should not see the sun again. This turned out to be the case. At 6^h 15^m the conditions were hopeless, and the sun was not seen again until half the partial phase had passed.

The system of time signals was carried out very efficiently by Capt. McClean's assistant, Mr. Chapman. In addition to preliminary signals, every minute was called out, beginning at four minutes before totality, and every second for thirty seconds before totality. The greatest darkness seemed to arrive at the moment 'one second' was called. The majority of the observers carried out their programmes according to schedule, although it was known that no results could be secured. During the total phase it was very dark, but no doubt the heavy clouds were responsible for this to a great extent.

It is pleasing to place on record the fact that every assistance was given to the party whenever it was desired, and special thanks are due to Capt. Nelson Rooke, acting for the Marquess of Zetland, who did all in his power to make the expedition a success.

WILLIAM J. S. LOCKYER.

REETH (SWALEDALE).

The Armstrong College party consisted of Messrs. H. W. Davis, T. Russell Goddard, G. R. Goldsbrough, Wilfred Hall, G. W. Todd, and Stanley Todd. The site selected was Gointar Lodge, near Reeth, Swaledale. The equipment consisted of a 5-inch photo-visual objective mounted in a fixed horizontal position, and served by a celostat; a

14 cm. photographic objective in an equatorial mounting and three fixed cameras of shorter focal length for instantaneous exposures. These were all intended for photographing the corona. There were also a Hilger two-prism stellar spectrograph mounted equatorially with a Zeiss objective; an objective prism with 3-inch objective mounted equatorially; and a grating and fixed camera served by a small cœlostast. These were intended for flash spectra and, if possible, coronal spectra.

During the early phases there were broken clouds which allowed occasional glimpses of the sun. There was a clearer view just before totality, and the last thin crescent was distinctly seen with Baily's Beads forming at the cusps. The crescent also seemed to be tremulous. Then just as totality was about to begin a thick cloud covered up the sun, and no plates could be exposed.

Reeth—10 miles up Swaledale, west of Richmond—had moderate eclipse luck. The day before looked most unpromising, but with some hope at night in spite of the gloomy weather forecast. At 3.35 A.M. Jupiter was visible and there were wide areas of clear sky. On arrival at our observation post, on the ridge above Marrick Abbey, a couple of miles east of Reeth, the eastern sky was covered by dense cloud, but there were clear areas to west and south-east. Breaks in the clouds gave a view of the sun when a fifth covered; we saw it a dozen times, the last being about 4 minutes before totality. Then the cold seemed to condense cloud in the eastern gaps and we saw the sun no more. Eight diverging rays marked its position. They vanished suddenly at totality, and reappeared as suddenly at its end. The inky darkness below the sun was impressive, but we saw no advancing shadow from the west, and the western sky was much lighter.

On somewhat higher ground to the south, on the edge of Wensleydale above Leyburn, experiences were much the same—ten views of the sun through gaps and its disappearance 4.5 minutes before totality. Observers on the plateau to the north of us enjoyed only one early view of the sun. Mist rested on some hills to the south-west.

J. W. GREGORY.

COLWYN BAY.

Although dense clouds veiled the whole of this phenomenon from Colwyn Bay, it was possible to time the end of totality within a second or so by the passage of the edge of the moon's shadow (which was well defined on the clouds) over the known place of the sun. The time, using the wireless signals, was 5^h 23^m 55^s U.T. Both the descent of darkness and the return of light happened several seconds before the predicted times, since these were produced by the shadow on the cloud layer above us, and as the shadow was only some 10° from the horizontal position, it reached a particular cloud several seconds before it would have reached the point on the ground vertically

below. The colour of the sky during totality was a beautiful blue with a purplish tinge. The darkness was considerable, being increased by the thick layer of clouds. A. C. D. CROMMELIN.

The Royal Irish Academy party undertook a programme of observations on atmospheric electricity at the old telegraph station at Llysfaen, near Colwyn Bay. On the mornings of June 28, 29, and 30, from 4.20 A.M. to 8.30 A.M., continuous measurements were made of the atmospheric potential gradient, of the atmospheric conductivity, positive and negative, and of the concentration of condensation nuclei. No effect attributable to the solar eclipse was detected, but any moderate change would have been masked owing to the disturbance in the atmospheric electric elements caused by the rain which fell during the eclipse. Apart from the question of possible effects due to the eclipse, the examination of the results obtained is expected to give useful information in connexion with the equilibrium of atmospheric ionisation.

J. J. NOLAN.

The astrophysical observations which were hoped for at Llysfaen, near Colwyn Bay, were completely spoiled by clouds. No glimpse of the sun was obtained on June 29 before, during, or for several hours after the time of eclipse. One member of the party, however, who carried out experiments on wireless reception, obtained results which may be of value, and his statement is subjoined.

HERBERT DINGLE.

The special transmissions from Eindhoven, on a wave-length of 30.2 metres, were received by means of a short wave receiver, and measurements were made of the variation in signal strength over the period 4.30 to 8.30 B.S.T. on the morning of the eclipse, and of the day before and after. On June 29, generally similar variations to those obtained on the other days were observed for some time before totality. During totality, however, the signals faded out completely, and the station was only heard very faintly and irregularly from then until after 7 A.M., when the reception began to improve again. The results for the normal days before and after the eclipse showed no such marked fading over the same period (6.23 A.M. to 7 A.M.).

CRICCIETH.

Criccieth eclipse station had very heavy rain during all phases of the eclipse, and no photographs were obtained either of the corona or of the spectrum.

Dr. J. H. Shaxby, of the National School of Medicine, Cardiff, assisted by Mr. Deniol Williams, of Aberystwyth University College, took photometric measurements throughout the eclipse with particular attention to the period from 6.20 to 6.30 Summer Time, and I have asked Dr. Shaxby to send NATURE certain of the results of his work. The curve is an interesting one, although not so valuable perhaps as it would have been had we been favoured with good weather.

It was a glorious quest well worth the effort, and all the party thoroughly enjoyed the work in spite of the disappointment.

We had a 21-inch siderostat and were working from it with a 6-inch mirror of 7 ft. focus, a 6-inch mirror of 24 inches focus, a two-prism objective prism spectroscope for the flash spectrum, and a grating spectroscope for the infra-red end. All our spectrum plates were special neocyanine ones with the ammonia doping to make them super-sensitive.

A. TAYLOR.

SNOWDON.

On the morning of the eclipse a whirling mist of cloud slashed with streaks of rain narrowly restricted the range of vision on Snowdon summit but did not quench the sunlight, which it uniformly diffused. The view-point which I had chosen the day before was not upon the cairn or the platform which, with buildings, artificialise the highest peak, but a narrow spur of rugged rock about fifty feet lower, overhanging precipitous descents on either hand of which the bottom was undiscernible on either day. Pointed battlements of rock a few feet distant fenced the turret of my outlook; beyond, the luminous obscurity of cloud reached from the zenith nearly to the nadir. I was alone, and no human form loomed into sight through the mist.

The wildness of the scene was enhanced by the veering and backing of a gusty wind which drove

the pelting rain upon the crags, and its monotony was unrelieved during the partial eclipse, for the murk of the morning seemed but a thickening of cloud. At length, on a sudden, there was a shutting-off of light as if a curtain had been quickly drawn part way across the window of heaven. Before I could recover from the start, a second and greater darkening occurred, as if the window had been completely curtained, and all around was the blue-blackness of night. The jutting rocks were blackest. The atmospheric background, above and below, was uniform in tint, no longer showing whirls of mist or stretches of rain.

The condition of an unusually sombre night had continued for a sufficient number of seconds to let the mind begin to brood, when I was awakened as from a dream by the dawn of a new day, miraculous from the suddenness of its light and remarkable for the quick change of tint to a ruddy glow. The brightening of this first drawing-back of the curtain was much greater than the darkening of the first partial closing. Before surprise had passed there was a second flood of light, and one felt that the window of heaven was now completely uncurtained. There were no more phenomena, for ours was a total eclipse without the incidents of the partial phase. The narrowing of the view was lamentable, but the concentration in time to one breathless half-minute was extraordinarily dramatic, and the solemnity of the surroundings amply compensated for the discomforts of a lofty and exposed situation.

VAUGHAN CORNISH.

Archæological Work at Gerar.

By SIR FLINDERS PETRIE, F.R.S.

IT had long been desirable to obtain a more exact scale of dating in the archæology of Palestine. For this purpose the Egyptian connexions were needed, and the British School of Archæology in Egypt therefore settled last winter upon the mound of the city of Gerar, nine miles south of Gaza, almost in the desert. An area of about an acre was cleared, to thirty feet deep, through six superimposed layers of building from 400 to 1500 B.C. Each chamber found was lettered on the plans, and each object found was given its chamber letters and foot level. The planning was continuous, and 2000 objects were drawn in outline for publication. The record is therefore complete, without needing notebooks or card catalogues. The date of each of the six layers of building could be ascertained within ten years by the external history; the rate of accumulation happily proves to accord with the time scale throughout, to within a foot.

Iron furnaces of about 1200 B.C. were found, and by them were very large tools, as a pick of seven pounds weight, hoes, and plough points. The ore was probably hæmatite, resulting from decomposition of pyrites from the Beersheba basin. Iron knives were made from 1350 B.C., probably the earliest manufactured iron known. The flush of gold named in Judges viii. is apparent in the

many earrings and a gold frontlet which were all of that age, while none was found of later times. The influences were from the east and central Asia under Shishak, 900 B.C., but from Italy and Cyprus in 800 B.C. The business of the city was making the arms and clothing for the north-west tribes of Arabia, as now in modern Gaza. The position was important as being on the road from Egypt to the Judæan hills, and also as commanding the coast road; hence the Egyptian kings fortified the place whenever they occupied Palestine. The Persians also made this an army base of supplies for invading Egypt, building large granaries to hold enough corn for 100,000 men for two months. This fertility of the plain in good seasons accords with the great number of flint sickles found, of about 1800 to 1400 B.C., and the hundred-fold crops named in Genesis xxvi. The Philistine settled here was apparently a corn-factor to collect grain for supplying Crete, like the Philistine at Ekron in the middle of the Shephelah corn land.

It appears that the coast must have been submerged as much as 125 feet in late Roman times, and recovered later. There are stratified silt deposits up to that level at Gerar containing Roman pottery throughout, and three miles nearer the coast the stream cuts through 50 feet of these

deposits with Roman pottery from base to top. The top plane is at the same level at both places. As the valley is two miles wide and fifty feet deep, any artificial dam is improbable, and the silting must therefore have been due to an estuary reaching up to 125 ft. There are great deposits of recent shells on hills by the coast up to about

80 ft. The Egyptian movement at Alexandria was at least 40 ft. of submersion, and a later recovery of 18 ft. This corner of the Mediterranean needs an historical survey, including the pottery and other remains. The collection brought to London will be on view at University College, Gower Street, until July 16.

News and Views.

It is announced that the Secretary of State for the Colonies has appointed a Committee "to formulate practical proposals for submission to the Colonial Governments to give effect to the resolution for the Colonial Office Conference on the subject of Colonial Agricultural Scientific and Research Services." These proposals are to "include a scheme, based on contributions to a common pool, for the creation of a Colonial Agricultural Scientific and Research Service available for the requirements of the whole Colonial Empire for the support of institutions needed for that purpose, and for the increase of research and study facilities in connection with specialist services of the Colonies generally." The committee is thus constituted: Lord Lovat, Parliamentary Under-Secretary of State for Dominion Affairs (chairman), Mr. W. Ormsby-Gore, Parliamentary Under-Secretary of State for the Colonies; Sir Graeme Thomson, Governor of Nigeria; Mr. A. S. Jelf, Colonial Secretary, Jamaica; Mr. O. G. R. Williams, Assistant Secretary, Colonial Office; Major R. D. Furse, Private Secretary (Appointments) to the Secretary of State for the Colonies; Sir J. B. Farmer, Dr. A. W. Hill, Mr. F. L. Engledow, and Dr. A. T. Stanton, Chief Medical Adviser to the Secretary of State for the Colonies.

If reference be made to the second paragraph of the leading article in this issue of NATURE, it will be observed that to this committee has been relegated one part of the more comprehensive task given to the Committee appointed by the Colonial Office Conference at its first session. At that Conference were gathered together official and authoritative representatives from most of the thirty different colonial administrations. The scheme for agricultural research recommended by the committee they appointed involved them in a total annual cost of £175,000, the greater part of which is already a charge on their revenues. The Conference approved the recommendations of the committee, which in the main were those of a Commission on Agricultural Research and Administration in the Non-Self-governing Dependencies, appointed some years ago, the report of which had just been published. General consent might have been obtained immediately, it might be presumed, for some systematic method of determining the contributions of the various colonial governments to the central pool and matters of detail left to the Agricultural Research Council. The appointment of this further committee will inevitably involve more delay in the long overdue reorganisation of the colonial agricultural research and scientific services.

THE Golden Valley is one of the chief beauties of the famous Hindhead district, in the neighbourhood of Farnham and Winchester, and its wild and beautiful slopes, wooded with pine, birch, and hawthorn, and chequered by gorse and broom, make an essential complement to the neighbouring land secured for the people under the National Trust. At short notice the Golden Valley was put up to sale for building plots, but the prompt action of Dr. Marie Stopes in stepping in to purchase the Valley (at the surprisingly low figure of £5650) gave the residents time to form a committee to collect funds which would save the land from the builder. The completion date for the sale was June 30, but the vendors have granted a short extension, and the National Trust, to which the property would be handed over, now issues an urgent appeal for the small sum needful to complete the purchase price. Residents and local sympathisers have played their part, for already approximately £4500 has been subscribed. Less than £1500 is required, and we feel assured that so good a cause need only be mentioned to obtain the support it deserves. It would be a calamity were this spot, where artists, writers, and naturalists have gained inspiration, to become lines of villas. Contributions to the Golden Valley fund, so marked, should be sent to S. H. Hamer, The National Trust, 7 Buckingham Palace Gardens, London, S.W.1.

ON July 14 occurs the centenary of the death of Augustin Jean Fresnel, the distinguished French physicist who shares with Young the honour of establishing the undulating theory of light. Born at Broglie (Eure) on May 10, 1788, Fresnel was a few years younger than Arago, Brewster, Biot, and Malus, all of whom laboured in the same field. He was educated at Caen; at sixteen years of age he passed into the École Polytechnique, and after being trained as a government civil engineer in the École des Ponts et Chaussées, was employed in various provincial departments. His important scientific work began with his paper on diffraction read to the Paris Academy of Sciences in 1815. Just as Young in England met with opposition, so Fresnel had to face the criticisms of Laplace, Poisson, Biot, and others. Fresnel, in addition to his theoretical work, made practical improvements which led to the adoption of polyzonal lenses in lighthouses adopted first in France and then in foreign countries. Towards the end of his life he acted as examiner to the École Polytechnique, but his various duties proved somewhat too much for his feeble constitution, and he died at

Ville d'Avray on July 14, 1827, at the early age of thirty-nine years. Only a few days before this, he had received at the hands of Arago, the Rumford Medal of the Royal Society, awarded him for "His Development of the Undulatory Theory, as applied to the phenomena of Polarised Light; and for his various important Discoveries in Physical Optics." Some of his memoirs lay unpublished until 1884, the year his memorial was unveiled at Broglie. These were found among the papers of Ampère and relate to electromagnetism. Fresnel's great lenses are preserved in the Paris Observatory.

THE thirty-eighth Congress of the Royal Sanitary Institute will be held at Hastings on July 11-16, under the presidency of the Right Hon. Sir William Joynson-Hicks, Bart. The lecture to the Congress will be given on July 12, by Sir William Willcox on "Chronic Rheumatism in its relation to Industry," and on Friday evening Sir Henry Gauvain will give an address and show a film dealing with "The Treatment and Training of Crippled Children." The business of the Congress will be carried on in seven sections and six conferences, covering various aspects of personal and public health and hygiene. A special feature of the meeting will be the conference dealing with health resorts, over which Dr. A. Rollier, of Leysin, will preside. Among the topics to be discussed at the Congress are the following: The notifiable infectious diseases of the nervous system; industry and disease; inspection and consumption of food; tubercular infection in milk; treatment and disposal of sewage. Many visits and excursions to places of professional and general interest have been arranged. The Health Exhibition, which is an important part of the Congress, will include exhibits relating to domestic health and comfort, municipal sanitation, etc.

THE provisional programme of the annual meeting of the British Medical Association, to be held at Edinburgh on July 15-23, includes many discussions, several of which are of general scientific interest. These include the following, the section or sections arranging the discussion and the opener's name being given in brackets: the results of insulin therapy in diabetes mellitus (Section of Medicine, Prof. Hugh Maclean) on July 20; immunity (Sections of Pathology and Bacteriology and Comparative Medicine, Dr. R. A. O'Brien and Prof. Carl H. Browning) on July 21; the therapeutic uses of calcium salts (Section of Therapeutics and Pharmacology, Prof. F. R. Fraser) on July 21; the duties of the State in regard to food supplies (Section of Preventive Medicine, Prof. E. Mellanby) on July 21; the structure and function of the spleen (Prof. John Tait) and the influence of internal secretions on sex characters (Dr. F. A. E. Crew) on July 21, and chemical changes accompanying muscular activity (Prof. T. H. Milroy) and hæmolysis (Dr. E. H. Ponder) on July 22 (Section of Physiology and Biochemistry); the historic evolution of disease (Section of History of Medicine, Sir Humphry Rolleston) on July 22. A feature of the meeting

will be the celebration of the centenary of the birth of Lord Lister; a meeting presided over by Lord Balfour will be held in the M'Ewan Hall on July 20, and short addresses will be delivered by Sir W. Watson Cheyne, Bart., Prof. Tuffier (Paris), Prof. Harvey Cushing (Harvard), and Dr. James Stewart (Halifax, Nova Scotia). A museum of relics of Lister will be open throughout the week in the Upper Library of the Old University. The honorary local general secretary is Dr. A. Fergus Hewat, 14 Chester Street, Edinburgh.

WE learn from a Daily Service News Bulletin recently issued by Science Service, Washington, that the "dangerous fish tapeworm of Europe," *Dibothriocephalus latus*, which is adult in man and has become established in the United States, is to be the object of special study this summer by a group of investigators under the direction of Prof. H. B. Ward. The investigation, which is supported by the National Research Council, will be carried out in the extreme north of Minnesota, which is the centre of the infected area. The tapeworm appears to have been introduced into the United States by immigrant labourers in the iron and lumber industries, who not only carried the parasites internally but also imported their favourite dried and salt fish from their central and eastern European homelands. Salting of the fish does not kill the young stage of the tapeworm, and imperfect smoking also leaves the worm alive. There is evidence that the native fishes in some of the northern lakes of the United States may have become infected, and the investigators hope to secure definite evidence on this point and to work out methods for keeping the infection from spreading.

ABOUT two years ago the Astronomical Society of the Pacific proposed to reprint some of the popularly-written descriptions of topical developments and discoveries in astronomy which from time to time appear in various publications, provided a sufficiently widespread desire for such reprints was manifested by the members. We have now received a batch of nine leaflets of the character indicated, from which it may be inferred that the proposal has been favourably received. They consist of double-leaved pamphlets, about 6 in. by 4 in. in size, containing 1000-2000 words, and the subjects dealt with and the manner of their treatment are well indicated by the titles: "Mira, second largest star, could engulf earth's orbit"; "Why popular interest in Mars?"; "Island Universes"; "The strange companion of Sirius"; "A close-up of the moon"; "How far away is that star, and how do you know?"; "The Magellanic Clouds"; "The Pleiades"; "The Great Nebula in Orion." The notes are written by astronomers of repute, and most of the leaflets contain reproductions of photographs illustrating the subject treated; Dr. Moore's article, for example, on the great nebula in Orion, is accompanied by an admirable view of that object. We congratulate the Astronomical Society of the Pacific on this excellent idea, which, if it meets with the success it deserves, will, we hope, be taken

up by responsible bodies in other branches of science. We should like, in fact, to see the project extended beyond the boundaries of scientific societies. Religious and political organisations have long realised the value of the tract as a means of bringing their respective gospels before the public at large, and if funds are available, there appears to be no reason why the gospel of science and of education in general should not be proclaimed in a similar manner. The leaflets before us are admirably suited for such a purpose.

BRITISH scientific workers tend to be conservative in their reading of the foreign technical press. It is therefore with some pleasure that one notes the increasing vogue of foreign technical abstracts in British journals. The *Journal of the Royal Aeronautical Society* publishes each month extracts from the scientific and technical press as issued by the directorates of technical development and scientific research. These are excellent as giving a short résumé in compact form of the most recent work in aerodynamics. In the May and June issues, for example, there is a number of excellent abstracts from the French and German press on the work which is proceeding in these countries on fluid motion. Experimental criticisms have been levelled by H. Benard against Karman's laws of frequency and distribution of vorticity behind an obstacle. The latter, in an excellent reply, points out the existence of surface ripples in Benard's experiments, estimates the effect due to these, and verifies his previous results. A number of abstracts deal with the rate of spread of turbulence in a viscous fluid, while others treat the problem of heat transference from liquids or gases to solid walls, a subject to which Prandtl and Karman have contributed so much in recent years. These abstracts give an idea of the inspired work which is proceeding at various German centres along these lines. It would appear that during recent years the centre of gravity of pure hydrodynamical investigation has definitely shifted to the Continent.

THE current issue of the *Svenska Linné-Sällskapets Årsskrift* (Årgång 10, 1927) is of much historical interest. It is devoted to the publication of papers illustrative of the life and work of Linnæus, delivered at the Swedish Linné Society's commemorative meeting, which took place in his native village in Småland on May 23 of last year, the anniversary of the birth of the great botanist. Much of the material is of biographical rather than of botanical interest. Prof. Robert Fries, chairman of the Society, contributes an account of Linnæus' connexion with Småland, his early life there, and the botanical influence which helped to shape his career. Prof. H. O. Juel and Mr. G. Drake give some interesting botanical and pharmacological notes on Linnæus' "Report on the Medicinal plants growing in Sweden." Mention is also made of his abortive attempt to introduce the tea plant from China. The somewhat complex disposition of Linnæus is admirably analysed by the Rev. E. Malmeström, who holds a brief for the great systematist's exaggerated self-esteem, and the laudatory

terms in which he refers to himself. Shorter articles deal with various topics of local and historical interest.

PROF. HENRY LOUIS, emeritus professor of mining at Armstrong College, Newcastle-on-Tyne (University of Durham), has been appointed president of the Institution of Mining Engineers in succession to Dr. J. S. Haldane. He will take office at the annual meeting in London in November.

DR. WHITMAN CROSS, of Washington, and Prof. A. G. Högbom, University of Upsala, have been elected foreign members of the Geological Society. Prof. F. X. Schaffer (University of Vienna), Prof. C. Schuchert (Yale University), Prof. F. Slavik (University of Prague), and Dr. E. O. Ulrich (U.S. Geological Survey) have been elected foreign correspondents of the Geological Society.

A RECENT news bulletin issued by Science Service of Washington states that the State of Montana has allocated 60,000 dollars for the erection of an entomological laboratory at Hamilton, Montana, with 25,000 dollars per annum for the next two years for research there. One of the pressing problems to be investigated is Rocky Mountain spotted fever, which is conveyed by a tick. It is hoped that a parasite of the tick may be utilised for its destruction, and so the conveyance of the disease may be prevented.

A NUMBER of useful papers appear in the recently published *Proceedings* of the Chemical Engineering Group of the Society of Chemical Industry, vols. 6 (1924) and 7 (1925). The 1924 section contains four papers, two on crystallisation and two on chemical works costs. A considerable portion of volume 7, containing 17 papers, is devoted to fuel questions, but it includes articles on the internal combustion boiler, the treatment of solvents used in dry cleaning, crushing and grinding mills, aerosols in industry, and other subjects of importance to the chemical engineer. The volume of 200 pages is well illustrated, and it will be valued by all interested in large-scale chemistry.

COMBUSTION engineers have often discussed the possibilities of having central heating stations for supplying steam for the steam-pipe heating of buildings and flats. We learn that 45 miles of mains for this purpose have already been laid in New York, and that more than 7000 million pounds of steam are being sold yearly by meters. The steam is used in addition for electrical generation for lighting and for working lifts in office buildings. Many householders discard their furnaces and buy steam instead of coal. To produce this steam last year 350 thousand tons of the cheapest grades of anthracite and pulverised bituminous coal were used. Recent improvements in the main steam pipes, which carry large quantities of steam long distances, have made this method of supplying heat a rival to electric and gas heating. Somewhat similar methods are used on a smaller scale in other parts of the world.

THE "Statistical Report of the Health of the Navy for the year 1924" has recently been issued (London: H.M. Stationery Office. 4s. 6d. net.). The returns for the total force show a decrease in the incidence of disease as compared with the three years' average, but a slight increase in relation to 1923. The invaliding and death ratios also show a decrease in comparison with the three years' average. The Mediterranean Station showed the lowest sick rate, and the China Station the highest. Bronchial catarrh caused the largest number of cases (5641) of sickness, and influenza, 2407 cases. As in the Army, tonsillitis shows a considerable incidence with 2602 cases.

PROF. SAMUEL J. RECORD, of the Yale School of Forestry, has presented to the Smithsonian Institution a valuable collection of plants illustrative of the flora of Honduras, one of the few regions in North or Central America which is still practically unknown botanically. In view of the lack of knowledge of the forest flora of Honduras, it is not surprising that study of the collection has revealed the presence of several new species, a genus new to North America, and several extensions of range. The collection includes many woods of economic importance, and it is probable that much information of value to the lumber industry will result from the study of the economic woods of Honduras which this collection makes possible.

WE have received a copy of the Index of the Faraday Society *Transactions*, vols. 1-20 (paper cover, 10s. 6d. net; cloth, 13s. 6d. net). The entries have been emphasised in such a way that quick reference is facilitated. For this reason the titles of the papers have in some cases been slightly altered in the Subject Index, hence, when original titles are required, reference should be made in the Author Index. It is obvious that great care has been exercised in compiling this publication, and it will undoubtedly prove very useful.

WE have received the annual report of the Calcutta School of Tropical Medicine, Institute of Hygiene, and the Carmichael Hospital for Tropical Diseases for 1926. A history of the School is given, together with a summary of the past year's work and of the research work carried out, with a portrait of its founder, Sir Leonard Rogers.

THE British Drug Houses, Ltd., Graham Street, City Road, N.1, issues a useful booklet on the use of stains in bacteriology and pathology, with their formulæ, and a price list of standard microscopic stains. For those who only occasionally employ stains, small quantities of the solutions are supplied.

WE have received from Messrs. Baird and Tatlock, Ltd. (14-15 Cross St., Hatton Garden, E.C.1), vol. 3 of their "Standard Catalogue of Scientific Apparatus" (1927). This deals with the biological sciences, excluding physiology, to which vol. 2 is devoted. It contains a very full list of apparatus for teaching and research required in anatomy and microscopy, botany and zoology, bacteriology, pathology and hygiene, and

agricultural science. In addition to making apparatus in their own workshops at Walthamstow (of which several excellent plates are inserted), the firm also acts as agent for many individual makers of scientific instruments, e.g. microscopes and microtomes. The catalogue is extraordinarily complete, and an almost bewildering range of apparatus is listed. It is profusely illustrated, and being printed on paper with a good surface, the illustrations are very clear and distinct. Messrs. Baird and Tatlock also design and supply laboratory furniture and equipment.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A registrar of the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (July 11). An assistant lecturer in botany at the University College of North Wales, Bangor—The Secretary and Registrar, University College of North Wales, Bangor (July 12). Junior assistants at the National Physical Laboratory for work in connexion with photometry and metallurgy—The Director, National Physical Laboratory, Teddington (July 16). An instructor for carpentry and joinery and building construction in the School of Building, Willesden—The Principal, Willesden Polytechnic, Priory Park Road, Kilburn, N.W.6 (July 16). A lecturer in biology in the Edinburgh and East of Scotland College of Agriculture—The Secretary, Edinburgh and East of Scotland College of Agriculture, 13 George Square, Edinburgh (July 18). A full-time lecturer in the Department of Mechanical and Civil Engineering of Loughborough College—The Registrar, The College, Loughborough (July 18). A demonstrator in geology in the Queen's University of Belfast—The Secretary, Queen's University, Belfast (July 20). A lecturer in zoology at Armstrong College, Newcastle-upon-Tyne—The Registrar, Armstrong College, Newcastle-upon-Tyne (July 23). A senior lecturer in the Department of Electrical Engineering of Loughborough College—The Registrar, The College, Loughborough (July 23). A reader in organic chemistry in the University of Dacca, India—The Registrar, University of Dacca, East Bengal (July 30). A university lecturer in structural crystallography in the University of Cambridge—Prof. A. Hutchinson, Pembroke Lodge, Cambridge (July 31). A professor of chemistry in the University of Adelaide—The Registrar, The University, Adelaide, South Australia (August 15), or the Agent-General for South Australia, Australia House, 112 Strand, W.C.2 (October 1). A test assistant in the Metallurgical Department of the Royal Aircraft Establishment—The Chief Superintendent, R.A.E., South Farnborough, Hants (quoting A.193). A visiting lecturer in structural engineering, drawing, and graphics at the Borough Polytechnic Institute—The Principal, Borough Polytechnic Institute, Borough Road, S.E.1. A woman clinical pathologist at the Lady Hardinge Medical College, New Delhi, India—Dr. Kate Platt, 59 Queen Anne Street, W.1. A professor of medicine in the University of Edinburgh—The Secretary to the Curators, 4 Albany Place, Edinburgh.

Research Items.

A JAINA IMAGE OF AJITANĀTHA.—In the *Indian Antiquary* for April, N. C. Mehta figures and describes a beautiful image of Ajitanātha, according to tradition, a contemporary and cousin of the mythical prince Sagara. It was executed in A.D. 1053, when Jainism, having suffered an eclipse in the south after the sixth century A.D., was approaching its climax in western India under the Solanki rulers of Gujarat. The image is 51 inches, or, with the pedestal, 63 inches in height. Judging from the exceptionally bright and yellow lustre of the body, the metal must contain a large amount of gold. It stands in the characteristic pose of a Jaina *kevali*, i.e. "one who has attained the Peace born of perfect knowledge and of absence of attachment to things mundane." The face is that of a young man, strikingly handsome, and the limbs are beautifully modelled and of pleasing proportions. The loin cloth is attached to an elaborately carved girdle of fine design. The *ushnisha*, the symbol of enlightenment, is just indicated, while the Jewel of Illumination is prominently shown on the forehead. An inscription states that this statue was set up in memory of the saint Shālibhadra by his pupil Pūrṇabhadra. The statue is still worshipped in the Ajitanātha Temple in Zaverivādā at Ahmadābād. It is a very favourable example of the art of casting metallic images which reached a high standard in medieval Gujarat, and of which a large number of good specimens are still to be found in the Jaina temples scattered throughout Gujarat and Rajputana.

FOOD AND HABITS OF MEGANYCTIPHANES.—An account is given by Mr. R. Macdonald (*Jour. Marine Biol. Assoc.*, vol. 14, No. 3, March 1927, pp. 753-84) of work carried out in the Clyde area from the Marine Biological Station at Millport on the biology of this euphausiid, which is of great importance in the economy of certain fish, particularly hake and herring. He finds it to be a suspension feeder, subsisting on minute organisms and detritus. Vegetable detritus of land or coastal origin appears to be of special importance as a source of food in the area studied. Evidence is given of partial diurnal migration in a vertical direction, but further work seems to be required to establish the conditions of such movements. In the second paper, Mr. Macdonald describes certain irregularities in the larval development of *M. norvegica* (*ibid.* pp. 785-94).

A FLAGELLATE IN A NEMATODE.—Dr. T. Goodey and Miss M. J. Triffitt (*Protozoology*, No. 3, 1927) describe observations on flagellates in the intestine of the nematode *Diplogaster longicauda*. This worm was living in numbers among decayed material from a narcissus bulb, and many of the worms harboured the flagellates in their intestine—in some cases the gut "was literally packed with them." The flagellates are 10 μ to 12 μ long, fusiform in shape, and have a single flagellum. Occasionally the flagellates issued from the anus of the worm into the fluid—material from the decayed bulb plus a little tap-water—and in some of them a contractile vacuole was seen to make its appearance towards the anterior end of the body, but a contractile vacuole was not seen in any of the flagellates still in the gut of the worm. The nucleus of the flagellate is of the vesicular type with large karyosomes, the parabasal body is rod-shaped or oval, and there is a small anterior centrosome from which the axoneme takes origin. The free part of the flagellum is 8 μ to 12 μ long. Both leptomonad and cithridial forms were observed and division stages of both forms were seen. A Leishmania stage was not

met with. The flagellates agree with *Leptomonas butschlii* in general shape and size, but the authors prefer to leave open the question of the name of the organism.

GROWTH OF THE SKELETON IN TWO ECHINOIDS.—Although much valuable research has been conducted on the embryology of sea-urchins, few workers have investigated the development of the skeletal plates from the embryo to the adult, and indeed the difficulty of rearing the forms in an aquarium has been a sufficient hindrance to any complete study. Fortunately, modern methods have at last enabled Prof. MacBride and his pupil Dr. Isabella Gordon to obtain excellent series of a regular urchin, *Echinus miliaris*, and an irregular heart-urchin, *Echinocardium cordatum*, and very thorough and complete accounts of the development of the test have been published by Dr. Gordon (*Phil. Trans. Roy. Soc.*, B, vols. 214 and 215). Both memoirs contain valuable additions to our knowledge, but the latter lends itself better to summary here. While the adult heart-urchin has the outline which its name implies, with the apical system from which radiate five petal-shaped ambulacra, on the upper surface, with the mouth shifted to the front of the under surface, and with the anus at the other end of the body, the young as it emerges from the larval stage has an almost circular outline, with the mouth central on the under surface, and the anus enclosed by the central apical system, from which radiate ambulacra of primitive structure. Dr. Gordon traces in minute detail the shifting of mouth and anus and the gradual growth and specialisation of the ambulacra. For her statement of facts we have nothing but praise, but when she says that "the migration of the anus within the periproct is due to a difference in the rate of growth of the various plates," or that the periproct is encircled by the inter-ambulacrum "as a result of" the addition of inter-ambulacral plates, then we suggest that the alleged cause is merely a concurrent phenomenon. If anything, it is the tension on the gut as the body elongates that pulls down the anus; and the plate-building follows this.

SEISMOGRAPH RECORDS.—In the issue of the *Proceedings of the Imperial Academy of Japan* for March, Mr. K. Suyehiro directs attention to the possibility of a seismograph installed so as to be sensitive to earth movements in a particular direction being set in motion by disturbances at right angles to those it is intended to record. He shows that an instrument set up, for example, to record movements in the north-south direction may be set in motion by an east-west movement of half the natural period of the instrument, and that the records of such an instrument are liable to misinterpretation on this account. The possibility of the motion of the instrument to which attention is thus directed, will be recognised by those who are acquainted with Melde's experiment, in which a stretched wire is set into transverse oscillation by one end of it being attached to the prong of a tuning-fork vibrating along the axis of the wire.

GEOPHYSICS IN FRANCE.—The Institut de Physique du Globe de l'Université de Paris, with which is associated the Bureau Central de Magnétisme Terrestre, under the directorship of M. Maurain, has recently published vol. 4 of its *Annales*. It gives an interesting and valuable record of the considerable activity which now exists in France in the investigation of

terrestrial magnetism and other branches of geophysics. It contains nineteen articles, of which the first and longest is the report of the Val Joyeux magnetic observatory, including tables of hourly values of the three elements, for 1924. A shorter report of the less comprehensive observations at Nantes is also given. The remaining articles on magnetism mainly refer to survey measurements in various parts of France, and also in Syria. Other sections deal with meteorology, seismology, and actinometry at Parc Saint-Maur, and with atmospheric electricity observations made on board the ship *Pourquoi-Pas?* in the Arctic region.

THE HEIGHT OF IRIDESCENT CLOUDS.—In Geophysical Publication No. 2 of Volume 5, published by the Norwegian Academy of Science, Oslo, Prof. Carl Störmer gives the results of his measurements of the heights of iridescent or mother-of-pearl clouds. His method is to take simultaneous photographs of the clouds from two distant stations at a time when some of the brighter stars will show on the plates. The altitude of the cloud can then be calculated from its parallax. From observations taken at stations 26 kilometres apart during the evening of Dec. 30, 1926, he finds the altitude to be 27 kilometres.

CAUSES OF TROPICAL RAINFALL.—The rainfall of the Sudan, both west and east, has been found to fluctuate considerably from year to year, not infrequently to such an extent that deficiency or irregularity leads to famine. In discussing the causes for this in a paper in *Matériaux pour l'étude des calamités* (No. 11, 1926), Mr. G. T. Renner maintained that all tropical rainfall is really monsoonal in character. During the period of high sun, the land masses are centres of low pressure surrounded on sea and land by areas of higher pressure. Monsoonal currents blowing from the sea into these areas of low pressure bring heavy rainfall. The alternate cooling of the tropical lands, when the sun is low, leads to a high pressure and a dry season. The double rainy season of equatorial regions is caused by those areas being crossed by both sets of monsoonal currents. Thus variations in the rainfall of the Sudan are due to variations in the intensity of the low pressure and the resultant strength of the monsoon currents. Variation in solar weather must cause the variation in the intensity of the low pressure. Mr. Renner further points out that while all tropical rainfall is liable to vary from year to year, it is only in the savanna and grassland regions, where normal rainfall makes agriculture just possible, that a marked deficiency leads to famine conditions. He thus considers that all the tropical savannas and grasslands are potential famine areas.

THE SENSITIVE CENTRES OF SILVER BROMIDE PARTICLES.—It is well established that in the development of an exposed gelatino-bromide plate the reduction of the silver salt to metal (the blackening), starts at 'centres' or points on the crystals or particles of the silver salt. It is generally assumed that these points where the action begins are more sensitive than the rest of the crystal or particle. Dr. S. E. Sheppard has found that this sensitiveness is caused by certain sulphur-containing organic bodies present in the gelatin, and considers that the extra sensitive points are invisibly small specks of silver sulphide. The existence of these centres or starting-points of action has been demonstrated by stopping development at a very early stage, before the reduction has had time to extend to the whole particle. Messrs. Sheppard, Trivelli, and Wightman now find (*Journal of the Royal Photographic Society*, June 1927) that the

existence of these centres may be shown also by 'printing-out,' that is, merely prolonging the exposure by subjecting the plate to the action of an intense beam of white light for four minutes. They find, too, that by soaking a plate for one hour in a very dilute solution of allylthiourea and then for five minutes in a 1 per cent. solution of sodium carbonate, a number of black specks appear that were not there before. They "feel safe in saying" that these black specks are formed by the transformation of invisible specks of allylthiourea-silver bromide into silver sulphide. The communication is illustrated with excellent photographs which clearly show the results stated.

PHOTOCHEMICAL EQUILIBRIUM IN NITROGEN PEROXIDE.—In the course of some photochemical investigations, R. G. W. Norrish noticed that nitrogen peroxide enclosed in a water-jacketed vessel and illuminated by the rays from a quartz mercury vapour lamp showed a considerable increase of pressure, which was too great to be attributed to the heating effect of the absorbed light. The experiments which have been carried out in order to determine the cause of this pressure change are described in the April issue of the *Journal of the Chemical Society*. It has been found that the establishment of a photochemical equilibrium between nitrogen peroxide and nitric oxide and oxygen is the chief cause of the increase of pressure. To this must be added the direct heating effect of the absorbed radiation, and the effect of the heat liberated from the reverse reaction $2NO + O_2 \rightarrow 2NO_2$. A reaction mechanism is suggested which is capable of giving results in quantitative agreement with those determined experimentally.

THE CHLORIDES OF SULPHUR.—Although the evidence as to the exact nature of the chlorination products of sulphur is somewhat contradictory, it is generally agreed that a monochloride and a tetrachloride exist, and that the so-called 'dichloride' is merely a mixture of these two. This conclusion is largely based on cryoscopic experiments, and in the *Journal of the Chemical Society* for April, Lowry, M'Hatton, and Jones describe the results of a careful redetermination of the freezing-point curve of the chlorides of sulphur over the range from 16.70 per cent. of sulphur. This re-determination has revealed, in addition to the main sections corresponding to the separation of the monochloride and the tetrachloride, two well-defined breaks which are attributed to the crystallisation of the dichloride and of a trisulphur tetrachloride of the formula S_3Cl_4 which has not been prepared before. It is proposed to discuss the molecular structure of these compounds in a later paper.

COKING PROPERTIES OF COAL.—One branch of the work of the Fuel Research Division is the physical and chemical survey of British coal seams. Dr. J. T. Burdekin, of the South Yorkshire Survey Staff, has published an investigation of the caking power of coal (Fuel Research Survey, Paper No. 8. London: H.M. Stationery Office. 1s. net). Numerous attempts have been made to give a quantitative figure to the tendency of a coal to produce a coke on carbonisation. So many factors operate that a single simple test is difficult to find. The author has carbonised different mixtures of the coal with calcined anthracite at defined and various rates of heating, and determined the crushing strength of the product in a special machine. The results are displayed as 'caking power curves' (crushing strength against composition of coal-anthracite mixture), and it is believed that these curves can be interpreted as giving a measure of the capacity of a fuel to give a satisfactory coal in an oven.

The Expedition of the *Meteor* in the South Atlantic.

THE third report¹ on the progress of the *Meteor* Expedition, of which an account was given in NATURE of Jan. 1, includes some interesting results of an extensive survey of the chemical and physical conditions of the waters of the South Atlantic.

Water cooled below the Arctic ice in the northern hemisphere falls and creeps slowly southward as a deep current, rising in the zone 50°-60° S. and turning back to flow as an intermediate current at a depth of between 500 metres and 1000 metres towards the equatorial zone, where it mingles with the upper layers. A similar type of circulation was recently found in the Indian Ocean by Schott.²

The estimations of dissolved phosphate made on this expedition are singularly interesting as a factor governing the fertility of the ocean, for the conclusions based on them by Wattenberg are in excellent agreement with the conclusions arrived at by Atkins³ from his work in the North Atlantic and around the coasts of Britain. In the tropics the sudden increase of phosphate with depth is accounted for by its utilisation in the surface layers by vegetable plankton

On the West African coast, water rising from the depths continually enriches the surface layers and occasions a rich growth of plankton. A considerable fouling of the ship's bottom in this area was also noticed, and it was observed that the colour of the sea was modified by the greater number of plankton organisms in it, which by reflecting yellow and green light give it a greenish blue appearance on looking down over the ship's side.

A table by Hentschel shows the average number of individual plankton organisms per litre found during the course of the ten cruises already made across the ocean, and brings out very clearly the relation of fertility of the water to latitude.

Mean latitude	55° S.	48° S.	42° S.	35° S.	28° S.	23° S.	15° S.	10° S.	3° S.	2° N.
Plankton organisms per litre at 200 metres	1528	1415	302	718	171	695	443	600	747	702
Plankton organisms per litre at 1000 metres	74	29	34	49	19	28	24	55	62	62

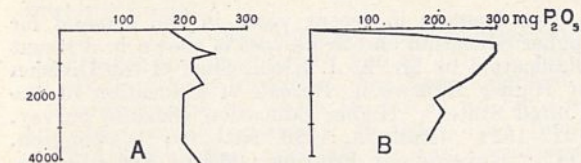


FIG. 1.—Vertical distribution of dissolved phosphate in the South Atlantic. Abscissae show milligrams P₂O₅ per cubic metre, ordinates depth in metres. A: ca. 50° S.; B: Tropics.

organisms; here the sudden difference in density between the light warm upper layers and the cold heavy water below hinders mixing by means of convection currents, whereas in more southerly latitudes the upper layers, nearer in density to the water below, are continually being renewed by this means, giving rise to much greater plant growth.

¹ Die Deutsche Atlantische Expedition auf *Meteor*. Bericht 3. Zeitsch. der Gesells. für Erdkunde zu Berlin, 1927.
² Ann. der Hydrog., 54, 417-431; 1926.
³ Jour. Marine Biol. Assn., 13, 119-150, 700-720, 14, 447; 1923-1926. NATURE, 116, 784; 1926.

The minimum of life does not occur in the equatorial region but around latitude 28° S., in the region corresponding to the Sargasso Sea in the North Atlantic, where warm surface water forms a pool in the ocean.

In this connexion it is interesting that Lohmann⁴ in the *Deutschland* found more plankton in the equatorial region than in about 20° N. The explanation in both cases seems to be that water rich in phosphate and nitrates rises near the equator to take the place of that which flows away in the west-going currents, whereas immediately north and south of this zone the upper layers are not enriched from below to any appreciable extent and plant life is reduced to a minimum, giving rise to the barren deep blue areas of the oceans.

Estimations of alkalinity of the water in the tropical regions indicated that the surface layers were to a slight extent depleted of dissolved calcium carbonate through the agency of minute plant organisms which secrete an enveloping shield of calcareous plates, while the water close to the bottom was somewhat richer than the intermediate layers owing to solution of calcium carbonate from the detritus of dead organisms. Sea water generally is almost, but not quite, saturated with respect to calcium carbonate.

⁴ Arch. für Biontologie, 4, Heft 3. Berlin, 1920.

The Gas Industry and Carbonisation.

UNDER the presidency of Mr. J. Wilkinson, of Nottingham, the Institution of Gas Engineers held its annual meeting in London on June 14-16. Mr. T. Carmichael discussed the economics of carbonisation as based on operations of the Portsmouth Gas Company, where a wide range of plant is at work. The cost of production of gas in vertical and horizontal retorts showed no great difference and is only half that of the cost of producing carburetted water gas. There is then no incentive to produce gaseous fuel from oil at the present time, so far as cost of production is concerned. Mr. G. M. Gill described types of modern chamber ovens and coke ovens and discussed their suitability as carbonisation units for gas-works purposes. Mr. T. Canning devoted a paper to the relations of a gas undertaking to its consumers. The pre-carbonisation of coal before combustion is to-day kept constantly in the public eye. The town's gas industry is carrying out such processes under strictly commercial conditions, and is the

only industry doing so on a national scale. Its results and experiences as indicated by these papers deserve close study by all advocates of coal carbonisation.

The progressiveness of the industry is indicated by the great space devoted to the various reports on research. The Gas Research Fellow's report of a study of the properties of coke prosecuted at the University of Leeds contains more observations on the remarkable influence of inorganic catalysts on the gasification of coke in steam, carbon dioxide, and oxygen. Sodium carbonate is again shown to have a far-reaching effect on these reactions. An interesting experimental technique is described for studying the reactivity of carbon with oxygen which, owing to the great evolution of heat, has been a very difficult matter. In the eighteenth Report of the Joint Research Committee with the University of Leeds, an account is given of studies of the carbonisation process as applied to 30-lb. charges. The rôle of sodium carbonate, which had been demonstrated on

the laboratory scale, has been confirmed on 30-lb. charges and a striking increase in the production of gas was shown, doubtless owing to the decomposition of water vapour present by the carbon, stimulated by the presence of the soda.

The seventeenth Report of the same Committee gives a continuation of the study of the products of combustion of gas fires. In order to do this, it was necessary to develop and revise the method of determining carbon monoxide to deal with the minute traces which here require measurement. It was considered possible to do this with a precision of 1 part in a million. It was also established that carbon monoxide is always present in a city atmosphere in quantities reaching 6 parts per million under normal conditions, and in foggy weather reaching 25 parts. In association with the British Refractories Research Association, the Institution of Gas Engineers supports a wide range of experimental work which was reported to the meeting.

University and Educational Intelligence.

BIRMINGHAM.—The Charter has been revised so as to embody alterations and additions the desirability of which has been suggested by experience. The chief points are: (1) Alterations in the titles of officers of the University. The "Vice-Chancellor" becomes "Pro-Chancellor," and the "Pro-Vice-Chancellor" becomes "Deputy Pro-Chancellor." The "Principal" becomes "Vice-Chancellor and Principal" and the conferring of degrees will be one of his functions. (2) The appointment of the Vice-Chancellor and Principal is to be made by the Court of Governors, on the recommendation of the Council, who shall have consulted the Senate. The appointment was formerly made by the Crown. (3) The Guild of Graduates will elect a representative on the Council, and the non-professional staff will elect from its number one member of Council and six representatives on the Court of Governors. (4) Power has been granted to create a Faculty of Law. The revised Charter has been approved by the King in Council.

OXFORD.—The Board of the Faculty of Physical Sciences has appointed Mr. Bertram Lambert, fellow of Merton College, to be Aldrichian demonstrator in chemistry for four years from the first day of Michaelmas term, 1927.

ST. ANDREWS.—At the graduation ceremonial on June 28, the honorary degree of LL.D. was conferred (*in absentia*) upon Prof. John Rankine Brown, of Victoria College, Wellington, New Zealand. The degree of D.Sc. was conferred upon W. S. Duke Elder for a thesis on "The Nature of the Intraocular Fluids and the Pressure Equilibrium in the Eye," and on David Stiven for a thesis entitled "A Study of the Phosphatase-Phosphatase System of Muscle Extract."

THE University of Maryland has conferred the honorary degree of Doctor of Science on Sir John Russell, Director of the Rothamsted Experimental Station.

THE degree of Doctor of Science has been conferred by Columbia University, New York, on Frank B. Jewett, vice-president of the American Telephone and Telegraph Company, and president of Bell Telephone Laboratories, New York. In conferring the degree, President Butler referred to Dr. Jewett as "bringing to the art of telephony and its development the full weight and power of modern scientific knowledge; building on this foundation a notable organisation of

research workers and applied scientists, and thereby contributing in highest degree to the perfection of the art of communication between human beings and over increasing distances."

IN a letter in the *Times Educational Supplement* for May 28, the chairman of a special committee of the Science Masters' Association directs attention to the strange diversity in the attitude taken up by different universities with regard to the recognition of advanced courses in science in secondary schools. While exact uniformity may not be essential, there seems to be a danger that the progress of scientific education may be hampered in certain areas owing to the policy of the local university; Oxford and Cambridge show their appreciation of the advanced courses by granting certain exemptions to students who have passed the higher certificate, and their influence, fortunately, is not confined to any particular locality. The last year at school is often of supreme importance in the formation of the mind and character of a boy; if injudicious pressure is brought to bear upon him to leave school and enter on a career of narrow specialisation at too early an age, the boy himself may never attain to his full mental stature, the university will receive less competent students, the standard of science teaching for all boys in the school will be depressed and the status of science relative to other subjects will inevitably suffer.

THE increase in recent years in the demand for higher education and in its cost is shown in a recent publication by Mr. A. J. Klein, Chief of the Division of Higher Education, Bureau of Education of the United States ("Higher Education Biennial Survey, 1922-1924" (Bulletin, 1926, No. 20); Washington, D.C.: Government Printing Office). For example, in 1912 there were 255,673 students enrolled in the colleges and universities of the United States; in 1922 the number had become 550,906. The income of higher institutions in 1912, excluding additions for endowment, was 90 million dollars; by 1922 it had risen to 273 million. This increase is far greater than the increase in population or in the income of the country. The additional money has been largely used in increasing teachers' salaries. In small colleges salaries have risen from an average of about 1400 dollars to an average of 2000; in medium-sized institutions from 2500 dollars to 4000; in large institutions from 5000 dollars to 8000 or 10,000. The number of members of staff increased from 30,000 in 1912 to 50,000 in 1922. There has been much criticism of the products of higher education. There is a general demand that those who enjoy its benefits should contribute more largely to its cost. Everywhere there has been a tendency to increase tuition and institutional fees, but this has had little effect in reducing the number of students. Various measures have been adopted with the view of restricting admission to those who are most likely to benefit from a university training; e.g. Harvard has limited its entering class to 1000 and changed its entrance requirements; while the personal interview has also been used. The junior-senior high-school system is being modified with the view of providing completion courses for those who are not proceeding to college. "The burden upon the [university] institutions makes them friendly towards the idea of developing separate two-year junior colleges," which will (1) provide a liberal arts course leading to entrance to the 'junior year' in a university, *i.e.* skipping the freshman and sophomore years; (2) conduct two-year professional or pre-professional courses; (3) offer two-year completion courses for those who do not desire to secure a degree or enter a profession.

Calendar of Discovery and Invention.

July 10, 1817.—For his important discoveries on the polarisation of light, Brewster in 1815 received the Copley Medal. In his investigations he was led to the invention of the simple scientific apparatus, the kaleidoscope, which he patented on July 10, 1817. As a toy the kaleidoscope quickly gained immense popularity in England and America. Writing from London in May 1818, Brewster said, "You can form no conception of the effect which the instrument excited in London. . . . Infants are seen carrying them in their hands, the coachmen on their boxes are busy using them, and thousands of poor people make their bread by making and selling them."

July 11, 1861.—Kirchhoff's great paper "On the Solar Spectrum," containing his views of the true nature and the chemical constitution of the sun from his interpretation of the Fraunhofer lines, was read before the Berlin Academy of Sciences on July 11, 1861. To no one did Kirchhoff's work appeal more than to Huggins, who years afterwards wrote: "This news was to me like the coming upon a spring of water in a dry and thirsty land. Here at last presented itself the very order of work for which in an indefinite way I was looking—namely, to extend his novel methods of research upon the sun, to the other heavenly bodies."

July 12, 1770.—The spinning jenny constructed by Hargreaves and patented by him on July 12, 1770—an epoch-making invention—has been described as "the instrument by which (so far as we have any authentic and trustworthy evidence) the human individual was first enabled, for any permanently advantageous and profitable purpose to spin wool, cotton, or flax into a plurality of threads at the same time and by one operation."

July 12, 1771.—On this day H.M.S. *Endeavour* anchored in the Downs, after her three years' voyage round the world under the command of James Cook. In 1769, observations of the transit of Venus had been made, and this was followed by the circumnavigation of New Zealand and the survey of the Great Barrier Reef of Australia.

July 12, 1796.—In a letter to Sir Joseph Banks, dated July 12, 1796, Rumford offered £1000 to the Royal Society "to the end that the interest of the same may be by them and by their successors, received from time to time for ever," and the amount applied every second year as a premium to the author of the most important discovery which shall be published in any part of Europe during the preceding two years, on heat or on light.

July 13, 1897.—After his demonstrations in Bologna in 1895 and in England in 1896, Marconi, at the invitation of the Italian government, made experiments at Spezia, where, on July 13, 1897, radio messages were sent between a land station and Italian warships over a distance of 12 miles.

July 15, 1662.—The beginning of the "Royal Society of London for Improving Natural Knowledge" dates from July 15, 1662, when the first charter passed the Great Seal. Weld in his history says: "The first Charter is on four sheets of Vellum; it was drawn by Sir Robert Sawyer, then Attorney-General, and is remarkable for its clearness and legal terseness; the first sheet contains some remarkably handsome ornamental capitals and flowers, with a finely executed Portrait of Charles II. in Indian Ink with the initial letter C. The Great Seal of the Kingdom in green wax is appended to the Charter."

E. C. S.

Societies and Academies.

LONDON.

Royal Society, June 30.—A. V. Hill, K. Furusawa, and J. L. Parkinson: The dynamics of 'sprint' running. By an application of the theory of dimensions it is shown that the speed of an animal, such as man, is limited by the inertial stresses to which the structures are subjected during movement. The 'viscosity' of the muscles is the chief factor. For experimental work it is necessary to employ maximal contractions. The case of submaximal contractions is theoretically discussed. A runner exerting maximal effort propels himself with constant force. The 'constants' of a given runner can be determined with very fair accuracy, and the work done, in running, against viscosity and resistance of the muscles can also be determined.

A. V. Hill, K. Furusawa, and J. L. Parkinson: The energy used in 'sprint' running. The mechanical work done against the viscous resistance of the muscles of the runner has been compared with the amount of oxygen used in recovering from the effort. The result shows a 'mechanical efficiency' of about 38 per cent. In a man running 200 yards, at top speed throughout, fatigue begins to appear after 70 yards, and by the end the speed has fallen by about 12 per cent. This fatigue is due to the enormous rate of expenditure of energy in running at top speed; one subject, who ran his first 100 yards in 9.88 sec., and his second in 9.57 sec., developing $8\frac{1}{2}$ horsepower at his maximum velocity (11.46 yards per sec.) and liberating 4 gm. of lactic acid per sec. in his muscles.

R. G. Canti and F. G. Spear: The effect of gamma irradiation on cell division in tissue culture *in vitro*. The extent of inhibition of mitosis was determined by making counts of the total number of cells undergoing mitosis and expressing these counts as percentages of the total number of cells undergoing mitosis in the same number of unirradiated cultures of the same batch used as controls. For a given intensity of irradiation, there is a period of time of exposure which must be exceeded before any change in the number of cells undergoing mitosis is observed, and after this minimum time is passed the effect upon mitosis is sudden and well marked. Under the conditions of experiment, a longer time is required to bring about this biological effect with weaker intensities than would be expected from the physical determinations, and there is a minimum intensity of irradiation below which no such effect takes place.

A. N. Richards and J. B. Barnwell: Experiments concerning the question of secretion of phenolphthaleine by the renal tubule. Phenol red applied to the surface of a decapsulated rabbit's or frog's kidney passes into the urine eliminated by it. When salt solution is made to flow from the ureter through the tubule to the capsule of Bowman, during perfusion of the renal portal system with phenol red solution, phenol red can be identified in the saline collected from the capsule. Complete obstruction of the circulation through the glomerulus does not prevent phenol red from entering the tubule and becoming concentrated there. When an excised frog's kidney is immersed in oxygenated phenol red solution, the dye passes into the tubule and becomes concentrated. These facts, which present the appearance of secretion of phenol red by tubule cells, are best explained by assuming diffusion of water and dye into the tubule at one level, active extrusion of water and retention of dye at another, and a fluid current within the tubule from one level to the other.

S. B. Schryver and H. W. Buston: The isolation of some undescribed products of hydrolysis of proteins (Part iv.). When gelatin is hydrolysed rapidly with sulphuric acid, it yields about 20 per cent. of its nitrogen in the form of diamino-acids; if, however, the gelatin is allowed to stand with acid in the cold for a day before hydrolysis, the diamino-acid content is increased to about 29 per cent. This increase is due mainly to the formation of *dl*-lysine; at the same time there is a slight increase in the amounts of arginine and active lysine. The *dl*-lysine is not formed by mere racemisation of active lysine, but must be formed from some precursor which only yields the base by the action of cold acids.

J. B. Cohen, with others: The therapeutic action of some bismuthyl derivatives of organic hydroxy-acids. The therapeutic action of several of these substances on *Spirochæta Laverani* has been investigated. The action depends not only on the bismuth content, but also on the chemical constitution of the product under investigation, so far as the effect on mice infected with *Sp. Laverani* was concerned. The effect of bismuthyl saccharic acid and its sodium salt has been tried in human subjects, but these substances possess no great advantage over the bismuth preparations in general use. The main fact emerging from a chemical study of the bismuthyl series is the greater reactivity of esters over the corresponding hydroxy-acids.

T. S. P. Strangeways and Honor B. Fell: A study of the direct and indirect action of X-rays upon the tissues of the embryonic fowl. The destructive effect of a given dose of X-rays upon the tissues of an embryo is correlated with the age of the embryo irradiated. With the exception of a relatively small number of cells destroyed by the direct action of radiation, the death of the tissues in 6-day embryos is due to an indirect action. There is no evidence that the cells *qua* cells of a 6-day embryo are more susceptible to the action of X-rays than those of a 20-25-hour embryo. The degenerative changes induced in the tissues of 6-day embryos by X-rays are intimately related to cell metabolism, since they are inhibited or greatly retarded when metabolism is arrested by low temperatures. The lethal action of X-rays is not due to the formation of stable toxic products.

C. M. Yonge: Structure and function of the organs of feeding and digestion in the septibranchs, *Cuspidaria* and *Poromya*. The septibranchs are carnivorous and specialised for taking in and digesting large food particles, which, with water, are drawn in by the action of the septum, a highly muscular organ, striated in *Cuspidaria*, but not in *Poromya*. Water passes from the infra-septal cavity into the supra-septal by way of fine pores in *Cuspidaria*, and by two pairs of branchial sieves in *Poromya*. Labial palps are small, ciliated on inner side, muscular; they push food into the mouth. All cilia in infra-septal cavity carry particles *away* from mouth, either into supra-septal cavity or to posterior end of infra-septal. The oesophagus is wide and muscular, stomach long and cylindrical, lined throughout with thick cuticle, muscular and free from surrounding tissues; it acts as a gizzard. The digestive diverticula have unusually short and wide ducts and the tubules provide the only absorptive surface in the gut. All modifications of gut appear correlated with the type of food.

B. K. Das: The bionomics of certain air-breathing fishes of India, together with an account of the development of their air-breathing organs. The post-larval development of the air-breathing organs in six genera of air-breathing fresh-water fishes, namely, *Clarias*, *Saccobranchus*, *Anabas*, *Ophio-*

cephalus and *Amphipnous*, is described. In *Anabas* and *Macropodus* the organ consists of an air-chamber, or secondary lung, situated on either side of posterior region of head, each of which lodges three vascular shelly labyrinthiform plates; in *Clarias* there are two vascular tree-like structures inside the air-chamber; *Saccobranchus* has a long tubular lung-like structure extending back from the gill chamber to the sides of body; *Ophiocephalus* has a vascular air-chamber situated on each side of head, whereas in *Amphipnous* there are two large 'bladders' resembling amphibian lungs and extending to a short distance behind the head.

(To be continued.)

Royal Anthropological Institute, June 14.—Sir Baldwin Spencer: Recent researches amongst the Arunta with special reference to the Alchera and Churinga beliefs. The chief features of the earlier work of the late F. J. Gillen and the author were (1) the demonstration of the fundamental importance of group relationship in regard to social organisation of the tribes, the existence of which in Australia had first been shown by Howitt and Fison; (2) the complex development of the totemic system and of the customs and beliefs associated with this; and (3) the existence of a theory of conception related to a belief in an ancestral spirit individual who voluntarily and without any necessary relation to natural processes reappeared in successive incarnations. The Rev. C. Strehlow, in charge of a Mission Station amongst the Arunta, has arrived at conclusions in regard to the significance of the Churinga and, more especially, of the Alchera belief, which are different from these. Recent inquiries have confirmed Spencer and Gillen's original account, so far as it went. The term Alchera is of somewhat vague and wide import. It is associated in the native mind with the far past times in which his ancestors came into existence, lived and died. Every individual has his, or her, Alchera. Its use by missionaries as the equivalent of god is wrong and misleading. The Churinga belief, according to which the spirit part of every individual is associated with one of these sacred slabs of stone or wood, is fundamentally as Spencer and Gillen described it. A great leader, Numbakulla, who appears in various forms in tradition, originally made everything. The original Churinga were split into two, with one of which a male and with the other a female spirit became associated. When the Alchera ancestor died his spirit part also split into two, one forming an everlasting Arumburinga, the other a Kuruna that continually undergoes re-incarnation.

MANCHESTER.

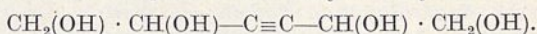
Literary and Philosophical Society, May 10.—A. Lapworth and E. N. Mottram: A survey of direct and collateral evidence bearing on some stereochemical inversions and cross-saturation processes. Bedo's view (*Compt. rend.*, 183, 750, 1926) that the oxygen atom in cyclohexeneoxide lies in the plane of the cyclohexane ring is not accepted. The theory which appears to be most nearly consistent with collateral evidence is that in each of the three steps: (1) cyclohexene to cyclohexene-halogenhydrin, (2) -halogenhydrin to -oxide, and (3) -oxide to -glycol involves a 'cross-reaction,' this term being used to include both 'simple stereochemical inversions' (such as, for example, the Walden inversion) and *trans*- or *cross*-addition processes. Oxidation of ethylenic compounds by means of permanganate is known to lead, in effect, to *cis*-addition of 2OH groups, whilst oxidation by hydrogen and other peroxides similarly leads to *trans*- or *cross*-addition. The authors criticise theoretical treatment

of the subject by Hilditch (*Trans. Chem. Soc.*, **129**, 1830; 1926 *et seq.*), and by Boesekin and Belinfante (*Rec. des Travaux Chimiques*, **45**, 917; 1926), as the glycols obtained from an ethylenic compound by *cis*- or *trans*-addition are, so far as is known, equally closely related to the original compound: they agree, however, with the authors last named in holding that, contrary to the views of Hilditch (*loc. cit.*), there is no evidence of any inversion when permanganate is used, but that a stereochemical inversion probably does occur at the breakdown of ethylene-oxides formed as intermediate products when peroxide is used.

PARIS.

Academy of Sciences, May 30.—Ch. Barrois, Paul Bertrand, and Pierre Pruvost: The coal measures of Anzin. The principal result of the palaeontological study of this field is the exact connexion of the veins opened up at Anzin with those of the western end of the Pas-de-Calais, on one part, and with those of Borinage, Limbourg, and the Ruhr on the other part. Moreover, for the first time, the thickness of the Westphalian series at the Belgian frontier can now be fixed.—E. L. Bouvier: The Saturnia of Africa.—André Blondel: The regulation of governors with direct control furnished with dampers.—Léon Guillet: The addition of nitrogen to steels. Measurements of the hardness changes produced in various types of steel by the addition of nitrogen. The effects of various reagents on these steels were also studied.—Ph. Glangeaud: The origin of the fumarole mineral springs of Royat (Puy-de-Dôme).—Jean Effront: The synthesis of proteins by the saccharomycetes. In the course of the anaerobic life of yeast, the part of the sugar which serves for the synthesis of the proteins undergoes a preliminary decomposition without any carbon dioxide being given off and the whole of the carbon in the sugar remains in the yeast produced. If, on the contrary, the solution is strongly aerated, a certain quantity of the sugar is completely burnt and the sugar remaining is transformed into acetaldehyde, which furnishes the carbon for the synthesis of the proteins.—Charles Nicolle and Charles Anderson: The resistance of the pig to the virus of Spanish recurrent fever and the natural conditions of existence of this disease and of other spirochaetoses.—Paul Helbronner was elected *membre libre* in succession to the late Haton de la Goupillière.—S. Mandelbrojt: A particular class of integral series.—S. A. Gheorghiu: The growth of the denominator $D(\lambda)$ of Fredholm.—Eugène Selivanowski: A class of ensembles defined by an enumerable infinity of conditions.—Basile Demtchenko: The stability of cavitations.—R. Swyngedaew: The reinforcement of the tension of a belt by the fact of its being wound on the pulley.—Émile Henriot: The resolution into two of a ray of light by the passage through a bent transparent plate. If a beam of light from a collimator falls on a bent plate with parallel faces, it is split up into two bundles, which, received in a telescope, give two images of the slit. If n is the refractive index before deformation, n_o and n_e the ordinary and extraordinary indices after deformation, it has been proved that $n(n_o - n_e)/(n^2 - 1)^2$ is independent of the wave-length. This is in agreement with Havelock's law.—G. Balasse: Continuous spectra obtained by the electrodeless discharge in mercury vapour. From the experimental results described it is concluded that passing from a state of ionisation $p+1$ to a state of ionisation p , this passage is accompanied by the emission of a continuous spectrum, and this is a certain criterion of this passage.—Mlle. St. Maracineanu: Researches on the radioactivity of lead which has been submitted for a long period to solar radiation.

Experiments carried out on the leaden roof of the Meudon Observatory prove that this lead, after prolonged exposure to the sun, possesses radioactivity.—Deslandres: Remarks on the preceding communication. These experiments probably prove the emission of a special radiation (possibly ultra X-rays) which is capable, by a kind of phosphorescence, of modifying the radioactivity of bodies or even of causing it. A repetition of these experiments by other persons and in other places is desirable.—Joliot: A new method of studying the electrolytic deposit of the radioelements. The electrode on which the substance is being deposited forms part of the wall of the electrolytic vessel and is sufficiently thin to be traversed by the radiation of the active body deposited. The radiation, liberated through the window thus formed, enters an ionisation chamber. The corresponding saturation current is proportional to the quantity of the active body deposited.—Victor Lombard: The permeability of nickel to hydrogen. The influence of the thickness of the metal. An experimental verification of the theoretical formula of Richardson, according to which the diffusion of gas through a metal is inversely proportional to the thickness of the metal.—Lespieau: The acetylenic erythrite



E. E. Blaise and Herzog: The constitution of the chlorides of the α -acetoxyacids.—Max and Michel Polonovski: β -Pyridyl- α -pyrrolidine (nornicotine).—Mlle. Jeanne Lévy and M. Sîras: The isomerisation of some ethylene oxides of the general formula $\text{C}_6\text{H}_5 - (\text{CH}_2)_n - \text{CH} = \text{CH}_2$.—Marcel Sommelet: The



N-alkylimines of benzophenone.—Louis Besson: The cooling of the air at sunset. Starting with twenty years' observations at the Montsouris Observatory, an empirical formula is developed giving the lowering of temperature three hours after sunset as a function of the temperature of the air and the pressure of aqueous vapour in the air.—F. X. Skupiński: The evolutive cycle in *Didymium difforme*. Cytological study.—É. Fleurent: The composition of fenugreek seed and the inconveniences of its admixture with wheats intended for grinding.—Maurice Fontaine: The mode of action of high pressures on the tissues.—Mme L. Randoïn and R. Lecoq: The evolution of avitaminosis B in its relations with the constitution of the glucides in the food.—Georges Bourguignon and Mlle. Renée Déjean: Normal chronaxy of the vestibular nerve in man.—Javillier, H. Allaire, and Mlle. S. Rousseau: Nucleic phosphorus, phosphorus balance, and ratios in the course of growth.—M. and Mme. Enselme: Contribution to the chemistry of cancerous tissue. In cancerous tissue there is a notable increase in the nucleic phosphorus compared with the amount of phosphorus in the healthy tissue. Irradiation with ultra-penetrating rays tends to make this excess of phosphorus disappear.—Constantin Gorini: Pathogenic bacteria, mixed ferments of milk.—Raoul Bayeux: The mechanical element, decompression, and the biochemical element, hypo-oxygenation, in the genesis of pulmonary or blood lesions in animals in rarefied atmospheres. Experiments on rabbits in which the effects due to lack of oxygen and those due to low pressure could be examined separately.—G. Mouriquand, A. Leulier, and P. Sedallian: The diphtheric toxin and adrenaline of the suprarenals.

VIENNA.

Academy of Sciences, April 28.—A. Müller and A. Sauerwald: The action of *p*-toluol-sulphamide on 1, 4-dibrom-*n*-butane and a new synthesis

of pyrrolidin.—H. Suida and H. Pröll: The composition of acetone oils.—P. Gross: The heat of dilution of electrolytic solutions.—W. J. Müller and E. Noack: The passivity of chromium.—B. P. Wiesner: The sexual cycle of the rat (v.). The secretion pause during the interval.—L. Schmid and G. Bilowitzki: Communications on inulin (iii.). Piperidin was used as a solvent to determine molecular weight by boiling-point methods.—F. Sigmund and G. Marchart: The behaviour of aldehyde-acetals during hydration after the method of Sabatier and Senderens.—R. Dworzak and P. Pfifferling: Studies on α -brom- and oxalaldehyde.—O. Koller and K. Lohberger: Fish from the Thian-Shan.—M. Holly: Siluridæ, Cyprinodontidæ, Acanthopterygiæ, and Mastacembelidæ from Kamerun.—J. Kozeny: Capillary conduction of water in the ground, its rise, oozing away, and application to irrigation.—A. Paltauf: The colouring of living cell nuclei. Experiments with weak erythrosin solution on onions and with eosin on dahlia. Salts of magnesium and potassium favour intake of colour.—R. Andreasch: On aceto-guanamin-sulphonic-acid and related bodies.—F. Werner and others: Miscellanea Sudanica, being part xxiv. of the scientific results of a zoological expedition to the Anglo-Egyptian Sudan.—G. Kirsch and H. Pettersson: Atomic disintegration by α -particles. (v.) On the question of the existence of atomic fragments of short range. (vi.) The disintegration of carbon. The fragments from carbon, at least in a large part, are hydrogen particles.—G. Stetter: Determination of the quotient, charge over mass, for atomic fragments from carbon, boron, and iron.—R. Holoubek: The detection of atomic fragments by the Wilson method.—E. Kainradl: Contributions to the biology of *Hydrolea spinosa*, with special consideration of the pericarp and seed development. The epithelial cells are a food store. A typical light germinator.

Official Publications Received.

BRITISH.

- The National University of Ireland. Calendar for the Year 1927. Pp. viii+326+428+173. (Dublin.)
- Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 6: Chemistry in 'Hraja and Persia in the Tenth Century A.D. By H. E. Stapleton, the late R. F. Azo, and Prof. M. Hidayat Husain. Pp. 315-417. 5.1 rupees. Vol. 9, No. 3: Geographic and Oceanographic Research in Indian Waters. By R. B. Seymour Sewell. Pp. 51-129. 2.13 rupees. (Calcutta.)
- Union of South Africa: Department of Agriculture. Reprint No. 30: Weeds of South Africa, Part 4. By K. A. Lansdell. Pp. 35. (Pretoria: Government Printing and Stationery Office.) 3d.
- Canada. Department of Mines: Mines Branch. Abrasives: Products of Canada, Technology and Application. Part 2: Corundum and Diamond. By V. L. Eardley-Wilmot. (No. 675.) Pp. v+51. 15 cents. Abrasives: Products of Canada, Technology and Application. Part 3: Garnet. By V. L. Eardley-Wilmot. (No. 677.) Pp. vii+69. 20 cents. (Ottawa: F. A. Acland.)
- Union of South Africa: Department of Mines and Industries. Geological Survey, Memoir No. 25: A Bibliography of South African Geology for the Years 1921 to 1925 (Inclusive). Authors' Index. By Dr. A. L. Hall. Pp. 117. (Pretoria: Government Printing and Stationery Office.) 5s.
- Medical Research Council. Seventh Annual Report of the Industrial Fatigue Research Board to 31st December 1926. Pp. 23. (London: H. M. Stationery Office.) 9d. net.
- Quarterly Journal of Experimental Physiology. Vol. 17: Sutherland Simpson Memorial Volume. Pp. viii+210+25 plates. (London: Charles Griffin and Co., Ltd.) 30s.

FOREIGN.

- Methods and Problems of Medical Education. (Seventh Series.) Pp. iv+99. (New York: The Rockefeller Foundation.)
- Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 24: Studies on Inflammability of Hydrogen. By Yoshio Tanaka and Yuzaburo Nagai. iii: Influence of Di-ethyl Selenide on the Limits of Inflammability of Hydrogen-Air Mixtures. Pp. 265-273. 0.20 yen. No. 25: Studies on Inflammability of Hydrogen. By Yoshio Tanaka and Yuzaburo Nagai. iv: Influence of Hydrogen Selenide on the Limits of Inflammability of Hydrogen-Air Mixtures. Pp. 275-284. 0.20 yen. (Tôkyô: Koseikai Publishing Office.)
- The Carnegie Foundation for the Advancement of Teaching. Twenty-first Annual Report of the President and of the Treasurer. Pp. vii+250. (New York.)

Proceedings of the United States National Museum. Vol. 69, Art. 5: Catalogue of Human Crania in the United States National Museum Collections. The Algonkin and related Iroquois; Siguan, Caddoan, Salish and Sahaptin, Shoshonean, and Californian Indians. By Ales Hrdlicka. (No. 2631.) Pp. 127. (Washington, D.C.: Government Printing Office.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1926. Pp. 30. (Wetlevreden: Landsdrukkerij.)

Proceedings of the United States National Museum. Vol. 70, Art. 4: A Taxonomic and Ecological Review of the North American Chalcid-Flies of the Genus *Callimome*. By L. L. Huber. (No. 2663.) Pp. 114+4 plates. Vol. 71, Art. 7: Orthopteroïd Insects from the Maritime Province of Siberia. (On the Insect Fauna of the Maritime Province of Siberia.) By A. N. Caudell. (No. 2679.) Pp. 7. Vol. 71, Art. 8: Larger Foraminifera of the Genus *Lepidocyclus* related to *Lepidocyclus* mantelli. By T. Wayland Vaughan. (No. 2680.) Pp. 5+4 plates. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 26, Part 2: The Piperaceae of Panama. By William Trelease. Pp. v+15-50+vii-viii. (Washington, D.C.: Government Printing Office.) 10 cents.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 73: A Rapid and Accurate Means of Estimating Nicotine in Tobacco and Tobacco Extracts. By Dr. R. R. Le Geyt Worsley. Pp. 5. (Cairo: Government Publications Office.) 2 P.T.

CATALOGUES.

- The Thomas Gas Meter for the Accurate Measurement of Gas. Pp. 24. (London: Cambridge Instrument Co., Ltd.) (List No. 151.)
- Siemens Electrical Distance Thermometers. (Pamphlet 840 A.) Pp. 12. Siemens Electrical Pyrometers and Thermometers. (Leaflet 2050.) Pp. 4. (London: Siemens Bros. and Co., Ltd.)

Diary of Societies.

SATURDAY, JULY 9.

BRITISH MYCOLOGICAL SOCIETY (Phytopathological Meeting) (at the Research Station, East Malling, Kent), at 11.30.—R. G. Hatton: General Account of the Station and its Activities.—At 12.—Demonstration of Reversion in Black Currants, by Mr. Hatton and Mr. Amos.—At 1.30.—Dr. H. Wormald: Brief Outline of the Pathological Problems under Investigation at East Malling.—1.45 to 3.45.—Tour of Egham Field and Great East Field, and Examination of Specimens, Cultures, etc., in the Laboratory. Features of pathological interest include examples of 'Die-back' in Plum Trees, various Raspberry Diseases, Walnut Bacteriosis, Spraying Experiments against Raspberry Anthracnose, and Apple Spraying Experiments, etc.—At 4.30.—General Discussion.

HARVEIAN SOCIETY OF LONDON (at Star and Garter Hospital, Richmond), at 4.30.

SATURDAY, JULY 16.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Eastern District Meeting) (at Guildhall, Cambridge), at 2.

CONGRESSES.

JULY 11 TO 16.

- ROYAL SANITARY INSTITUTE (at Hastings).
Monday, July 11, at 5.—Sir William Joynson-Hicks, Bart.: Inaugural Address.
Tuesday, July 12, at 10 A.M.—Meetings of Sections, and Conferences as follows:—Sanitary Science and Preventive Medicine, Representatives of Sanitary Authorities, Engineers and Surveyors, Health Visitors.
At 8 P.M.—Sir William H. Wilcox: Chronic Rheumatism in its Relation to Industry (Lecture).
Wednesday, July 13, at 10 A.M.—Meetings of Sections, and Conferences as follows:—Sanitary Science and Preventive Medicine, Personal and Domestic Hygiene, Hygiene in Industry, Authorities of Health Resorts, Sanitary Inspectors.
Thursday, July 14, at 10 A.M.—Meetings of Sections, and Conferences as follows:—Engineering and Architecture, Maternity and Child Welfare, including School Hygiene, Veterinary Hygiene, Medical Officers of Health.
Friday, July 15, at 10 A.M.—Meetings of Sections, and Conferences as follows:—Engineering and Architecture, Maternity and Child Welfare, including School Hygiene, Hygiene of Food, Veterinary Hygiene.
At 8 P.M.—Film illustrating The Treatment and Training of Crippled Children, by Sir Henry Gauvain.
Saturday, July 16.—Excursions.

JULY 18 TO 22.

- ROYAL MEDICO-PSYCHOLOGICAL ASSOCIATION (at Royal College of Physicians and the University, Edinburgh).
July 19.—Dr. H. C. MAIT: Dante and Rabelais: An Account of Two Mediaeval Physicians, with a Summary of their Philosophy.
July 20.—Dr. W. Hunter, Sir William Wilcox, Sir Berkeley Moynihan, Dr. C. H. Bond, Dr. H. A. Cotton, Dr. T. C. Graves, Lieut.-Col. J. R. Lord, Dr. W. F. Menzies, Dr. A. Meyer, and Dr. D. C. Watson: Discussion on Chronic Sepsis as a Cause of Mental Disorder.
July 21.—Dr. Ivy Mackenzie, Dr. J. G. Greenfield, Dr. R. M. Marshall, Dr. G. Riddoch, and others: Discussion on Epidemic Encephalitis.
July 22.—Prof. G. M. Robertson and others: Discussion on Points in the Lunacy Commission (England) Report—(1) What legal facilities are required for treatment? (2) How far is judicial intervention necessary? (3) What safeguards against improper detention are inadequate?