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West African Development.[1]

II.

IT is 134 years since William Pitt, speaking of Africa, said: "We may live to behold the natives of Africa engaged in the calm occupation of industry, in the pursuit of a just and legitimate commerce. We may behold the beams of science and philosophy breaking in upon the land." The material vision is fulfilled, but the beams of science and philosophy have not yet penetrated the veil of mists and obscurity in which our administration is enveloped. We have been in trading relationship with West Africa for more than three hundred years; the British Crown has been directly responsible for the administration of a great part of its territories since 1886; the native races in the British zones are among the most intelligent races of Africa: but we have been content to leave the education of its peoples to missionaries, with the result that an inordinate number of native lawyers, preachers, and clerks have been created, but practically no men trained in science or its application.

Tropical Africa is a country with vast potential agricultural resources. It already supplies the world with enormous quantities of raw materials—oil-seeds, rubber, fibres, grains, cocoa, coffee, tea, tobacco, and timbers. But over the greater part of the territory under British control they are being produced with a maximum of waste. Practically nothing has been done to improve native methods of crop production. "The plough is as yet unknown to the natives of West Africa and cultivation is done with the hoe." In spite of the fertility of the soil, "Nigeria imports large quantities of rice and wheat flour to make up some of the deficiencies in its local food supply. The Gold Coast imports much rice and even tinned foods for native consumption." Oil-seeds and oil-nuts are still exported in their raw state, instead of their essential oils being extracted locally. Where the natives extract the oil by their own methods, as in the palm-oil industry, "it is calculated that, quite apart from the deterioration in quality produced by the native method, not less than 50 per cent. of the oil is largely lost in the processes." As in East Africa, many of the tribes practise shifting cultivation, with consequent deterioration and desiccation of the soil and the destruction of forests—a serious danger where forests constitute a bulwark against the encroachment of the desert. In the Gold Coast Colony "little or nothing has been done in the way of manuring" on the cocoa lands.

As regards husbandry, very little has been done to assist the natives to improve the quality and the quantity of their domestic stock, practically all the

[1] Continued from p. 616.

labours of the veterinary departments being devoted to the prevention and cure of disease. There are large areas in Sierra Leone free from tsetse fly, but no attempt has been made to introduce cattle. The researches of the French and the Belgians in the adjacent territories into the breeding of types of cattle immune from trypanosomiasis seem to be unknown to us, although Mr. Ormsby-Gore mentions the fact that there are a few thousand head of a small type of non-humped forest cattle in Southern Nigeria, uniformly healthy, apparently unaffected by the tsetse fly with which they are frequently in contact.

It was the existence of this immune type in Fonta-Djalon, Upper Guinea, Upper Gambia, and the Lower Saloum which led the French to investigate the relation between species, the size of species, and immunity, and to the interesting discovery that susceptibility to trypanosomiasis in all types of domestic or semi-domestic stock increases with their size. Further, it was established that the native herdmen had made use of this fact to produce, by crossing the immune species with the larger zebu (humped) varieties of cattle, the Djakore or Bambara species of cattle which retain much of the original resistance. On these bases crossing experiments were carried out in the Belgian Congo, with marvellous results, according to M. Roubaud, the chief of the laboratory of the Pasteur Institute.

Another aspect of animal husbandry is also emphasised: "Research in the mineral, as well as the vegetable, nutrition of stock appears to be well worth undertaking. The whole question of crossing, selection of bulls, and the improvement of herds is ripe for examination." In regard to plant products, it is recommended that each of the four territories should maintain a central research station, to which should be attached experimental farms, and connected with the principal agricultural training college for natives. The research carried out at these stations "should be co-ordinated not merely in West Africa, but with the similar research which is being carried on in Trinidad and at Amani in East Africa." Scientific workers will welcome the statement: "If we are to develop our tropical possessions we must realise the value of the scientific staff, both in the laboratory and in the field, and we must provide careers in the agricultural departments in the Colonies which will attract personnel possessed not only of high technical qualifications, but of capacity for leadership and ability to inspire others."

Mr. Ormsby-Gore, while recommending a research policy, makes no recommendation as to the priority of research. A fairly comprehensive programme of investigation is laid down, particularly in regard to human, animal, and plant diseases, and the breeding of improved varieties of domestic stock and plants, but what is lacking is a definite recommendation for the allocation of a specific sum to research. What is wanted in tropical Africa is a fund similar to that at the disposal of the Department of Scientific and Industrial Research in Great Britain, which would not depend upon the vagaries of the local directors of agriculture or the local governors. Such a fund might be created by the apportionment of a percentage of an export tax on palm-oil, cotton, cocoa, or any other of the principal products.

The need for further research in tropical diseases and the measures to be taken to secure a healthy and increasing population are emphasised, but not over-emphasised. In the absence of vital statistics, it is impossible to determine whether the population of West Africa is increasing, or stationary, or declining. Mr. Ormsby-Gore states that the general impression appears to be that the native population is increasing, but very slowly and imperceptibly. Where there are statistics available regarding the native population, as in certain parts of South Africa, it is proved that the rate of increase of native population is steadily diminishing. Contact with the white races apparently has this inevitable effect. Generally speaking, it can be said that in spite of the energetic methods adopted to stamp out disease, in spite of the knowledge we have acquired of the diseases which afflict the African populations and the means by which they can be prevented, the native population over the whole of tropical Africa is either stationary or declining in numbers. Bodily disease is not the only determining factor in this result. A psychological factor has to be taken into account. Rivers and others have attributed the decline of primitive populations to the loss of interest in life following upon the breakdown of their institutions, the suppression of their customs, and the atrophy of native arts and crafts on impact with our different institutions and different culture. We are confronted, therefore, with the dual task of disseminating knowledge of the means of preventing disease and getting the natives to apply it, and of arousing interests in new activities to replace those which have been lost.

The identifiable diseases which take the greatest toll of human life and energy in West Africa are malaria, dysentery, yaws, yellow and blackwater fevers, sleeping sickness, and leprosy among tropical diseases, and plague, venereal diseases, smallpox, and tuberculosis among the general afflictions of mankind. Many of these diseases could be dealt with at village dispensaries, if trained dispensers were available. Mr. Ormsby-Gore rightly stresses the need for the provision of centres where natives can be trained in the diagnosis and treatment of the commoner complaints, and for native sanitary orderlies whose duties would include the

destruction of the breeding-places of mosquitoes, both anophelines and Stegomyiæ, the destruction of rats, supervision of the general sanitation of towns and villages, the prevention of water pollution, and the notification of disease. These subordinate medical and sanitary staffs should not be drawn exclusively from the better educated coast natives, but, so far as possible, from every tribe in the interior. "A native is prepared to trust a European medical officer; he is also prepared to pay attention to a man of his own race, but he is not prepared to extend the same confidence to the African from another tribe." Even if he were, it is obviously desirable that knowledge of disease and its prevention should be possessed by some members of every tribe. We must help to supplant the 'medicine man' by the medical man drawn from the same tribe.

Emphasis is also laid on the need for training women for maternity and child-welfare centres. The infant mortality rate is grievously high in western as in all parts of tropical Africa, and the high proportion of still-births to births is one of the most deplorable features of tribal life. For the high mortality rate malnutrition is to be held responsible, but the number of still-births and abortions must be attributed to the prevalence of venereal disease and malaria. It seems fairly well established from the recent researches of Mr. Buxton in Melanesia that malaria is one of the principal determining causes of abortion and still-births. There is no reference, however, to these recent researches in the report before us. The difficulties in finding women sufficiently well educated to undertake the work of maternity and infant welfare are due to the neglect of female education. "The comparatively small provision which has been made for the education of girls as compared with the provision made for boys is very noticeable throughout West Africa." Mr. Ormsby-Gore's plea for going slow in this matter is not one which will commend itself to any well-wisher of West Africa. There is an urgent need for immediate and even precipitate action directed towards raising up a well-educated class of women. Reading the report, one feels that Mr. Ormsby-Gore overestimates the value of hospitals where surgical operations can be carried out, and underestimates the possibilities of schools for the native infants and adults where much could be done to build up the necessary outlook on disease. The creation of a large number of hospitals, which he advocates, while there are very few schools, is as wise as the present habit in Great Britain of spending large sums of money on the maintenance of sanatoria for consumptives but doing practically nothing to destroy the slums which provide the greater number of patients for the sanatoria.

A tremendous importance is attached by Mr. Ormsby-Gore to the need for greater transport development. He instances the remarkable progress made in the export of ground-nuts following the construction of the railway to Kano. Between 1910 and 1925 the exports of this crop from the Kano-Zaria district rose from 1910 tons to no less than 127,000 tons. He shares with Sir Frederick Lugard the belief in the productive capacity of the peoples to make any railway pay, and in the civilising influence of the railway. A considerable part of the report is devoted to detailed consideration of a railway, road, and harbour programme, but only passing reference is made to the need for systematic research into the possibilities of the flexible track vehicle. This type of vehicle, which is already in an advanced stage of development, and has been used by the Empire Cotton Growing Corporation for the transport of cotton from remote areas, possesses the inestimable advantage that it can traverse roadless country. It is a road-maker rather than a road-breaker. If improved, it would enable every part of the tropics, however remote, to be brought within the reach of regular transport services, and thus not only free for productive work thousands of labourers at present engaged in the wasteful system of head-porterage, but would also save the country the expense of making metalled roads, which are expensive to make and more expensive than a railway to maintain.

The report as a whole will repay the closest study by scientific workers. They have every reason to be grateful to Mr. Ormsby-Gore for re-emphasising the urgent necessity for applying the methods and results of science to the problems of tropical development, both in administration and production. A vast field of research is indicated, a field which it may be hoped will be surveyed with the least possible delay. Scientific workers must realise that they have a special responsibility in the matter. The knowledge which can be gained from scientific research is probably the most important factor in the full realisation of the potentialities of the vast British tropical possessions, and it is essential therefore that funds should be forthcoming immediately for the initiation of a bold programme of research. There is not the least excuse for Great Britain to lag behind other Colonial powers in this respect; there is every reason for it to lead the way. It is not enough for Mr. Ormsby-Gore to produce a report which will establish his reputation as the most far-sighted younger statesman of the day. His observations, his vision, and his recommendations must be appreciated by the nation, and this will be possible only if the scientific community assist the nation to a fuller understanding of the value of scientific research in every sphere of national and imperial endeavour.

Echoes of Tennessee.

Evolution and Religion in Education: Polemics of the Fundamentalist Controversy of 1922 to 1926. By Prof. Henry Fairfield Osborn. Pp. xiv+240. (New York and London: Charles Scribner's Sons, 1926.) 7*s.* 6*d.* net.

ECHOES of the Fundamentalist controversy continue to travel across the Atlantic. The present volume consists of a collection of articles and addresses by Prof. H. F. Osborn dealing with the situation created by this strange revival. It is a phenomenon very difficult to cope with, being a product of popular education and democratic government. The only cure is more education of the right sort, but the Fundamentalists are striving to capture the educational machine. Prof. Osborn is aware that a mental atmosphere prevails not very favourable to scientific truth. "I hold," he says, "that the press and the movies are by far the most potent influences upon conduct in America at the present time." He regards the sum of press influence as morally good but intellectually bad, "because it creates what I call the jazz mind and a disproportionate sense of relative values."

The trouble with people at a certain stage is not only that they cannot appreciate evidence, but rather that they have positively no sense of spiritual or religious values. To attach religious value to the historicity of the myths in Genesis is a mark not only of intellectual, but also of religious, myopia. At this stage, one is either a Fundamentalist or a Secularist; it does not greatly matter which, for the two are correlatives. The tragedy of the situation, as Prof. Osborn points out, is that this recrudescence of superstition has broken out just at a time when the conceptions of men of science have become anti-materialistic. He himself says (p. 91): "If I have made a single contribution to biology which I feel confident is permanent, it is the profession that living Nature is purposive."

One remark of Prof. Osborn's seems to us especially noteworthy: "In my opinion religion and science will unite to control the future of mankind. This will be a simplified religion and a reverent science" (p. 177). But what is a "simplified" religion? Apparently Prof. Osborn hopes to get people to agree upon "a simple, elemental, and more or less primeval teaching on which all men, except those who persuade themselves that they are atheists, agree." It would include the Ten Commandments, the Lord's Prayer, the Sermon on the Mount, and "passages from the teachings of St. Paul and other missionaries." But this is the eighteenth-century chimera of natural religion in a new dress. Prof. Osborn overlooks the fact that these enshrinements of religious and moral teachings are based on a definite philosophical outlook, not always formulated, but capable of quite definite formulation.

This 'hang theology' attitude will not work—at least not for long. If the specific Christian view of God goes, the Christian value-scheme will follow, and carry along with it Christian ethics. This strikes us as a surrender. The strength of the Fundamentalist lies in his quite definite scheme of belief; and unless the Modernist or man of science can offer something equally definite and equally religious, he will neither win nor deserve to win. The future will be divided between the Fundamentalists and the Secularists, who alike know what they believe and why they believe it. There is no room for a vague religiosity, at least in a democratic country like America.

We have left ourselves very little space for estimating the more definitely scientific aspects of the book. Indeed, its excellence here should be beyond criticism. Prof. Osborn speaks throughout with the directness, lucidity, and easy freedom of the specialist and experienced teacher. Especially interesting is his exposure of the Fundamentalist misrepresentation of evolutionary teaching as deriving man's descent from apes. "The entire monkey-ape theory of human descent is a pure fiction," he says. The human line of descent is entirely independent of the apes; it is to a common ancestor that the two may be traced. This, perhaps, is all one to the Fundamentalist, in whose arguments caricature and invective take the place of facts and logic. We may hope that the perusal of this book may abate some Fundamentalist prejudices, at least in the case of those whose minds are still capable of reflection. We think that Prof. Osborn has done a public service to his countrymen in preparing and publishing it; it cannot always have been congenial work for a disinterested student of science who stands above the clamours of controversy.

J. C. H.

Prehistory in Britain.

Proceedings of the Spelæological Society for 1925. No. 3, Vol. 2. (University of Bristol.) 3*s.*

WHEN the editor of NATURE asked me to review the above work, I was particularly pleased to do so. It has always been a source of satisfaction to me personally that I was partly instrumental in turning the attention of the Spelæological Society of the University of Bristol, shortly after the War, towards prehistoric investigations. Previously, though the Society and its predecessor bore an honourable record for researches on underground water-ways, etc., little serious prehistoric work had been attempted. The

work of the 'Spelæos' has barely received the recognition it deserves; most people would be astonished to see how much material has been already collected and classified in the last few years; a visit to the Society's museum—housed in the new buildings of the University of Bristol—has become a necessity for all prehistorians. The difficulty has been that a few years ago—rightly or wrongly—the Society decided to publish its own *Proceedings* instead of combining with one of the older societies for this purpose. Folk as a rule are rather suspicious of new provincial publications of this kind, and it is to combat these suspicions in this particular case that this review is written.

The Society started its prehistoric explorations by having two pieces of rare good luck. I often wonder if my friends the 'Spelæos' realise how fortunate they were! Avelines Hole has proved a most important find of late Palæolithic date, and has yielded a rich and interesting collection of flint implements, not to speak of a harpoon—one of the very few found in Britain—and several portions of human skulls. The second 'plum' was the Keltic Age cavern, and this was certainly no small discovery. Although starting off straight away with these first-class sites, members rose to the occasion and very creditable excavations were undertaken and duly published. Lately attention has been turned northwards and investigations started in the Wye valley; of course, Mendip—the first love—is by no means being neglected.

The present *Proceedings* contain a most attractive series of papers; mostly they are concerned with the various activities of the Society, but one or two articles on more general matters by outside contributors are included. The contents comprise: A fifth report on Rowberrow cavern, a third report on excavation of Mendip Barrows, a second report on excavations in the Wye valley, and a note on a Roman site on Bedminster Down; a short account of Guy's Rift, Slaughterford, follows, with a detailed description by Mr. L. H. D. Buxton of the early Iron Age skull found there. Other articles include: A study of certain caves in the north in relation to the ice ages by Messrs. L. S. Palmer and L. S. Lee, a survey of Upper Palæolithic industries from some Mendip caves by Mr. J. A. Davies, a note on the Upper Palæolithic in Britain by Miss D. A. E. Garrod, and a study of flint-flaking by Mr. H. Warren.

Among so much that is interesting it is rather invidious to pick out any special paper, but it is clearly impossible here to discuss such a long table of contents. Perhaps readers will be especially interested in the reports on Rowberrow cavern and the investigations in the Wye valley. The 'Spelæos' started work at Rowberrow several years ago—their first publication on the subject was in the *Proceedings* for 1920–21. Thanks to outside financial assistance, it has been possible to proceed on a large scale and the present (fifth) report gives a very complete picture of the various cultures found there. Quite a number of flint implements occurred, but it has been found that, though a late Neolithic industry is present, they mostly date to more recent periods—some being even Roman in age. Of course, it has been realised for some time past that the introduction of metal into the British Isles did not lead to the complete eclipse of all flint work, and that many of the surface finds are comparatively recent in date, but it is always satisfactory to have fresh confirmation, especially when a definite stratigraphy occurs. The discovery at Rowberrow of pigmy tools—though without, of course, the Tardenoisean burin—in late Neolithic layers is also interesting and confirms the assertions of H. Warren, who claims that some geometric pigmies in Essex are certainly not earlier in time than the late Neolithic and may even date to an early metal age.

Somehow or other the Wye valley seems to have been rather neglected by prehistorians. So long ago as 1919, in a note in the first *Proceedings* of the Society, I urged that attention should be turned to this favoured valley. The results of two seasons' work merely whet the appetite for more. King Arthur's cave—originally excavated in the 'seventies—has naturally first attracted the diggers, and it is surprising what they have obtained from what appeared at first sight a completely emptied chamber. But the whole district is simply riddled with caves and rock-shelters, and it will be astonishing if further investigation in future years does not bring to light other and still more interesting 'King Arthur's caves.'

The current *Proceedings* forms a notable publication, and the Society is to be indeed congratulated: archæologists can no longer afford to neglect its activities.

M. C. BURKITT.

Surfaces, Molecules and Ions.

An Introduction to Surface Chemistry. By Eric Keightley Rideal. Pp. viii + 336. (Cambridge: At the University Press, 1926.) 18*s*. net.

THAT the cohesive forces which hold solid and liquid masses together, and produce the phenomena of capillarity at their surfaces, are ultimately identical with the forces producing chemical change, is an idea which has been latent in studies on capillarity since their inception. But the growth of this idea into a living theory, with power to inspire and guide many researches into the structure of surfaces, the surface properties of molecules, and the

mechanism of evaporation, solution, and catalysis, has been delayed until the last fifteen years. Dr. Rideal's book is probably the first in any language to attempt a presentation of all the modern developments of this idea. After an introductory chapter on pure liquids and their surface energy, the author presents Gibbs' adsorption equation—the reappearance of much of the original proof is to be welcomed—and plunges into the most recent work on surface films on liquids. A chapter on liquid-liquid interfaces includes information on emulsions and suggestions for bridging the gap in our knowledge between the theory of capillarity and of solution; solid-gas interfaces are treated with reference to crystal structure and to recent work on catalysis; adsorption, surface reactions, crystallisation, and disintegration are included under solid-liquid interfaces, and the section on electrification deals with the adsorption of ions, the double layer, cataphoresis, the Donnan equilibrium, and other subjects. There are two concluding chapters on the most important points in the theory of colloids, including the theory of Brownian movement, the charge on colloidal particles, and the structure of gels. The effects of adsorption in its manifold forms are traced through a great variety of phenomena.

The book is an able survey of an extensive literature full of interest at the present time. It is written with a keen enthusiasm and abounds in well-chosen references and in original suggestions. Its conception and plan are excellent. But close reading reveals that it is not particularly trustworthy as a text-book, and that it suffers from lack of thorough and critical digestion of the material and from hasty revision. For example, in the table of cross-sections of organic groupings on p. 77, values appear for –NC and CONHϕ, neither of which has been measured, and there are several other mistakes besides. On p. 129 the formula for the rate of growth of tarnish films on metals, as limited by the slow diffusion through the film already formed, is given without proof, and wrongly. It is not quite fair to the uninitiated reader to expect him to recognise the physical factors at work in this phenomenon from a misprinted formula, and no further explanation than that it is "the ordinary diffusion law." Elsewhere a thermodynamical argument is based on the hysteresis of the contact angle as if it were a reversible phenomenon, although it has been shown to be frictional in nature and irreversible; Harkins' 'oriented wedge' theory of the inversion of emulsions is given without noticing that its author has brought forward evidence very damaging to its simple form; and the theory of the very important 'maximum bubble pressure' method for determining surface tension is dismissed with an approximate formula and the remark that it "corresponds closely with that of the drop-weight method," which is scarcely a correct indication of the actual state of these theories. Sugden's development of the first of these methods ought to have been at least mentioned, as it gives not only the most accurate theory at the present time, but also an apparatus which, on the grounds of convenience and accuracy combined, is probably the best now available for ordinary use. Sometimes the author seems merely to have handed his notes to the printer, as when on p. 295 a hypothesis is given and the fact of its having been tested, a few words necessary for grammar are omitted, and the result of the test is not stated; and the nickname "McLewis" surely should not be used in print.

Some blemishes are, however, inevitable in a pioneer work on a rapidly growing subject, and the reader who will consult the original literature to which this book introduces him, when he needs fulness and accuracy, will find the book invaluable. It is alarming that, only a few months after the appearance of the book, it is already seriously out-of-date on some points fundamental to the theory of surface films. The book is likely to be found readable by fully trained students of physical chemistry; other scientific readers may find that the demands made on a previous knowledge of current technical terms and mathematical symbols are too heavy. Those who, like the reviewer, are already engaged in investigations on the subject will find it indispensable; and we may look confidently for fresh students to be attracted as a result of reading it.

N. K. ADAM.

Transmission of Stimuli in Plants.

The Nervous Mechanism of Plants. By Sir Jagadis Chunder Bose. Pp. xix+224. (London: Longmans, Green and Co., Ltd., 1926.) 16*s.* net.

ALL the recent work on cell respiration and nutrition leads to the conclusion that a real similarity exists between these processes in the plant and animal organisms. This being the case, it would seem possible that the mechanism of the transmission of stimuli may also be fundamentally the same in both. The problem of transmission in the plant has not received so much attention as that in the animal, on account of the comparative difficulty of dissecting plant tissues for experiment, but nevertheless a considerable number of theories have been put forward to explain the few known facts. Broadly speaking, the theories hitherto produced fall into two classes: those which attempt an explanation on a mechanical basis and those which incline to the idea of chemical stimulation. Sir

Jagadis Bose introduces a new conception—that of 'physiological excitation.'

None of the older theories has been sufficient to explain all the facts and the extreme rapidity with which a stimulus is effective in *Mimosa pudica* and other sensitive plants: these, when not completely ignored, have always been a stumbling-block. It is therefore of interest that in the present work, Mimosa has been chosen for the subject of the fundamental experiments.

Briefly, Sir Jagadis Bose claims to have found that in Mimosa there exists a definite nervous system which he believes is in practically every way identical with that of the animal. He repeats on this plant most of the classical experiments on animal nerves and nerve-muscle preparations. By means of the most ingenious apparatus he identifies the phloem with the actual conducting tissue; he demonstrates the falling of the leaflets under various stimuli, the time between the application of the stimulus and the response varying with the distance of the leaflet from the point of excitation. He finds that the falling leaflets are confined to the stimulated side except when the stimulus (usually electrical) is intense, when the response travels up one side and down the other; this is taken as evidence for two unilateral conducting strands meeting at the apex of the leaf. The latent period and the rate of transmission of the stimulus have also been measured, and it is found that the phenomena of make-and-break electrical stimulation are the same as in animal tissues.

Mimosa was chosen for these experiments on account of its rapid and definite reactions, but this class of plant stands alone in the vegetable kingdom, and it is doubtful whether theories based entirely on such experiments as these could be applied to all plants. An electrical reaction corresponding to the action current of an animal nerve is said to have been demonstrated for several plants.

In view of the need of confirmatory evidence and of the hostile criticism which this work is likely to evoke from orthodox botanists, it is greatly to be regretted that the experimental conditions are not given in greater detail. We have no doubt that every reasonable precaution was used, but it is hard to reconcile the observation that temperature has a very definite effect on the rate of transmission with entire absence of any attempt to control it in other experiments. Apart from any effect on the plants, the conditions must surely have been very carefully controlled when dealing with such very sensitive apparatus; the reflecting galvanometer used in some of the experiments gave a deflexion of 1 mm. at a distance of 1 metre for a current of 10^{-10} amperes.

Sir Jagadis Bose is to be congratulated on the way in which he has treated the problems and on designing so many instruments for exact measurement. It is difficult to believe, however, that he will succeed in demonstrating in plants a central nervous system, the presence of which he seems to suspect.

Our Bookshelf

Citrus Diseases and their Control. By Prof. Howard S. Fawcett. With Sections on Oriental Citrus Diseases by H. Atherton Lee. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xii + 582. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 25*s.* net.

A LARGE amount of valuable investigation has been carried out during the last twenty years on the etiology and control of citrus diseases in the main producing areas, but no book embracing the results of this work as a whole had been offered to the industry. This deficiency is very adequately met by Fawcett and Lee's volume.

The elder author's work, first in Florida and later in California, has established his name as that of the foremost citrus pathologist, and the book is necessarily, in no small measure, a record of his own investigations, adapted in a clear practical way to the needs of the California and Florida growers.

Lee's first-hand acquaintance with diseases in the Philippines and in parts of China and Japan, the recognition of those present in the Mediterranean region, Australia, South Africa, and the West Indies, and the extensive bibliography, make the work useful also to pathologists.

The arrangement of the matter follows customary lines, and the numerous illustrations are mostly from photographs showing the macroscopic characters of the lesions; many of the plates, in colour, appear strikingly true to Nature. In the treatment of the diseases definitely proved to be caused by parasites, enough is said, doubtless, of the micro-organisms concerned to satisfy the curiosity of the practical man. A number of new terms are proposed, with the view of furthering uniformity in the international nomenclature of plant diseases. These terms, like some which have already been gaining ground, such as gummosis, psorosis, and verrucosis, are based on some salient character of the lesion or gross appearance. The three terms mentioned indicate the difficulties involved: verrucosis is caused by a definite parasite; the cause of psorosis is unknown; gummosis may be due to a number of things, including five parasites at least, so the name of the parasite must be added to define the particular case (Pythiacystis *gummosis*, Diplodia *gummosis*, Botrytis *gummosis*, etc.). Among the rather strange-sounding new terms may be mentioned cancrosis for citrus canker and rubellosis for the pink disease of the tropics, both caused by specific parasites; foliocellosis (frenching or mottle-leaf), endoxerosis (internal decline of the lemon fruit), adustiosis (red blotch), and oleocellosis (oily spot) are non-parasitic diseases.

The Useful Trees of Northern Nigeria. By H. V. Lely. Pp. xii+128+120 plates. (London: The Crown Agents for the Colonies, 1925.) 10*s.* net.

MR. LELY has rendered a service to African forestry by the preparation and publication of his descriptive account of 128 of the useful trees of Northern Nigeria. This book will be helpful not only to his colleagues but also to forest officers in other African colonies, to which many of the trees described extend their range. The author's method may be commended to the consideration of others who, we hope, will follow his example; as he expresses it, his aim has been to describe and illustrate the material as it appears to be and not only as it actually is from the scientific point of view, avoiding botanical terms except where they have no alternative. Technical descriptions can always be provided by the compiler of a flora, working at home, but information such as that supplied by the author of the work under review can only be given by 'the man in the field.'

If other colonial forest officers will follow Mr. Lely's lead, by giving us illustrated accounts of the dominant trees of their areas, it will be of great assistance to their colleagues and successors, and will help to prevent many erroneous determinations such as are now so commonly met with. Such accounts would tend also to bring to light the still too numerous species not yet identified botanically, and would furnish us with much-needed information as to the 'habit' of the various species discussed.

A few slight corrections ought, perhaps, to be noted for the benefit of African forest officers. The genus Lophira has been retained by Mr. Lely in the Dipterocarpaceæ instead of in the Ochnaceæ, to which family it is now referred. The genera Eriodendron, Ceiba, and Bombax are now usually separated from the Malvaceæ to form a distinct family, the Bombacaceæ; *Eugenia guineensis* is now generally placed in a separate genus, Syzygium, as *S. guineense.* Sir David Prain's revision of the African species of 'Afzelia' under the generic name Pahudia appears to have been overlooked, for *Pahudia africana* (Sm.) Prain appears as *Afzelia africana.*

We sincerely hope that Mr. Lely will feel encouraged to continue the good work until all the trees of his region have been described and figured.

J. BURTT DAVY.

Synonymy of the British Non-Marine Mollusca (Recent and Post-Tertiary). Compiled and Annotated by A. S. Kennard and B. B. Woodward. Pp. xxiv+447. (London: British Museum (Natural History), 1926.) 20*s.*

THIS work is almost devoid of readable matter, but is nevertheless of fundamental importance to all who are engaged in research on non-marine Mollusca or on the Pleistocene deposits. It gives a list of all the genera, sub-genera, and species (recent and post-Tertiary), with bibliographical references, together with the etymology of the names adopted, and the geological range of the species in Great Britain. The names used are those which, in the opinion of the authors, most nearly accord with the requirements of the International Rules of Zoological Nomenclature. 172 species of gasteropods and 37 of lamellibranchs are recorded, most of which are found fossil in the Pleistocene, and some in the Pliocene deposits. About 16 per cent. of the species are extinct in Great Britain. Some idea of the immense labour involved in the preparation of this work can be formed from the bibliography, which occupies 54 pages.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland. Area 5: Glasgow East, Coatbridge and Airdrie; with Chryston, Glenboig, Greengairs, Slamannan, Caldercruix and Salsburgh. By Dr. C. T. Clough, L. W. Hinxman, W. B. Wright, E. M. Anderson, and R. G. Carruthers; with contributions from Dr. R. Kidston, Dr. G. W. Lee. Second edition, with additions by M. Macgregor. Pp. x+171+13 plates. (Edinburgh and London: H.M. Stationery Office; Southampton: Ordnance Survey Office, 1926.) 5*s.* net.

THIS memoir is a new edition (with corrections and additions) of that on the same area, first published in 1916. In addition to minor corrections and amplifications, Chapter ii. dealing with the Carboniferous Limestone series, in which certain important coal seams occur, has been almost entirely rewritten, whilst there have also been some changes in Chapter iii. dealing with the Millstone Grit. It is evidently of great importance that, as fresh information is available, works such as these should be kept up-to-date and amplified where necessary.

Erde und Weltall. Von Svante Arrhenius. Aus dem Schwedischen übersetzt von Dr. Finkelstein. Pp. vii+342+2 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) 12 gold marks.

THIS is a German translation from the Swedish; it is a combined and revised version of the two earlier works by the author, published in 1906 and 1915. The book deals only with the solar system, with special reference to the earth and geophysics (including atmospheric physics and climatology). It is written in picturesque and discursive style, and there are numerous small illustrations. Many references are made to very recent work.

Solutions of the Examples in a Treatise on Dynamics of a Particle and of Rigid Bodies. By S. L. Loney. Pp. vi+240. (Cambridge: At the University Press, 1926.) 17*s.* 6*d.* net.

PROF. LONEY has here provided complete and concise solutions to the examples of his well-known treatise on dynamics, which will be very useful to teachers and to those advanced students of applied mathematics who are sufficiently mature to know the legitimate use of such a key.

Physische Erdkunde: die Gestaltung der Erdoberfläche. Von Prof. Dr. Richard Lehmann. Pp. vii+240. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1925.) 12·50 gold marks.

THIS is a text-book of physical geography, of the usual type. The processes of development of surface features are described at length, and the illustrations are numerous. The earth's thermal state is mentioned, but radioactivity is not.

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.*]

Welsh Romani.

I HAVE just read Prof. Turner's review of my "Dialect of the Gypsies of Wales" in NATURE of August 28, and trust you will permit me to make a few comments.

Prof. Turner refers to the "well-established rules of Gypsy," *i.e.* the phonetic correspondences between Sanskrit and Romani, but omits to mention that my book is the first to supply a full and systematic series of these phonetic equations; for the earlier lists of Ascoli and Miklosich are too incomplete to be of service. These equations have been deduced in the first place from examples where the correspondence between a Sanskrit and Romani word is indisputable, and afterwards applied to the elucidation of words the etymology of which is in doubt. Hence my etymologies, which he appears to assign to guesswork, have all been based upon a belief in that "constancy of sound-laws" which he charges me with ignoring. By no other method would it have been possible to arrive at such new derivations as *bār*, 'stone,' from Skr. vaṭa; *bivan*, 'unripe,' from Skr. vimlāna; *lil*, 'book,' from Skr. likhita; *phabai*, 'apple,' by reduplication from Skr. phala, and many others. I am therefore in agreement with Prof. Turner as to the principle that "a given sound in a given dialect will develop in the same way in all words in which it appears under the same conditions," and only question his application of this rule.

In the single example cited by Prof. Turner, namely, Rom. *šukār*<Skr. sukṛta, he emphasises his point by the statement that I give this derivation "without hesitation," although in the vocabulary I first quote Miklosich's śukra, following it by a doubtful "rather perhaps to be connected with Skr. sukṛta"; while in my chapter on the History of Romani Sounds (§ 130) I cite it with a prefixed query mark. My reason for connecting Gypsy *šukār* with Skr. sukṛta is the analogy of three other Romani words from the same Skr. √ kṛ, compounded with prefixes ending in a vowel, where the -k-, though intervocalic, remains. These are:

raker- (Gk. Gyp. *vraker-*, Arm. Gyp. *pakr-*), 'to talk,' derived by Finck from Skr. prakṛ, Prākr. pakar- —an etymology which the Sanskritist Ernst Kuhn in 1909 hails as 'sehr glücklich,' explaining as it does the forms in Eastern and Western dialects;

pariker-, 'to thank'<Skr. pratikṛ, Prakr. paḍiker-;

dūrker-, *duriker-*, 'to foretell'<Skr. dūrīkṛ. In stating dogmatically that Skr. sukṛta "would have become something like **suil*"—a word of singularly unGypsy-like appearance — Prof. Turner assumes that intervocalic Skr. -t-, if it survives, must necessarily have become European Gypsy -l-; but it might equally well have become -r- (§ 130, No. 3), *e.g.* Skr. pat->Prākr. paḍ->Rom. *per-*, 'to fall,'; Skr. prefix prati->Prākr. paḍi->Rom. *pari-*.

Prof. Turner's second adverse criticism arises, I think, from a misapprehension of the scope and purpose of my book. When in my vocabulary, appended to Romani words of Indian origin, I cite Sanskrit, Prākrit, and Hindi forms, I do so with very different degrees of reverence. Sanskrit in almost every case is quoted as the source in which we find preserved the primitive form of Gypsy words, while Prākrit serves mainly to illustrate processes of sound-change which are often identical with those found in Romani. The Hindi words are in an entirely different category, and from the Gypsy viewpoint practically negligible. I supply them (as I explain in § 76) merely to indicate the usage in the central Modern Indian speech of to-day. But since the Gypsies had left India at least 200 years before the rise of Hindi and other vernaculars, these recent forms cannot have affected Romani.

Prof. Turner assumes that where the Hindi word is given by me I regard it in every instance as a true cognate. But this is not so. The distinction between tadbhavas (lineal descendants of Sanskrit words) and tatsamas (modern resuscitations from Sanskrit) is so well-known, and the examples in my vocabulary so obvious, that it would have been superfluous to have differentiated the two classes. He selects for rebuke (with judicious omissions which suggest that I try to connect a Romani word with a Hindi tatsama) the Gypsy *thulo*, 'fat.' In my vocabulary it appears thus: "*thulo*, adj. [Skr. sthūla, 'thick,' 'bulky,' 'gross'; Prākr. thulla; Hind. sthūl; Dard. tūla, tullo, tul, 'fat'],"where the Hindi sthūl stands out prominently as an unmistakable tatsama. Hindi being historically out of account, it seemed to me to be of first importance to the student of Gypsy to direct attention to the fact that an inherited word, which has survived in Romani, should have been lost and artificially restored in the Modern Indian vernaculars. Prof. Turner, writing as though my book were designed as a text-book on Modern Indian dialects rather than a work on comparative Romani, says: "Such an attitude and such mistakes invalidate the whole of [my] comparative work"—a remark which sheds a curious light on the attitude of the "Junggrammatiker."

JOHN SAMPSON.

The University,
Liverpool.

THE main ground of my criticism of Dr. Sampson's book was that in it he pays little regard to the principle of the constancy of sound-laws. In his reply, however, he professes his adherence to this principle; and proceeds forthwith to deny it. For by this method, he says, he arrived at the new conclusion, among others, that *bār*, 'stone,' is derived from Sanskrit *vaṭa*. It is true that initial *v-* regularly becomes *b*, and that intervocalic *-ṭ-* regularly becomes *r*. So far, so good. But it is a well-established law that in European Romani Skt. *ă* followed by one consonant only becomes *e*, as appears to be admitted by Dr. Sampson on p. 44 of his book. Therefore if *bār* is to be derived from *vaṭa*, a special explanation of the presence of *ā* (instead of *e*) is required: Dr. Sampson offers none, nor even indicates the need. He has already betrayed the principle of the constancy of sound laws. Actually this word is derived from a Middle Indian **vaṭṭa-* (cf. Pali *vaṭṭo*, 'round, rolling'), common in the N.W. languages, *e.g.* Panjabi *waṭṭā*, which Khowar *bŏrt* shows to be from earlier *varta-*.

I regret having seemed to ascribe to Dr. Sampson greater confidence in his etymology of *šukār* from *sukṛta-* than he expressed: by the words 'without hesitation' I intended to imply 'without directing attention to the phonetic irregularities involved in his etymology.' Nevertheless, he still stoutly upholds this etymology. But it behoves him, as a professed follower of the Junggrammatiker he sneers at, to explain why the word has *š* in all the dialects except the Greek (in which *ś* usually appears as *s*). He neither solves, nor even poses, the problem. The

retention of *-k-* he explains on the ground that it is an initial of the second member of a compound. That would be possible if the consciousness of its being a compound was retained up to the time when *-k-* ordinarily disappeared. But the support he gives for this contention is weak, and still further accuses him of deserting the principle of constancy. He derives *raker-*, 'to speak,' from *prakaroti* (which does not mean 'speak,' but 'accomplish'): yet the regular correspondence for Skt. *pr-* is Rom. *pr-* (Asiatic, Armenian, and perhaps English Rom. *p-*). He must therefore explain Engl. *r-*, Gk. *vr-* before he quotes this word in support, and this unfortunate lack not even Prof. Kuhn's "sehr glücklich" supplies. He derives *pariker-*, 'to thank,' from Skt. *pratikaroti*, but omits to explain why *a* appears instead of *e* in the first syllable. He derives *duriker-*, 'to foretell,' from Skt. *dūrīkaroti*, used by a scholiast on Pāṇini in the sense 'remove.' Obviously we have here not a descendant of Skt. *dūrīkaroti*, but a new Romani compound formed of two separate Romani words, *dur(i)* and *ker-*. Finally, he objects to my assumption that Skt. *-t-* would become *l*; and quotes *per-*, 'to fall,' from Skt. *patati*. *Per-* is not derived directly from Skt. *pátati*, but from Middle Indian **paṭati* (cf. Pkt. *paḍaï*), which has given rise to forms like Hindi *paṛnā*, while *pátati* is to be found in forms of the North-West, like Sindhi *pawaṇu*, Kashmiri *pyonu*.

In my review I quoted only one example of what I considered to be Dr. Sampson's neglect of the principle of the constancy of sound-laws, because in the space at my disposal I wished to deal with other and far more valuable aspects of his book. Nevertheless his pages abound in such examples. Lest I be accused of unfounded criticism, I select a few. *Niser-*, 'to go out,' said to be from Skt. *niṣkṛṣ-*, 'to drag out.' What has happened to the group *sk*, which becomes Middle Indian *kk*, and must remain in Romani as *k*? Skt. *niḥsarati*, 'he goes out,' provides a better etymology, which accords with Romani sound-laws. *Kam-*, 'to wish,' from *kāmayati*: yet *-m-* regularly becomes *v*; possibly from a form **kāmya-*, but probably borrowed from Persian *kām*, 'wish'; Pehlevi *kāmītan*, 'to wish.' *Kerav-*, 'to boil, from *kārayati*, 'to cause to do,' despite the fact that Skt. *ā* regularly remains Romani *a*. It is from a Middle Indian **kaṭhati* (cf. Pali *kaṭhito*, 'boiled'; Skt. *kvathati*, 'boils'). *Khino*, 'tired,' from Skt. *khinna-*, 'oppressed,' which would have given a Romani form with *χ-*: Miklosich's derivation from *kṣīṇá-*, 'worn out,' is correct, for *kṣ* becomes *kh*. *Gōrō*, 'non-gypsy,' from Skt. *guru-*, 'preceptor,' with irregular *ō* from *u*: why not (with regular phonetic change) from *gaura-*, 'light-complexioned' (cf. Hindī, *gorā*, 'European')? *Son*, continental *con*, 'moon,' from *candra-*, with irregular *o* from *a*, an unlikely development of the group *ndr* not otherwise attested: it is from Skt. *jyotsnā*, Pkt. *joṇhā*, which would regularly become Rom. *con*. *Thil-*, 'to hold,' is explained as derived from Rom. *ther-* (correctly attributed to Skt. *dharati*); but *-r-* does not become *l*, nor does *e* normally become *i*: on the contrary *-t-* does become *l*, and *ṛ* does become *i*, so that *thil-* looks like a formation from *dhṛtá-*, the past participle which has furnished Modern Indian with many present stems. *Dud*, 'light,' from *dyota-*: but *dy* becomes *j*, and *-t-* becomes *l*. *Cărō*, 'bowl,' from *caru-*: but *a* becomes *e*; why not from **caṭṭa-*, H. *cāṭā*, 'bowl for sugarcane-juice'?

This part of Dr. Sampson's work is deserving of animadversion not because he makes mistakes in etymologies—that is, alas, the fate of all etymologers—but because in making them he does not pause to pose or to explain the phonetic irregularities involved. I say again that he has not been true to the principle of the constancy of sound-laws, and (what I did not say before) that he has as a necessary consequence been driven into guess-work. He upbraids me for not mentioning that his book is the first to supply a full and systematic series of the phonetic equations of Romani: I have tried to show that it does not do so.

The second point on which Dr. Sampson takes me to task is that I have wrongly accused him of comparing Sanskrit loanwords in Hindi with Romani words, as if they had been inherited Hindi words. He now says that it is clear that the Hindi words are borrowed, and not inherited; and he quotes § 76 in support. In this paragraph, however, there is no mention of *tatsama* or loanword, but only of Hindi cognates. By that most comparative philologists will understand inherited words, not literary loanwords. Further, Dr. Sampson does not confine himself to quoting only loanwords in Hindi, but gives as many, if not more, inherited words. Thus in the passage whence I took the particular example (taken from Part I., p. 52, not from the vocabulary, "with judicious omissions," as Dr. Sampson suggests) we may read: "*t'an tχan*, 'place,' S. sthāna, P. ṭhāṇa, H. thān; *t'ulo*, 'fat,' S. sthūla, P. thulla, H. sthūl." Of these two Hindi words, one, *thān*, is inherited and strictly to be called cognate; the other, *sthūl*, is a loanword. Dr. Sampson says that he knows this (though he does not explain what value, if any, the quotation of the literary loanword has); but is he right to assume that all his readers also will know? What, finally, is his principle of selection? Why does he compare in consecutive lines *thŭd*, 'milk,' with H. *dūdh* (inherited word), but *thuv*, 'smoke,' with H. *dhūm, dhūmā* (loanword). If it be, as he says above, "to direct attention to the fact that an inherited word, which has survived in Romani, should have been lost and artificially restored in the Modern Indian vernaculars," he is wrong; for the inherited word exists not only in the Hindi *dhuwā̃*, but also in almost every other Modern Indo-Aryan language. There are, in fact, very few, if any, Romani words of Indo-Aryan origin which have not cognates in one or other of the living languages.

No one more regrets the necessity for this criticism of Dr. Sampson's work than myself: for as a description of a particular Romani dialect, and as a most useful collection of other material, it is pre-eminent, and puts all students of Indo-Aryan in general, and of Romani in particular, under a great debt of gratitude to the author. But if he thinks that I considered it "designed as a text-book on Modern Indian dialects," I say at once—*μὴ γένοιτο*.

R. L. TURNER.

Science and Psychical Research.

I BEG space for a short comment on Dr. Tillyard's remarks in NATURE of October 23, so far as they concern my letter which appeared in the issue of October 2. Dr. Tillyard misrepresented what I said when he wrote that I had given my own interpretation of the words "super-normal phenomena." These were his own words, chosen by me because I regarded them as better fitting this discussion than either "subjects of psychical research" or "spiritualism." For I am aware that although psychical research does certainly include the study of most, if not all, of the phenomena alleged by many to be referable to some 'spiritual' origin, there are many psychical researchers who do not accept this explanation of alleged communications between the living and the dead, but prefer to interpret such communications, and others

said to occur between living persons at a far distance from one another, by attributing them to an unknown power which was long ago named ' telepathy ' by one of the founders of the Society for Psychical Research.

Dr. Tillyard, in his review of the " History of Spiritualism " in NATURE of July 31, says that psychical research purports to be the scientific study of what are called " super-normal phenomena " ; and divides this study into two parts, calling the first ' physical,' the second ' mental.' In the mental part, however, are included practically all the various ' phenomena ' known generally under the term ' spiritualistic.' Seeing that the present discussion has been mainly concerned with these phenomena, I desired to make it quite clear that I was dealing only with that department of psychical research which was concerned with such phenomena as may be strictly called ' ghostly.'

Touching Dr. Tillyard's call upon me to explain what ' trance ' is, I reply that I do not know. But although he says he does not know the difference between trance and sleep he knows more than I do about this matter, for he states in NATURE of Aug. 28 that " Usually the medium is in deep trance and knows nothing of what is occurring." I have seen several ' occult ' cases in which strange phenomena have occurred during a period when the medium, often invisible but sometimes not so, has been stated to be in trance, and have heard first-hand accounts of many similar cases. But I have never known or heard of any independent examination being made to test the medium's alleged condition. The phenomena produced at séances with trance mediums play an important part in the exhibitions of ' super-normal phenomena,' the reports of which excite popular curiosity and pervade the journalism of to-day.

BRYAN DONKIN.

I CAN find in Sir Arthur Conan Doyle's letter in NATURE of October 16 no explanation or withdrawal of his grave but, as I have shown, entirely untrue accusation that a statement that I made about him in the issue for September 25 was a " pure invention " on my part.

A. A. CAMPBELL SWINTON.

40 Chester Square, S.W.1,
October 16.

MAY I add to—and I hope end—my correspondence with Mr. Campbell Swinton by saying that I regret that I used the term " pure invention " in alluding to one of his statements, since his conclusion was a natural one with the information which he then had at his disposal.

ARTHUR CONAN DOYLE.

October 21.

The Electrical Charges from Like Solids.

THE uncertainty as to the charges arising on insulating solids when rubbed together has ever provided perplexities for the investigator and pitfalls for the lecturer. I have shown in previous papers (*Proc. Phys. Soc.*, 1915, and *Proc. Roy. Soc.*, 1917 and 1926) that a clean solid, say glass, may have entirely different qualities according to the previous treatment of the surface. Ordinary dirt, adsorbed films, temperature change, and, in particular, strain left on the surface by the rough pressure of other solids, are variables which vitally influence surface electrification.

In the present brief note I want to direct attention to the charges found when two *like* solids are rubbed or struck together. Ebonite is very convenient for the purpose. Two rods of this substance are cut from the same sheet and mounted with sealing wax in glass tubes which serve as handles. The free ends of the ebonite are thoroughly but *lightly* scraped with a razor blade and then boiled for a few seconds in water. After drying and cooling, the ebonite surfaces are ready for use. They behave as follows :

(1) Placing the rods across one another, one (A) is rubbed down the other (B). We find A charged $-^{ve}$, $B+^{ve}$. Discharge the rods over, *not in*, a flame. Rub B down A. We find B charged $-^{ve}$, $A+^{ve}$. Thus the rods are identical in behaviour, the ' rubber ' in each case becoming $-^{ve}$, the ' rubbed ' $+^{ve}$.

When the surfaces behave alike, as above, we call them ' standard.'

There is a real distinction between ' rubber ' and ' rubbed,' a much smaller area of the former than of the latter taking part in the rub ; and of the two, the rubber attains at the rubbing point a higher temperature. Hence, the rubber is more likely to yield and be greatly strained under the tangential forces applied in friction.

(2) Continued rubbing brings about a change of effect ; the rubber, gradually losing its strong $-^{ve}$ quality, becomes first neutral and then more and more $+^{ve}$. When in the neutral condition, the rubber may be $-^{ve}$ or $+^{ve}$ according as the rub is light or heavy. Also at this stage it is sometimes possible to obtain one charge, say, $+^{ve}$, from a direct stroke, $-^{ve}$ from a reverse.

(3) By continuing the rubbing, the rubber becomes definitely $+^{ve}$ and remains so for the actual surface rubbed even after days of inaction. I propose to call the new state of surface, produced by rubbing, the ' strained ' state.

(4) The strain can be removed by boiling the rods in water for a few seconds or more, according to the amount of strain. If both rods are considerably strained, it is possible by boiling each in turn for short periods to make first one, then the other $-^{ve}$, until finally both are restored to the pristine standard state of no strain. It should be remarked that after boiling the rods are allowed to cool before rubbing.

(5) If the rods have been brought by rubbing to the intermediate state (see (2) above), suppose one rod, A, is slightly $+^{ve}$ to B. Then warming A makes it $-^{ve}$ to B. Next, warming B makes it $-^{ve}$ to A again. The rise in temperature of the surface need be only, say, 50°, and can be done by the heat from a carbon glow lamp.

(6) Sharp glancing blows of one rod on the other, whether the surfaces be standard or strained, give rise generally to contrary, *but unequal*, charges on the rods. The sum total charge is $-^{ve}$. If these impacts are oft repeated the sum total charge may be very great, and each rod may be $-^{ve}$.

In all these experiments the charges are considerable and can be easily observed with a sensitive gold-leaf electroscope.

The above behaviour of ebonite is found also with like specimens of caoutchouc, celluloid, shellac, resin, sealing wax, paraffin wax, charcoal, sulphur, glass, mica. I have found no exceptions to the rule, but that remarkable solid, caoutchouc, reveals its idiosyncrasies, in triboelectricity as in other well-known phenomena, thermal and elastic. In caoutchouc the rubber has a $+^{ve}$, not a $-^{ve}$, tendency due to rise in temperature.

Each material must be rendered standard as defined in (1) above, but the dual process of scraping and boiling, adopted with ebonite, is clearly not universally applicable.

From the above experiments three general principles, which I think are new, emerge :

(*a*) *Really identical surfaces charge one another according to a definite rule* (*Expt.* 1).

(*b*) *Friction between initially identical surfaces causes these to become strained, the strain being revealed by the nature of the charges arising, and by the fact that heating restores the surface* (*Expt.* 2, 3, 4, 5).

(*c*) *Rough impact between like bodies in general leaves them with unequal charges* (*Expt.* 6).

The earliest lessons inculcated in text-books on electricity are: first, that, to produce charges by rubbing, the two solids used must be different in nature; secondly, that the two charges are equal in amount and opposite in sign.

Both these principles, as we see, are erroneous, although the second one is true for the special case when the two solids are slowly rubbed, and not struck, together. In ebonite we find, after impact, a net $-^{ve}$ charge. The equal $+^{ve}$ charge has therefore escaped to the air.

There is food for reflection in these results. Since solids of like chemical, and even physical, nature can charge one another, we have hope of explaining all those baffling results so well known to all who have carefully experimented in contact electrification. For these results show that the physical state of a solid surface, being liable to great variation, is a factor of prime importance.

If small defilements, or strains, or temperature changes be imposed on the surface, they concentrate just where, on the actual superficies, their influence may fundamentally affect the surface characteristics. Some investigators in the past, finding erratic results, losing patience, have even dared to describe the effects as 'fortuitous.'

No sound information in this subject can be garnered unless the specimens used are carefully cleaned and otherwise prepared.

Two rods of any insulator, *e.g.* glass, ebonite, caoutchouc, cut from the same sheet, and merely wiped with a duster, are almost invariably different in surface qualities; on rubbing, one will charge $+^{ve}$, the other $-^{ve}$.

There is one interesting speculation deducible from the principles enunciated above. The old problem as to the genesis of electric sand storms and dust storms in Nature may find a solution from the two principles (*a*) and (*c*). For here we have like particles striking together and giving rise to a net charge on the particles and an opposite charge in the air.

This class of research is simple-seeming. But those who have spent time on the subject will allow that it is very baffling; those who have not done so, will at least remember that despite great efforts by physicists the subject has not yet passed the pioneer stage. The most important point in the technique is the production of a standard surface for the material used. Then if, in any experiment, effects become involved or difficult of interpretation, it is easy to reproduce the standard surface and begin again. This principle is emphasised in a recent paper by Mr. Jex and myself (*Proc. Roy. Soc.*, June 1926).

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Origin of Yolk in the Eggs of Scolopendra.

IN a previous paper (*Proc. Camb. Phil. Soc. Biol. Sci.*, October 1924) on the eggs of the centipede, *Lithobius forficatus*, one of us (V. N.) described two kinds of yolk, albuminous and fatty. The albuminous yolk is preceded by nucleolar extrusions of a remarkable type, and its origin seems to be associated with them, although no evidence could be adduced that they are *directly* transformed into the albuminous yolk. It was further shown that the juxta-nuclear Golgi apparatus fragments into small granules and small crescent-shaped Golgi elements. The former grow in size and give rise to the fatty yolk.

Miss S. D. King (*Scientific Proc. Roy. Dub. Soc.*, vol. 18) confirms the above account of the association of the albuminous yolk with the nucleolar extrusions, but in her opinion the albuminous yolk arises directly from the nucleolar extrusions. With regard to the Golgi apparatus, she admits that it fragments into small granules. Furthermore, she describes fatty yolk, but "the origin of this fatty yolk is doubtful, but it may possibly be connected with the Golgi apparatus, although no evidence in support of this theory has been discovered." In our opinion Miss S. D. King is doubtful about the origin of fatty yolk from the Golgi apparatus, because "both Mann-Kopsch and Da Fano material was studied, but the latter gave such favourable results that it was used *almost exclusively*" (italics ours). Now, it is well known that the Da Fano method fails to show fat in finished slides, while the Golgi apparatus is preserved. On the other hand, the Mann-Kopsch method preserves both Golgi apparatus and fat, and thus enables one to study the transformation of the former into the latter. Furthermore, Flemming-without-acetic, which Miss King has used, shows fat, but not the Golgi apparatus, at least in the egg of Lithobius.

In view of the above conflicting evidence, it was thought desirable to work out the origin of yolk in the eggs of the centipede, Scolopendra. Our observations on the eggs of this centipede strongly confirm the earlier observations of one of us on *Lithobius forficatus*. At the very beginning of the growth period of the egg of Scolopendra, the nucleolus buds off round bodies into the cytoplasm. This process lasts for some time, until at a particular stage it ceases and the nucleolar extrusions in the cytoplasm completely disappear. The extrusions do not fragment in the cytoplasm as they do in the case of *Lithobius forficatus*. After the disappearance of the extrusions there is a long pause; later, albuminous yolk puts in its appearance, and seems to arise *de novo* in the cytoplasm, as is the case in spiders (Von Bambeke, *Arch. de Biol.*, 1897, and Nath, NATURE, May 15, 1926), although the possibility remains that the material of the nucleolar extrusions which have disappeared may contribute towards the formation of the albuminous yolk. At this stage the egg has assumed a large size and the nucleus lies just below the egg membrane. The mitochondria are granular and form a ring all round the nucleus in the youngest egg, which, however, is thicker on one side. They increase in number and ultimately fill up the whole egg.

The behaviour of the Golgi apparatus is remarkable. In the youngest eggs it consists of a few juxta-nuclear rings and crescents. In Mann-Kopsch preparations the rings appear like vacuoles with a sharp chromophilic rim and a central chromophobic area (idiosome). The crescents also show a distinct idiosome material. The Golgi elements increase in numbers, so much so that the whole egg is full of them. The vacuole-like Golgi rings swell up and are directly transformed into the fatty yolk spheres which contain free unsaturated fat, as is shown by their blackening in Flemming-without-acetic, and their quick decolorisation in turpentine, both after Mann-Kopsch and F. W. A. When the fatty yolk spheres are blackened by osmic acid they appear solid, but when they are being decolorised in turpentine they appear like vacuoles with a black rim and clear contents exactly like the Golgi rings. Gradually the black rim also becomes colourless and the sphere remains as a clear white vacuole. An exactly similar process takes place in the eggs of spiders also. Furthermore, we find that the fatty yolk spheres are never smaller than the Golgi rings,

as should be the case if they were to arise *de novo*. Again, they appear only after the Golgi rings have increased both in numbers and size.

Lastly, we wish to emphasise the fact that in all eggs in which the Golgi apparatus is said to give rise to yolk (for reference see NATURE, May 15, 1926), such yolk is *always* fatty. This in itself is confirmatory of the above view, because the Golgi material is supposed to be a lipoid combined with a proteid.

A full account will be published later.

VISHWA NATH.
(Bhupindra Research Laboratory, Patiala.)
TASDIQUE HUSAIN.
(Government College, Lahore.)

Central Research Institute,
Kasauli (India),
September 9.

Kammerer's Alytes.

MAY I be permitted to reply briefly to Dr. Noble's letter on Kammerer's Alytes which appeared in NATURE of October 9? There are several questions involved: first, whether Dr. Noble was right in his statement to the British Association in 1925, that Kammerer's specimen did not show a genuine nuptial pad, because the characteristic glands were absent, and that the glands, not the spines, were diagnostic of these pads.

Champy, in his paper on the subject, states that the nuptial glands are merely the normal skin glands enlarged, and this is confirmed by Dr. Przibram's letter to NATURE of August 7.

Secondly, Dr. Noble makes the statement that the glands in Kammerer's controls shown in America were the same size as those in the sections of the pad.

This statement I can readily accept. I have photographs before me as I write both of Kammerer's earlier sections, sent to Bateson in 1919, and of his later ones exhibited in Cambridge in 1923. In the former the cornification of the epidermis is not so strongly developed as in the latter, and the disparity in size between the glands in the sections through pad and control is slight. In the latter, as stated, the glands in the pad are double the size of those in the control and the cornification is very strong. Kammerer obtained many of the modified males and reared them through several generations, and the acquired peculiarities became intensified in later generations.

As to the date at which the Alytes specimen was 'faked,' there are two passages in Dr. Noble's description which completely give his case away. His letter suggests that Dr. Kammerer perpetrated a wicked fraud on the scientific world. Dr. Noble could find no spines on the specimen in Vienna, and saw blackened patches on *both* hands: I saw spines and have a photograph of them, and on one of the hands I saw no blackened patch whatever.

Dr. Noble's reference to the large-eyed Proteus shows that he fails to grasp its bearing on the question. I consider it the most wonderful object ever exhibited to a scientific audience. The larval Proteus does not, as Dr. Noble suggests, possess an eye: it has, like other blind cave-animals, only the embryonic rudiment of one. If Dr. Noble can find other 'casual' examples of blind cave-animals developing large eyes, I shall be glad to hear of them.

Both the Alytes and the Proteus specimens are examples of the same phenomenon—a phenomenon termed by Prof. Semon 'ecphory'; that is, the revival of ancestral features by the reinstating of the ancestral environment. This process required for its completion five or six generations in Alytes and in Proteus only one, but it is essentially the same thing in both; and to try to represent the skilled experimenter who produced the Proteus as a clumsy trickster seems to me to be both unjust and unworthy.

I do not propose to discuss the merits of the inheritance of acquired characters in the present issue, but as Dr. Noble seems unconscious of the rising tide of Lamarckism, let me point out that Kammerer's conclusions are being confirmed by workers dealing with quite different animals, the last and most spectacular of these confirmations being the paper on the inheritance of habit by rats, read at the Oxford meeting of the British Association by Prof. William McDougall.

If Dr. Noble will forgive me for lapsing into his own expressive American, let me gently entreat him "to get on the band-waggon." Habit as the chief factor in evolution and the inheritability of acquired habits are accepted by leading systematists, palæontologists, and embryologists. Every year adds to the recruits, and I hope that Dr. Noble will join them. If he does, I am sure that he will "get the bulge" on many of his countrymen.

E. W. MACBRIDE.

Royal College of Science,
South Kensington, S.W.7.

The Anomalous Flocculation of Clay.

SOME further experiments have been performed in these laboratories which clear up the discrepancies between the experiments described in a previous letter on the above subject (NATURE, May 1, p. 624) and those of Messrs. Kermack and Williamson (NATURE, June 12, p. 824).

The following table gives the times required to flocculate a 0·1 per cent. purified clay suspension at various concentrations of sodium and calcium chlorides and hydroxides:

Concn. $Ca^{"}$ ion.	Time required for flocculation.		
	$Ca(OH)_2$.	$CaCl_2$.	Two equivalents of chlorides to one of hydroxide.
0·001	7 hours	14 min.	6 hours
0·002	28 min.	10 ,,	32 min.
0·003	2 ,,	7 ,,	12 ,,
0·004	1·5 ,,	6 ,,	4·5 ,,
0·005	1·5 ,,	6 ,,	3·5 ,,
0·010	1·5 ,,	6 ,,	1·5 ,,
0·014	1·5 ,,	6 ,,	1·5 ,,
Concn. Na ion.	NaOH.	NaCl.	NaCl : NaOH = 2 : 1.
0·05	2 hours	13 min.	2 hours
0·1	32 min.	13 ,,	32 min.
0·2	22 ,,	14 ,,	24 ,,
0·5	20 ,,	17 ,,	17 ,,
0·9	15 ,,	18 ,,	14 ,,

These results show that calcium hydroxide is a less powerful coagulant than calcium chloride, and actually tends to stabilise a suspension containing the latter salt, provided that the time of flocculation is longer than about twelve minutes.

If the concentration is such that coagulation takes place in 6 minutes or less, then calcium hydroxide flocculates more rapidly than the chloride at equivalent concentrations.

The results for sodium, on the other hand, suggest that even this latter effect should not be called anomalous, as at a concentration 0·9 normal, sodium

hydroxide was definitely a better flocculant than sodium chloride, while with the chloride-hydroxide mixture, this effect started at a concentration of 0·5 normal.

A preliminary experiment with a 0·1 per cent. suspension of highly purified amorphous silica gave the following results :

	Concentration required to flocculate in 1 hour.	
	Sodium.	Calcium.
Chloride .	No flocculation in 10 hr. in 1 *N* solution	No flocculation in 10 hr. in 1 *N* solution
Hydroxide .	0·13 *N*.	0·0015 *N*.

Thus both sodium and calcium hydroxides were far better flocculants than the corresponding chlorides. The writer suggests that if the term 'anomalous' must be used, it should be applied to the coagulation of silica by electrolytes rather than to the coagulating powers of calcium and sodium salts.

H. B. OAKLEY.

Wellcome Tropical Research Laboratories,
Khartoum, September 20.

The Anomalous Dilatation of Invar.

IN *Arkiv f. Mat., Astron. o. Fysik*, vol. 19 B (1925), Messrs. C. Benedicks and P. Sederholm gave a short account of dilatation measurements of invar in which they claim to have found a new property of this well-known material. Raising the temperature of an invar wire quickly by 50°, they find the coefficient of expansion has sensibly the normal value, *i.e.* 13×10^{-6}, at the first moment of heating. After 3 minutes a contraction sets in, a steady state being reached after 12 minutes.

In order to repeat their experiment, I cut a strip $120 \times 1{\cdot}5 \times 1$ mm. from an old piece of invar forged out to 1 mm. thickness, and drew this into a wire of diameter 0·5 mm., 60 cm. long. This was clamped at one end, stretched with a force of 1 kgm. or less by a spiral spring at the other end, and heated to 50° C. by passing a current through it. A micrometer microscope focussed on a scratch near the free end enabled changes of length to be measured to within 1μ.

No trace of the new effect was found. The wire took its final length in any case 10 sec. after starting the current, as well as after cutting it off. The cold drawn wire contracted 10μ on heating ; after annealing at a red heat it expanded 6μ (coefficients approximately $-0{\cdot}5 \times 10^{-6}$ resp. $+0{\cdot}3 \times 10^{-6}$), which shows that the wire was indeed the best quality of invar.

The above-mentioned authors detected by metallographic methods the existence of a second phase in invar, and then looked for an effect of a possible heterogeneous transformation on the thermal expansion. May I suggest that such an effect was found long ago by the exhaustive researches of M. Guillaume, in the form of a small thermal hysteresis which lasts for half an hour at 100° and a few days at 40° ? These times would seem more probable for a transformation in the solid state than 12 min. at room temperature.

As Mr. Benedicks used a wire only 8 cm. long, it may well be that a lag of some kind in his measuring arrangement—about which he gave no details—is responsible for his result.

F. ZERNIKE.

Physical Laboratory,
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Groningen.

Biological Research in the Tropics.

DURING the months July to September this year I was enabled to do some research work on protozoan parasites at the Imperial College of Tropical Agriculture in Trinidad, B.W.I., thanks to the generosity of the governing body in granting me free facilities there.

As I feel that the possibilities of the College as a centre for tropical research are not sufficiently known to biological workers at home, I venture to direct attention to the fact that for research workers in almost any branch of tropical biology, there is no more convenient place for headquarters than the College. Though, of course, its teaching activities deal more exclusively with agriculture, the governing body and the Principal, Dr. Leake, were most generous in allowing me facilities for prosecuting my research, which was not connected directly with agriculture.

At the present time the only tropical research laboratory easily accessible to British workers is the one at Kartabo, British Guiana, run by Mr. Beebe under the auspices of the New York Zoological Society. Trinidad has the advantage of involving a shorter journey, and the biological worker will find large laboratories, which will soon be very well equipped, thanks to the new government grant. But, of course, the main point of importance to the biologist in the tropics would be the abundance of tropical forms, and here Trinidad compares favourably with other West Indian islands, as it is the most tropical of them all, and the flora and fauna are more South American than West Indian in affinities. There are large tracts of primitive forest which are under government control and form wonderful collecting grounds.

To a worker who can spend only a short time in the tropics, the presence of an expert staff such as that at the Imperial College of Tropical Agriculture can be invaluable, especially when backed by the valuable entomological, etc., collections which the College possesses. The College works in happy unison also with the Department of Agriculture, where again one found the most able and ready assistance on the part of the local experts, including my friend Mr. Urich, who possesses an unrivalled knowledge of the island fauna.

On these grounds, and on others which are too numerous to enumerate here, I wish strongly to urge that biologists who desire to do tropical research could not do better than obtain permission to work at this College, permission which, I have no doubt, will be granted in all suitable cases. J. S. DUNKERLY.

The University, Manchester.

Magnetic Storms and Wireless Communication.

IT was reported a few days ago that communication with Canada, by the new beam system of rays of short wave-length, had been completely blocked by a magnetic storm. Why should this be ? The fluctuations of magnetic force are but slight, and one might expect the rays to arrive by an altered path. May we assign a deeper and more fundamental cause ? That the magnetic storm is itself due to an incursion of free electrons into the upper atmosphere, in such numbers as to upset all the ray-paths and twist them out of regularity. The number of foreign electrons need not be very great. The only alternative seems to be oscillation of the magnetic field, so rapid as to be comparable with the time of transit of the ray : which is very unlikely.

JOSEPH LARMOR.

Cambridge, October 26.

Aspects of Physical and Mental Inheritance.[1]

By Prof. R. RUGGLES GATES.

ONE of the most striking facts in modern biology is the discovery that hereditary differences commonly behave as independent fixed units, handed on generation after generation according to various characteristic but simple laws. The differences so transmitted may be large or they may be very minute, but they in some way maintain their identity throughout the welter of events which constitute the passage from one generation of adults to another: that is, the maturation of the germ cells and the development of the individual. Clearly a physical difference maintained in successive generations among individuals developing in the same environment must be due to an initial difference in the germinal material. Such differences are, moreover, as a rule equally inherited through either the egg or the sperm in crosses. The only structural materials in the germ cells of higher organisms which fulfil these requirements for transmission are the chromosomes.

These minute bodies in the nucleus evidently constitute the essential nexus between generations, in so far as the widespread Mendelian differences are concerned, but in plants certain characters may be controlled by plastids in the cytoplasm. It has furthermore been proved in certain plants and animals that visible differences in the chromosomes are accompanied by external differences in the resulting organism. Just as the cell theory of organic structure long ago emerged into fact, so the chromsome theory of inheritance has become a fact. This does not mean, however, that the chromosomes alone are concerned in inheritance.

An abundance of evidence from many sources leads to the view that the chromosome is a complicated structure composed of smaller units. The theory that these units or genes are arranged in linear fashion in the chromosomes, has been connected chiefly with the name of Morgan, because of his extensive studies of heredity and mutation in the fruit-fly, Drosophila; but its origin is really much older. While this theory of linear arrangement is not yet established, it may be said that no other reasonable theory has yet been put forward to explain the phenomena of crossing-over which have been so extensively investigated in this fly, and to a lesser extent in various other organisms.

We have, then, a picture of the chromosomes as containing large numbers of differentiated areas or groups of particles which, while in the uncompacted state, activate and control or determine the growth and differentiation of the cytoplasm and hence the development of the individual. Such conceptions are necessary to explain the unitary behaviour in inheritance of innumerable characteristics in man as well as in other organisms.

While, however, the units must be abstracted and considered separately for purposes of investigation, yet they form the elements of an extraordinarily complicated system and they cannot exist apart from it. Eyes may be blue or brown, and the difference is inherited as a unit, but the blue eye can only develop as a part of the whole system to which it belongs.[2] Here I am in fundamental agreement with the views expressed by Dr. Myers. Just as the developed character cannot exist apart from the organism to which it belongs —you cannot separate the serration from a leaf margin or the shape of the nose from that organ—so in the germplasm the various structural elements making up the configuration, though each produces its own effect through chemical action or structural arrangement, are interdependent in the system to which they belong. Mendelian inheritance consists in the substitution of one such unit for another which occupies the corresponding position in the architecture of the germplasm.

The phenomena of heredity are made possible by these structural arrangements within the organism, the body being composed of cells each with its nucleus, that nucleus containing two sets of chromosomes of corresponding structure, one derived from each parent. Thus are we woven out of the warp and woof derived by mitotic division from two parental sex cells, making a garment infinitely finer in texture and more intimately blended in its structural elements than any fabric. Yet the fact remains that these elements maintain their identity and usually segregate out again sharply when new germ cells are formed.

The orderliness of development in its minutest details, the interrelations and interfunctionings of the chemical and structural elements as they arise, impress every biologist deeply with their regularity and stability. The phenomena of individual development are thus as remarkable in some respects as those of evolution itself. In heredity all these potentialities of the organism must pass over the very narrow bridge of the two germ cells, one of which contributes little more than a nucleus. How this miracle of orderly development is accomplished we can only dimly picture in detail. But the ubiquitous facts of heredity continually emphasise the amazing orderliness of development.

It is sometimes stated that the clear-cut segregation which is so characteristic of Mendelian heredity applies only to abnormalities, and that normal racial and specific differences do not follow such laws. The fact that related species often differ visibly in their chromosome equipment certainly leads to many departures which may more or less completely obscure Mendelian phenomena in crossing. De Vries formerly took up the position that species and varieties differ in their behaviour on crossing. But there is nothing in the more recent work to show that such differences as exist are really fundamental in our present point of view, although they are certainly important. Variety differences are often single sharp units, while specific differences are more apt to represent accumulations of many, often multiple, differences, or chromosome differences which have come about in other ways than by simple Mendelian mutations. Interspecific sterility,

[1] Contribution to a joint discussion on "Heredity in its Physical and Mental Aspects," before Sections D (Zoology), H (Anthropology), and J (Psychology) of the British Association at Oxford on August 9.

[2] That this does not necessarily include the whole organism is shown by the recent tissue culture work of Strangeways and Fell, in which eye rudiments excised from embryo chicks continued their development.

however, all too frequently prevents crosses being made from which evidence of the nature of the differences could be obtained. There is some evidence, however, both in animals and plants, that in related species the germplasm is similarly constituted.

In the case of man, there is no evidence that the process of inheritance of racial characters differs in any important respect from that of abnormalities. In eye colour—a typical racial character—blue and brown have long been regarded as a Mendelian pair, and while different degrees of brown exist, there is evidence that each segregates sharply from blue. In my book "Heredity and Eugenics" the inheritance of a large number of abnormalities was considered, each following its own Mendelian law.

More recently I have considered the inheritance of racial differences[3] in man. Here multiple factors appear often to be characteristic, as in skin colour and stature. But everything indicates that inheritance of stature and cephalic index follows the same rules as the inheritance of size and shape in other organisms. Present knowledge indicates that the size factors in man differ in no important respect from those of rabbits or even of plants. Moreover, there is every indication that in interracial crosses, where stature and cephalic index are usually regarded as racial diagnostic features, the laws of inheritance of these differences are exactly the same as within a single human family. The more recent investigations indicate that far too much importance has been attached to cephalic index as a racial character, and the same is true to a lesser extent of stature. But it will be some time before a satisfactory analysis of head shape in terms of size and shape factors can be attempted.

Turning now for a moment to mental inheritance, I do not propose to discuss any of the philosophical views of the relations between mind and body, although I am inclined to adopt some such interpretation as that of Lloyd Morgan, namely, that the life of the organism can equally be viewed as a system of physiological or of mental events, without solving or attempting to solve the problem of their interrelations the one to the other. But from the biological point of view, as Prof. Dendy wrote, "It is only in so far as they are related to the brain [I should prefer to say the nervous system] that the discussion of the inheritance of mental characters can have any meaning." The analogy which is sometimes drawn between heredity and memory is really an attempt to explain the less obscure by comparison with the more obscure, or from the point of view just expressed it represents a jump from the physiological to the mental interpretation instead of adhering consistently to one or the other.

In one sense mental and physical inheritance are on exactly the same basis, for in both cases inheritance can only be determined by comparing parents with offspring or the latter with each other, and noting similarities and differences. Such comparisons lead to the clearest evidence of mental inheritance. But it should be recognised that observation of the fact of inheritance is one thing and explanation of how it comes about is quite another. Owing to the difficulty of defining and determining mental characters, progress in the study of mental inheritance has been retarded. Probably few psychologists would now deny the fact of mental inheritance, but biologists must look to them for an analysis of the mind which will enable us to determine what are the units which are really being inherited. Psychologists themselves are only beginning to consider these questions. McDougall's work has been most useful in the preliminary analysis of mental differences from a biological point of view.

When Galton began his studies of mental inheritance the faculty psychology was current, and he naturally made use of its conceptions. But now that the conception of the mind as made up of faculties has become obsolete and various other methods of analysis have taken its place, we still need an analysis of the mind which will be more biological in its characterisation. McDougall writes of the "structure of the mind," but scarcely in the sense in which a biologist would hope to see the term used.

There appear to be two possible lines of approach to a biological analysis of the mind from an hereditary point of view: (1) By the study of mental evolution; (2) by comparison of the mentality of related individuals. As regards mental evolution, the study of animal behaviour shows that increasing complexity of the nervous system is paralleled by increasing mental complexity or powers of reaction. This is clear to any one who compares, for example, a Paramœcium, a starfish, and an ape. Elliot Smith has pointed out in some detail how the mental evolution of man himself has taken place through increasing complication in the structure of the fore-brain. The mind has become an instrument for the recognition, confluence and co-ordination of relationships.

That many mental differences are the result of germinal variations arising in the nervous system is indicated by such extreme cases as (*a*) tumbler pigeons, (*b*) a race of goats which becomes partially paralysed when frightened,[4] and (*c*) in man, feeble-mindedness. It is questionable in how far any other source of mental variations is required to explain mental evolution. The cases cited are semi-pathological, but the smaller, normal differences which have been less studied are likely to show similar origin and hereditary behaviour.

There are no doubt many ways in which the human mind can be analysed and its elements classified; but I believe it will be found with mental, as with physical, inheritance that the only way to determine what are the inherited units is by comparing the mentality of parents with that of their children and relatives. The difficulties of such comparison are of course increased by the facts of proximity and imitation. But the *differences* which appear will often be more significant than the similarities. We have already seen that studies of physical heredity require that the organisms should develop in a similar environment. Obviously the same is true of mental inheritance; but as individuals develop they choose their own mental environment according to their inherited

[3] "Mendelian Heredity and Racial Differences," *Journ. Roy. Anthrop. Inst.*, **55**, 468-482, 1926.

[4] It appears not improbable that the 'death-feigning' instinct of certain insects and other animals has arisen in a similar way through germinal variations in the nervous system.

tastes and aptitudes. In the biographies of great men it often appears that escape from their early environment was their only means of finding self-expression for their inherited mental qualities.

From the point of view I am expressing, mental inheritance is just as real as physical inheritance, and a suitable mental environment is just as necessary for the development of mental characters as a suitable physical environment is for the development of physical characters. Further, the mental environment is extremely complex and intimate in the way it impinges upon the developing individual. One of the remarkable things about organisms, however, is the stability they often show under altered conditions of development, and this appears to be as true of mental as of physical characters. Mental tests apparently show that inherent intelligence, for example, does not develop or grow with the growth of the individual.

Another method by which mental inheritance has been studied is by the comparison of the mentality of identical twins. Galton, the pioneer in this field, cites many remarkable cases of such similarity, in some of which the twins were separated. More recently, many cases have been studied in some of which the separation took place at an early age, making it possible to study the effects of differences in upbringing upon the mental development and the innate abilities. While the mental environment is by no means negligible, and is often profound in its effects on the early development of the mentality, yet it seems clear that innate, *i.e.* inherited, differences persist, which are little if at all affected by the circumstances of life.

There is another matter which, I believe, adds greatly to the complexity of human behaviour. In 1923 I first suggested that when the individual is germinally heterozygous for a pair of contrasted character traits, they may both come into expression in his activities at different times. Indeed, this appears more likely than that there should be complete dominance of a mental character over its allelomorph. I am now looking upon traits of character as different methods of reacting in given circumstances. Since every one is doubtless heterozygous for many such character differences, this would help to account for some of the complexities as well as inconsistencies in human behaviour. Cases of multiple personality are possibly to be explained as more extreme examples of the same kind.

Finally, I should like to reiterate that what is most required now in the study of mental inheritance is an analysis of the mind by psychologists from an inheritance point of view. Psychologists have been so engrossed with the mind as such in its manifold activities that they appear to have neglected the kind of comparative psychology of individuals which is necessary for this purpose.

The Relation between Velocity of Wind and Wave.

By Dr. VAUGHAN CORNISH.

MANY years ago an investigation was begun by me to determine the relative velocity of wind and wave in deep water when the former has operated for a sufficient time to produce a constant condition, and with sufficient sea-room. The results are given in the *Quarterly Journal of the Royal Meteorological Society* for April last, and, at the invitation of the Editor of NATURE, some of the points of interest are brought together in this article.

The relation between velocity and period of deep-sea waves given by the ordinary formula for waves of infinitesimal height, namely, velocity in statute miles per hour = period in seconds multiplied by 3·493 agrees with that observed for ocean waves of conspicuous dimensions [1] sufficiently for the discussion of phenomena so numerous and irregular.

By timing the rise and fall of spots of spent foam upon the water, it is possible to determine from on board ship the period of both the wind-waves and of swell running at the time, whether crossing or concurrent. Employing this method I have never recorded waves with a speed greater than that of the wind, as has been done by other observers, an anomalous result which I attribute to mistaking a heavy swell for the wave when they are concurrent. Observations on a river at turn of tide, when the foam-spots were carried by the current first down-wind and then up-wind, have shown that their wind-drift is small relatively to the other magnitudes concerned.[2]

In the course of a voyage between Trinidad and Ushant, in very deep water all the time and free from considerable currents on every day but one, the speed of the waves was compared with the average speed maintained by the wind *for one hour or more*, as recorded by a Robinson anemometer fully exposed upon the bridge. When there was no crossing swell to interfere with the development of the waves, their speed was only 1·85 statute miles per hour less than that of wind, which had a sustained average velocity of 20 miles per hour. Thus there was blowing over the wave-crests only a 'light air,' the 'force 1' of Beaufort's scale, sufficient to drift the smoke issuing from a chimney but not strong enough to give direction to a wind-vane.

When hove-to in the Bay of Biscay in the storm of December 21, 1911, I determined the speed of the waves as 47·15 miles per hour, when the velocity of the wind, according to the logged Beaufort number, was 52·5 m.p.h. During the exceptionally stormy winter of 1898–99, when I was living within sight of the beach of Bournemouth Bay, the greatest period of a long-sustained series of breakers was 19 seconds, corresponding to a speed in deep water of 66·4 m.p.h. This was recorded on the afternoon of December 29. Gales in the North Atlantic from December 25 to December 29 were logged at 11 and 12 of Beaufort's scale, which correspond to wind velocity of 68 and greater than 75 miles per hour respectively. The greatest wind velocity on land during this winter, as recorded by instruments, was 70-76 miles per hour sustained for one hour.

The breakers above referred to, which were 139 in number and occupied three-quarters of an hour in arrival, were preceded in the morning by five groups

[1] See the author in *Jour. Roy. Soc. Arts*, Nov. 1, 1912, "Ocean Waves," and the *Field*, Feb. 13 and 27, 1915, "The Measurement of Waves at Sea."

[2] See papers by the author, British Association Report, Section A, Birmingham meeting, 1913, "On a Simple Method of Determining the Period of Waves at Sea," and *Q. J. Roy. Met. Soc.*, Apr. 1926, "Observations of Wind, Wave and Swell on the North Atlantic Ocean."

of a few breakers with longer period, corresponding to a deep-water speed of 69·5 m.p.h. The interval between the beginning of the first and the end of the last was 52 minutes, which strongly suggests that they were waves from the squall-struck portions of the stormy sea which outran their neighbours. The time occupied in arrival by the individual groups was from 1 to 2 minutes, which is normal for the duration of a short squall. The figures so far given suggest that the maximum speed of waves is somewhere about $\frac{8}{10}$ths that of the wind as maintained for one hour, and that a squall lasting for a minute or two can speed-up waves which have already been developed. Once when the waves were flattening down in a dying storm in the North Atlantic, I actually saw a travelling squall increase by some feet the height of the few waves subject to its force.

The observations during the fine-weather voyage on which an anemometer was used provide important evidence of the effect of crossing swell in hampering the development of waves by wind. The restriction of height was palpable to the eye. The restriction of speed was measured. With no swell, or with a concurrent swell, as in the Trades, the speed of the wave was only 1·85 m.p.h. less than that of the wind, but with a swell following obliquely the difference was 3·725 m.p.h., and when crossing at right angles or meeting the waves, 7·2 miles per hour.

A result of practical importance to seamen and meteorologists emerged from the observations on days of crossing swell. When this was oblique to the waves the curl, or break, on the water was considerably deflected and therefore ceased to be a trustworthy indication of the direction of the wind.

The following explanation is suggested of the effect of swell to hinder the wave-making action of wind. When there is no swell and the waves have attained considerable steepness a series of travelling eddies is established in the adjacent air with permanent undulations above, and this arrangement nurses the waves. If, however, a swell be also running, the pattern of the inequalities changes all the time, continually deforming the superimposed air, and making its action irregular. If the swell meet the waves, the pattern undergoes rapid change, and the rhythmic action of the wind is greatly hindered; if it follow the waves their pattern changes slowly and the rhythmic action of the wind is less impaired. When the swell cuts squarely across the waves the surface is patterned in cups and cupolas instead of ridges and furrows, which tends to set up air-whirls with vertical instead of horizontal axis, a condition which imposes an additional hindrance to wave-making.

The extent to which swell kept down the waves when crossing obliquely or squarely suggests that the rapid rise of waves on large lakes is not solely due to peculiarities of local winds but is aided by the fact that no residual swell hampers the action of the wind, as usually happens when it comes on to blow at sea. There is one condition at sea, however, when the development of waves is more rapid than in lakes, namely, when it comes on to blow in the direction of the swell already running and with a speed greater than that of the swell. This was the condition which so quickly created the huge regular waves of December 21, 1911, in the Bay of Biscay.

OBSERVATIONS BETWEEN TRINIDAD AND USHANT.

(Speed of wind as maintained for about one hour measured by Robinson anemometer.)

DIFFERENCES OF SPEED BETWEEN WIND AND WAVE, GROUPED ACCORDING TO DIRECTION OF SWELL.

Direction of swell.	Character of swell.	Date of observation (1914).	Amount by which speed of wind exceeded that of wave.	Average difference of speed in statute miles per hour.
Concurrent with waves	High, quick period, slow progression	Feb. 18	1·2	1·85
		„ 19	2·5	
	Quick period, slow progression	„ 20	3·9	3·725
		„ 21	3·3	
Following the waves obliquely	Slow period, quick progression	„ 28 (P.M.)	3·3	
		Mar. 1	4·4	
One concurrent, one at right angles	That at right angles very slight	Feb. 23	3·1	3·1
One following obliquely, one at right angles	That at right angles very slight	„ 22	6·3	6·3
Swell at right angles, or meeting obliquely	High, with slow period and swift progression	„ 26	6·0	7·2
		„ 27	7·7	
		„ 28 (A.M.)	7·9	

Mars in 1926.

By Dr. W. H. STEAVENSON.

THE present apparition of Mars is, for observers in the northern hemisphere, the most favourable that has occurred for many years. The planet, which was at opposition on November 4, made its closest approach to the earth on October 27, on which date its distance was approximately 42,600,000 miles and its apparent diameter 20″·4. On August 22, 1924, the distance was 8,000,000 miles less and the apparent diameter so great as 25″·1 (practically the maximum possible), but on this date the planet, at its greatest altitude, was not more than 21° above the horizon of London; whereas, on October 27, 1926, it crossed the meridian at an altitude of 53°. This increase of 32° was more than sufficient to make up for the shrinkage in apparent diameter, with the result that observers in Great Britain have, in general, been able to obtain more satisfactory views than at the closer approach of two years ago. Not until 1941 will there occur an equally favourable combination of altitude and apparent diameter.

In 1926, as in 1924, it is the southern hemisphere of Mars that is presented most favourably for observation, and this always happens at close oppositions of the planet. The Martian season at the time of opposition was not, however, quite the same on each occasion. In 1924 the planet was most favourably placed for observation during the early summer of its southern hemisphere, whereas in 1926 the summer solstice of this hemisphere occurred more than two months before opposition, so that we have a satisfactory seasonal overlap in the observations made in the two years.

The results of this overlap have been very evident

this year in the reduced size of the South Polar cap at the date of opposition, and also in the more advanced development of the usual seasonal changes in the dark markings. These changes, both of colour and intensity, are now firmly established facts, and can be predicted with considerable accuracy. But almost more interesting are those less regular changes of form and intensity which have not yet been found to conform to any definite law. They thus provide an element of variety in our observations of the planet, and, as they are often on quite a large scale, afford opportunities of useful and interesting work to the possessors of moderate-sized telescopes.

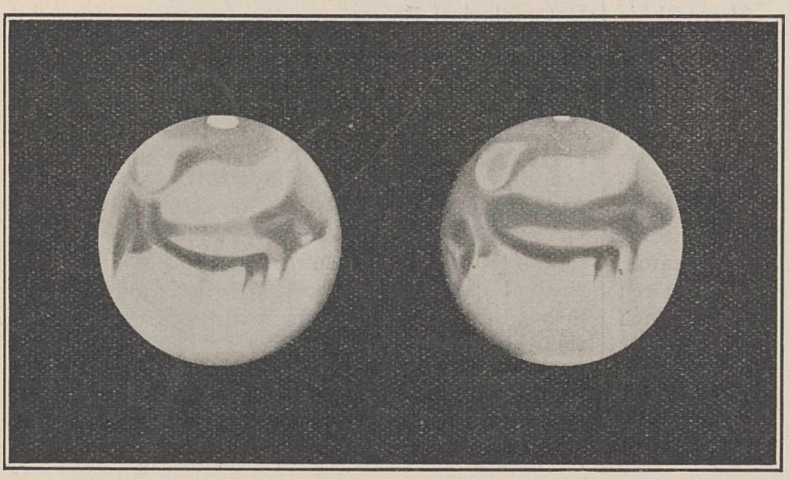

FIG. 1.—Aspects of Mars, September 1924 and October 1926, showing changes in the characters of *Sinus Sabaeus* and *Pandorae Fretum*.

Several changes of this kind have actually occurred since 1924, and some of them have been sufficiently extensive to be visible with quite small instruments. Figs. 1 and 2 show two of the more conspicuous alterations that have so far been noted. Just below the centre of the disc in the two views forming Fig. 1 is a dark belt-like marking. This, the *Sinus Sabaeus*, is nearly always a conspicuous feature; but above it, and separated from it by a lighter strip, is another dark streak, known as *Pandorae Fretum*, which is subject to marked changes from time to time. It will be observed that, whereas in 1924 it was faint and tapered towards the left, it was in 1926 much darker and approximately of the same breadth throughout. So far as the increase in intensity is concerned, the change is partly of a seasonal character, though the darkening took place earlier in 1926 than in 1924. But in the latter year the marking never attained quite the same breadth, so that to this extent the change is anomalous. More striking still has been the change observed in *Solis Lacus*, shown in Fig. 2. This marking, which lies in a region often referred to as the "Eye of Mars," will be readily recognised on both sketches just above the centre of the disc. Irregular changes in the size and outline of the *Lacus* have occurred several times during the past century, but for some years now it has generally appeared roughly pear-shaped, with a thick 'stalk' connecting it with the dark areas on the left. It was of this shape in 1924, as indicated by the first sketch, but since then a complete transformation of its outline has taken place. This, as will be seen, has been brought about by a wide extension of the free end of the 'pear' in a northerly direction, and this extension is much deeper in tone than was any part of the marking in 1924. Further, minor changes in the neighbouring regions will also be noted.

A satisfactory explanation of such gross changes as these, affecting thousands of square miles of the planet's surface, cannot at present be advanced; but if we assume, as now seems reasonable, that the dark areas of Mars represent tracts of vegetation, it appears possible that the irregular effects observed are due to seasonal abnormalities, such, for example, as the occurrence of unusually wet or dry summers.

There is need, however, for more study before we can reach confident conclusions upon the matter. Fortunately, the observations necessary are not of great delicacy, being in fact well within the range of the instruments commonly at the disposal of amateurs. In the writer's opinion, much valuable time and trouble has been wasted in the past in attempts to observe and delineate the more minute details of the surface of Mars. Such fine detail can at the best be only imperfectly seen in common instruments, and there is room for much difference of opinion as to its precise nature. On the other hand, the extensive modifications of outline and intensity already described are quite beyond all question, and present to us a most interesting problem to which there is good hope of an ultimate solution. Observations made on these lines will increase in value with the lapse of time, and will for many years to come provide profitable work for much smaller instruments than were at one time thought necessary for a successful study of the planet.

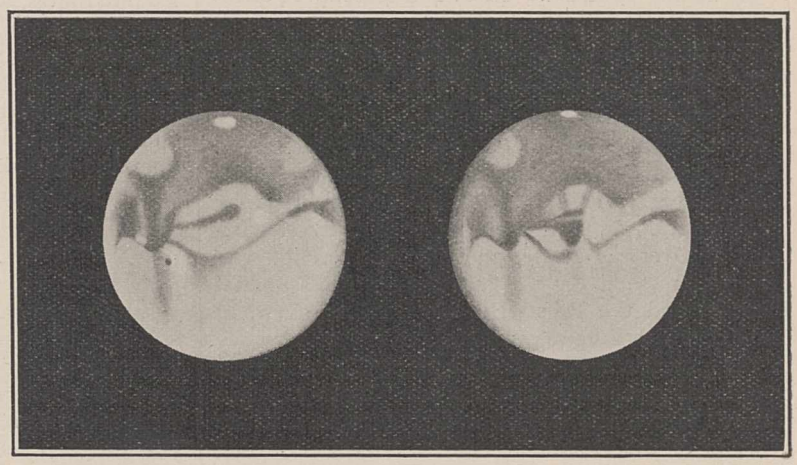

FIG. 2.—Aspects of Mars, October 1924 and October 1926, showing changes in the character of *Solis Lacus*.

News and Views.

LORD BALFOUR presided at the first meeting of the Imperial Conference Research Sub-Committee held on October 25. In his opening speech he re-emphasised the points made in Mr. Amery's address to the Empire delegates the previous week. Research is more important to the British Empire than to any other great power. The Empire in its different parts is confronted with a bewildering variety of problems of almost baffling complexity, the solution of which depends upon the success of the efforts of a considerable body of research workers and the effective co-ordination of their work. Reference was made to the co-ordinating machinery already developed, in which the Department of Scientific and Industrial Research, the Development Commission, the Medical Research Council, and the Royal Society participate. Much of the work undertaken by those bodies is of interest to the Dominions and Colonies, but it is an open question whether the existing machinery is adequate to the needs of the tropical countries of the Empire with their special needs and problems. Representatives of the Dominions followed Lord Balfour with accounts of the efforts being made in their respective countries to apply science to the solution of their particular problems, the representatives of Australia and New Zealand paying warm tributes to the assistance they had received from Sir Frank Heath during his recent visit. Mr. D. T. Chadwick said that the devolution of larger powers to the Provinces in India had been a serious obstacle to the effective co-ordination of research. Mr. Ormsby-Gore, who wound up the discussion, spoke of the isolation of the research workers in tropical colonies of Great Britain, their difficulties of inter-communication, and their dependence on the prosecution of research in the Dominions and Great Britain, and the more effective distribution of the results obtained. There is a scarcity of scientific investigators in the tropics, to remedy which he urged the provision of more highly paid posts such as would induce promising scientific workers to enter the Colonial Service.

AT the third meeting of this committee Mr. J. W. Dulany gave an account of the progress of research work in the Irish Free State. He was followed by Sir William Clark, Comptroller-General of the Department of Overseas Trade, and Dr. A. W. Hill, who described respectively the functions of the Imperial Institute and the Royal Botanic Gardens, Kew, in connexion with Empire research. The reference made to the potentialities of the Imperial Institute as a co-ordinating centre for imperial activities in scientific research is welcome in view of the sceptical attitude of some of the Dominion representatives regarding its work and functions expressed at the meeting of the Imperial Conference held in 1923. The Institute has been persistently starved for funds, the contributions of the Dominions and the Tropical Colonies having been niggardly in the extreme; its scientific staff has met with every kind of discouragement for years, having been inadequately paid, given no security of tenure, and forced to work with inadequate laboratory accommodation and equipment; and much of the work for which it was originally intended has been handed over to other bodies, *e.g.* the Imperial Entomological Bureau and the Imperial Mineral Resources Bureau. Nevertheless, it has a nucleus staff, the members of which have striven for years in the face of these various difficulties to investigate the problems in connexion with the utilisation of the plant and mineral resources of the Empire and to act as a clearing-house for Imperial researches. Properly endowed it could become a very important factor in the co-ordination of Empire research, and it is to be hoped that the awakening of the Dominions to the importance and meaning of scientific research means that they will be prepared to give this institution the support it deserves.

THE speech on Empire air transport by Sir Samuel Hoare, Secretary of State for Air, at the Imperial Conference on October 28, may be taken as giving the collective views of his engineering staff. It would be interesting to have individual opinions, and to compare their sum with their resultant. With regard to fighting forces, the need for aircraft is a *chose jugée*; every belligerent will acquire the most numerous and effective aircraft it can get, from its own or neutral industry, for scouting, bombing, and fighting. Civil air transport has been proved over so wide a range of conditions that its extension to an Empire network is practically a question of finance. Airship service in war seems to be ruled out by the restriction that an airship must never come within range of an aerodrome or an aeroplane carrier. With regard to civil transport by airship, the record of service is adverse to the hope that even lavish expenditure will maintain regular services over Empire routes, and a schedule of $2\frac{1}{2}$ days to Canada, 5 days to India, 6 days to Cape Town, 11 days to Australia, and 13 days to New Zealand, seems to outrun present knowledge. The technical staff concerned is working hard to reduce the difficulties inherent in the design of these vast structures, lighter than the turbulent atmosphere which sustains and buffets them, but the increase of size and change of form, by which it is hoped to solve some of the problems, demands extrapolation far beyond previous experience.

FOLLOWING the address of the Secretary of State for Air to the Imperial Conference, interesting accounts were given by the Dominion premiers and the Under-Secretary of State for India of the development of the air services for which they are responsible. The progress which has been made since the last Imperial Conference appears to be most gratifying and opens up romantic possibilities. It was evident that these appealed strongly to Mr. Amery, who summed up the discussion. He drew a picture of the isolated white worker in the tropics making business calls in his own aeroplane and flying to a bungalow in the nearest hills for a week-end rest. He remarked

on the potentialities of the aeroplane in connexion with forest, fishery, and geographical surveys. The use of aeroplanes for the extermination of insect pests in the American cotton plantations area opened up the possibility of its extended use to the extermination of the tsetse fly in Africa. He struck a welcome note when he mentioned the discoveries which have been made from the air of long-forgotten cities, an old sacrificial way to Stonehenge, and archæological treasures in Sind, remarking that the use of the aeroplane in archæological research, one of the least material of researches, is not unworthy of the notice of the British Empire.

THE first department of anthropology in Australia has just been established in the University of Sydney. Funds for this purpose have been provided by the Commonwealth Government and the Governments of the various Australian States. Prof. A. R. Radcliffe-Brown, for some years past professor of social anthropology in the University of Cape Town, has been appointed to the new chair and took up his duties at the beginning of July. Provision has been made for including anthropology as a subject for the B.A. and M.A. degrees, and it is also proposed to offer a diploma in anthroplogy similar to that offered at Cambridge. Plans are being made for a special course of training in anthropology to be given at Sydney to cadets entering the Administration of the Mandated Territory of New Guinea. Special courses are also being provided for officials in New Guinea and Papua, missionaries and missionary students, and others who are unable to attend the University for a year and therefore cannot take the full diploma course. The Rockefeller Foundation has placed at the disposal of the Australian National Research Council a sum of money for anthropological research in Australasia. The funds to be released in any one year are to be determined by the amount contributed for anthropological studies from other sources with a limit of 20,000 dollars a year. The Australian National Research Council has appointed a committee on anthropological research to advise on the expenditure of these funds, and plans are now in active preparation for carrying out researches in physical anthropology and ethnology.

THE report on the excavations at Lubaantun, British Honduras, on behalf of the British Museum, recently presented to the Trustees, of which a summary appeared in the *Times* of October 28, makes interesting reading. It is more than likely that this site will prove one of the most important in Central America in its bearing on the obscure question of the origin and early history of Maya culture. Not only is the site the largest, but it is also probably the earliest of Maya centres. Its extent, and the number and size of its buildings, including the hillside terraces which aroused so much interest when first reported, demand a very high antiquity for the period of its inception. The work must have been continued over a very long time as well as required the efforts of a numerous and highly organised population. Further, the pottery and the plaques and figurines from surface finds correspond with the artistic style of "Early Maya" on such early sites as Copan and Quirigua, obviously a product of a long period of development, so that when the lower strata at Lubaantun are excavated, discoveries illuminating for the early history of the Maya may be expected. In many respects the Lubaantun site has proved to be unique in Maya culture. Of the four styles of architecture found on the site, one style of building which employed huge blocks of stone, large enough almost to justify the title 'megalithic,' was not hitherto known in Central America, though it occurs in Peru; while a so-called 'in-and-out' style is new in American architecture.

SENATOR MARCONI gave a very interesting James Forrest lecture to the Institution of Civil Engineers on October 26, when he discussed radio communication, with special reference to waves of short wave-length—that is, to high-frequency waves. It is common knowledge that the ether is becoming very congested with radio waves of certain frequencies. It is necessary, therefore, in order to utilise radio communication to the utmost, to extend the range of commercial frequencies. It was first pointed out that many uses can be made of radio waves, particularly in controlling mechanisms such as targets, torpedoes, and aeroplanes at a distance. It is probable also that electric power will soon be transmitted through the ether over moderate distances. The difficulty that has to be overcome is to project the waves in a parallel beam so as to minimise the dispersion and diffusion of the energy into space. A few years ago, radio engineers were much more confident about their formulæ than they are to-day. Applying them logically, they found it necessary to use very large amounts of power and enormous and expensive aerial systems to ensure communication to great distances. Consequently the high working costs prevented any substantial reduction in telegraph rates. Senator Marconi said that the whole theory and practice of the art is being revolutionised. Until quite recently long-distance transmission was carried on exclusively by employing wave-lengths lying between 8000 and 30,000 metres (37·5 to 10 kilocycles per sec.) The Post Office Station at Rugby, for example, uses waves having frequencies of 16 kilocycles per sec. The total power used at this station is 1400 kilowatts. Many similar stations are operating in other parts of the world, their cost being of the order of 500,000*l*.

FOR the last ten years Senator Marconi, with the help of Mr. C. S. Franklin, has been experimenting with high-frequency waves. In 1923 and 1924 very satisfactory results with waves having 3260 kilocycles per sec. were obtained. It was found that the daylight range steadily increased as the frequency of the waves was increased, the absorption decreasing very rapidly the higher the frequency was made. These results, Marconi said, cannot be explained merely by refraction, as the signals received over world distances are thousands of times stronger than indicated by the refractive theory. The Australian tests showed that with 9370 kilocycles per sec. it was possible to communicate for more than 23 hours out of the 24. With these high-frequency

waves the dimensions of the aerials and reflectors are reduced proportionately and very little power is required. The Marconi Company has been given the contract to make high-frequency stations for Imperial communications. At the Bodmin station for communicating with Canada, thermionic valves generate the necessary high-frequency currents of 11,500 kilocycles per sec. Communication with Canada at the rate of 2500 letters per minute over the whole circuit has been maintained for hours at a time. With these waves 'atmospherics' interfere very little. Even thunderstorms in the vicinity of the receiving station only cause interference when they are inside the angle of the receiving reflector. The high-power low-frequency stations in Great Britain are receiving and transmitting to America at an average speed of twenty words per minute for 18 hours a day. The low-power high-frequency stations, however, can work at least five times as fast over the same distance and for the same time. We are yet a very long way from being able to utilise radio waves to anything like their full extent. Their range of usefulness can be very greatly extended, and this will occupy the attention of engineers for many years to come.

A VALUABLE survey of the development and present position of the chemistry of the proteins was afforded on October 28 to fellows of the Chemical Society, when Prof. S. P. L. Sørenson, of Copenhagen, delivered the Hugo Müller lecture. The work of Mulder, of Proust and Braconnot, of Liebig, of Cramer, and of Hopkins and Cole on the composition of protein substances was mentioned; Emil Fischer's view that they consist essentially of amino-acids united by –CO · NH– linkings for many years formed the general foundation of all such researches, but recent work invites a modification of that conception. Prof. Sørenson is of opinion that conclusive evidence in favour of Troensegaard's pyrrole-ring structure is lacking, although it is clear that linkings other than those of the simple peptide type are present. It is, in fact, highly probable that some part of the nitrogen is present in heterocyclic structures, probably diketopiperazine rings. The observation, however, that none of the usual proteolytic enzymes attack diketopiperazine, whilst polypeptides are readily decomposed by erepsin, supports Abderhalden's contention that the diketopiperazine section of the protein molecule probably exists in a labile, tautomeric form, a consideration which the lecturer discussed in some detail. Further, he said, it is absolutely necessary to submit to closer examination the question as to how compounds having the assumed structure will behave towards proteolytic enzymes before attempting to reach decisive conclusions regarding the constitution of protein substances. Such investigations are being carried on by Waldschmidt-Leitz and his collaborators.

PROF. SØRENSEN turned next to the problem of the characterisation of individual proteins, in which small differences in the elementary composition are of relatively great importance. So, also, it is essential to distinguish between integral constituents and adherent or loosely-bound substances. Linderstrøm-Lang has succeeded in obtaining casein fractions containing different amounts of phosphorus, naturally raising the question whether it is possible to prepare casein free from phosphorus, yet still able to give the rennin reaction. In egg-albumin the phosphorus content is practically constant, and that element appears to be intimately associated with the rest of the molecular complex; but only a small part of the coagulable phosphorus of the serum-proteins is precipitable by alcohol. Hence it appears that the phosphorus is but loosely associated with the serum-protein complexes. Purification of the two proteins concerned by precipitation with alcohol at -4° gives results entirely in harmony with this conclusion. Prof. Sørensen's estimate of the molecular weight of the egg-albumin molecule is 34,000, corresponding with about 380 nitrogen atoms. By the application of electro-analysis to egg-albumin solutions, it is possible to reduce the phosphorus content to a value not far removed from that required if one phosphorus atom is present in such a molecule. Similar results have been obtained by long-continued storage in ice.

THE Zentralanstalt for meteorology and geodynamics at Vienna was founded in 1851, at the instance of the Vienna Academy of Sciences; the seventy-fifth anniversary of the Institute therefore falls this year, and at the suggestion of the Director, Dr. F. M. Exner, the Academy has celebrated the event by issuing a *Festschrift* dedicated to the Institute. The volume, of about 200 pages, contains 13 papers by Austrian and German geophysicists, among the authors being Ficker, Exner, W. Schmidt, A. Wegener, Defant, Conrad, and A. Wagner. Wegener describes observations of twilight bows and zodiacal light made in Greenland in connexion with J. P. Koch's expedition of 1912–13; the last twilight bow appeared to be produced by the atmosphere at a height of not less than 700 km., an elevation unparalleled among atmospheric phenomena except by the aurora. The other papers, too numerous to summarise, are mainly meteorological, but there is one relating to variations of seismic activity in regions of folding, and another on the influence of the earth's rotation on the course of rivers.

THERE are now two international organisations which deal with meteorology: the International Union of Geodesy and Geophysics and the International Conference of Directors. By mutual arrangement, the former concerns itself only with the scientific side of meteorology, while the practical application is left entirely to the latter. The Conferences of Directors are held every six years, and at each a number of Commissions is appointed to deal with various aspects of practical meteorology, membership of which is not limited to members of meteorological services. Eight such Commissions met in Zurich on September 13-20. The British representatives were: Dr. G. C. Simpson, president of the Commission for the Réseau Mondial; Lieut.-Colonel E. Gold, president of the Commission for Synoptic Weather Information; Dr. C. Chree, president of the Commission for Terrestrial Magnetism and Atmospheric Electricity; Sir Gilbert Walker;

Sir Frederic Stupart (Toronto); Mr. C. J. P. Cave; Mr. C. Stewart (Pretoria); and Mr. R. A. Fisher. Afterwards the International Meteorological Committee met in Vienna on September 23-28 under the presidency of Prof. van Everdingen (Holland). The following are amongst the chief decisions reached: A system of visual gale warning signals, for day and night, was adopted for all national services, and agreement was reached as to the conversion of velocities read on anemometers into Beaufort Numbers for weather telegrams. The International Cloud Atlas—prepared in 1895 by Messrs. Hildebrandsson, Riggenbach, and Teisserenc de Bort—has for some time been out of print; a new atlas is to be prepared which will contain a new set of photographs and the proposed changes, for the consideration of the Conference of Directors meeting in 1929. An anonymous donor has generously provided funds for the purpose. Throughout its history the International Meteorological Committee has had no permanent staff and no funds. All secretarial work and the publication of the reports of the meetings have been undertaken by one or more of the national meteorological offices. It has now been decided that the time has come to establish a secretariat to look after the records of the Conference, Committees, and Commissions, to arrange the meetings, and to publish the records.

SCIENCE Service, the endowed organisation that supplies scientific news to ephemeral publications in the United States, has made a new departure by issuing its "Weekly News-Letter" in printed form to individual purchasers. The copy before us contains sixteen pages (10¾ in. × 8¾ in.), more than six of which are occupied by matter relating to the Service and by 'fillers,' the arrangement being such that any article can be cut out without damaging any other. To facilitate the indexing of cuttings, each article bears a key-word above the title and a date at the end. The price is the very moderate one of 5 dollars per annum, or 10 cents per copy, but teachers, professors, librarians, and club-leaders may obtain each issue for 6 cents. The idea of penetrating the class-room is good, and the matter should be useful for enlivening the teaching of science and geography. In style, the articles and notes are crisp and restrained, and although in some articles the language could have been simplified, as a whole they are better written than the scientific news items that occasionally appear in our daily press. They are, however, somewhat marred by the headings, which betray the inaccuracy born of sensationalism and the love of alliteration. Thus, the title "Ice Cream from Crude Oil" is chosen for a description of recent work on the use of certain petroleum constituents as raw material for making edible fats and other natural products; and an article entitled "Fighting Forest Fires with Weather Service" contains nothing about combating fires, but is an interesting account of work undertaken by the U.S. Weather Bureau in forecasting atmospheric conditions that favour the occurrence and propagation of forest fires (which are stated to do 16 million dollars' worth of damage every year). In a country like Germany, and to a less extent the United States, a publication of this kind should find a good market; in Great Britain, where scarcely a single scientific periodical is to be seen on a railway bookstall, or in a bookseller's shop, its chance of success would be very small.

THE opening meeting of the Illuminating Engineering Society on October 26 was, as usual, devoted to reports of progress and exhibits of novelties in lamps and lighting appliances, photometric instruments, etc. The summary of progress during the vacation presented by Mr. L. Gaster contained several interesting items of news, such as the references to the inclusion of provisions requiring sufficient and suitable lighting in the new Factory Bill now before Parliament, and to the formation of an Illuminating Engineering Society in Holland. The address also summarised experiences during Mr. Gaster's recent visit to the Continent, where illuminating engineering is being keenly studied. In view of the widespread propaganda on lighting and the efforts being made in all countries to develop the commercial exploitation of illuminating engineering, the need for the maintenance of a scientific and impartial attitude on the part of the illuminating engineering societies in the various countries was strongly emphasised. Another lengthy report, read by Mr. J. Y. Fletcher, surveyed progress in electric lighting during the past year. Afterwards there were a number of interesting exhibits. Developments in lighting on the railways were dealt with by Mr. S. G. Elliot (Underground Railways), and Mr. A. Cunningham (Southern Railway). A new form of daylight-factor meter was shown by Mr. H. Buckley of the National Physical Laboratory, Teddington, and the latest model of the Holophane Lumeter photometer by Mr. H. Allpress. Other exhibits included the new Sheringham reflector yielding a light visually resembling daylight in colour, the internally frosted electric incandescent lamps, and some pleasing forms of decorative lighting units of the enclosed type.

WITH the control over epidemic diseases which has been obtained in recent years, and with the increasing proportion of elderly persons in the population, cancer has come to be one of the most important killing diseases. On September 20 and the following days, an international conference, organised by the American Society for the Control of Cancer, was held at Lake Mohonk, New York State, and was attended by representatives from most European countries. The various papers and discussions brought out nothing of a very novel character, but they made clear the steady advance which is being achieved in diagnosis and treatment, and in an understanding of what cancer is. The results were issued to the public in the form of an agreed statement which should be helpful. The conference says that cancer (1) is not contagious or infectious, (2) is not hereditary, and (3) can, so far as is at present known, be controlled only by attention to personal hygiene and by early diagnosis and treatment. The interest and co-operation of the lay public have done much to

improve general healthiness; we may hope that equally good results will follow in dealing with cancer.

DR. RUDOLF ABEL, professor of hygiene, University of Jena, delivered two lectures under the Chadwick Trust on October 19 and 20, taking as his subject "The Development and Present State of Public Health in Germany." The lecturer first described the bad hygienic conditions formerly prevailing in Germany. It was only after the foundation of the German Empire in 1871 that practical care of health was developed, and the conversion of Germany from a mainly agrarian State into an industrial one, with the development of the towns that followed this change, took place without disaster, thanks to the improvements in sanitary conditions which had likewise been proceeding. Public Health administration and legislation were then discussed. The Medical Officer of Health in Germany is a State official paid by the State, but the cost of hygienic institutions and sanitary work is borne by the community. During the last fifty years the death-rate has diminished more in Germany than in England, so that now the two countries are nearly on a level. As regards infectious diseases in Germany, notification of and inquiry into the cases, isolation and disinfection, are very similar to those obtaining in England. The campaign against tuberculosis is carried on by means of dispensaries, visits to the family, sanatoria and hospitals, and by education of the people on a large scale. Venereal disease increased much during the War, but is being dealt with by free consultations and treatment. Alcoholism diminished during the War owing to shortage of alcoholic beverages, but has since shown a recrudescence and is being combated by licensing regulations, clinics, and temperance societies. Maternal and child welfare is being cared for by special legislation, and infant mortality is declining, though it is still higher than in England. Industrial hygiene has been regulated in detail by many legal enactments. Housing conditions are not good in German towns; there is much over-crowding and a great shortage of accommodation. Very much is also being done for the social welfare of the poorer classes.

PROF. W. J. HUSSEY, Associate of the Royal Astronomical Society, Director of Detroit Observatory, Ann Arbor, U.S.A., died very suddenly on Thursday last, October 28, in London, at sixty-four years of age. He had arrived from America a few days before, and was to have sailed the next day for South Africa, where he was to have set up a 27-inch telescope on a site to be chosen—probably Bloemfontein.

THE Norman Lockyer Lecture of the British Science Guild will be given in the Goldsmiths' Hall (by kind permission of the Goldsmiths' Company) on Tuesday, November 23, at 4 P.M., by Prof. J. S. Huxley, who will take as his subject "Biology and Human Life." Tickets for the lecture may be obtained on application to the Secretary, British Science Guild, 6 John Street, Adelphi, London, W.C.2.

AT the annual statutory meeting of the Royal Society of Edinburgh held on October 25 the following officers and new members of council were elected: *President*, Sir James Alfred Ewing; *Vice-Presidents*, Dr. W. B. Blaikie, Sir Robert Blyth Greig, Prof. T. H. Bryce, Prof. E. T. Whittaker, Dr. James Currie, Dr. A. Crichton Mitchell; *General Secretary*, Prof. R. A. Sampson; *Secretaries to Ordinary Meetings*, Dr. A. Lauder, Prof. W. Wright Smith; *Treasurer*, Dr. J. Watt; *Curator of Library and Museum*, Prof. D'Arcy W. Thompson; *New Members of Council*, Mr. J. W. Peck, Dr. J. Ritchie, Prof. R. Stanfield, Dr. A. L. Turner, Dr. G. W. Tyrrell.

THE sum of 400*l.* is allocated in each calendar year by the Institution of Petroleum Technologists to the advancement of research in petroleum technology and its basic sciences, and the Council is prepared to receive applications for assistance from this fund. Applicants proposing to engage in research in a university institution must be recommended by the professor under whom they propose to work. Applications from full members of the Institution require no additional support. Applications for grants from this fund must be received by the Secretary not later than December 1. Application forms may be obtained from the Secretary of the Institution at Aldine House, Bedford Street, Strand, London, W.C.2.

MESSRS. Automatic and Electric Furnaces, Limited, 173-175 Farringdon Road, London, E.C.1, inform us that they have a complete series of lantern slides, illustrating electric furnaces for hardening, tempering, carburising, annealing ferrous and non-ferrous metals, glass, etc., together with component parts of such furnaces, automatic temperature controls, and wiring diagrams, connected with various forms of circuits. These slides are available for the use of engineering societies and other technical associations.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer on electrical engineering at the Government Technical Institute, Insein, Burma—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 15). A Physicist to the Radio-Therapeutic Department of the Cancer Hospital—The Secretary, Cancer Hospital, Fulham Road, S.W.3 (November 20). A mistress of mathematics and science in the training department of the Dow Hill Girls' School, Kurseong, Bengal—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (November 27). A lecturer in physics in the Queen's University of Belfast—The Secretary (December 4). A junior technical officer at an Admiralty Experimental Establishment, with good practical knowledge of the design, manufacture and testing of wireless telegraph apparatus, and small alternating and direct current appliances—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. An assistant chemist under the Empire Cotton Growing Corporation for soil investigations in the Sudan—Dr. E. M. Crowther, Rothamsted Experimental Station, Harpenden.

Research Items.

THE RAINMAKER AMONG THE LOTUKO, S. SUDAN.—In *Sudan Notes and Records*, Vol. 8, No. 2, Prof. C. G. and Mrs. Seligman have published notes on material relating to social organisation collected among the Lotuko of the Southern Sudan in the winter of 1921–1922. The Lotuko are organised into a number of independent territorial groups, each including a number of villages and divided into clans. At its head is a rainmaker (*Kobu*, fem. *nobu*), who is commonly referred to as "Sultan" by any Arabic-speaking Lotuko. He is the religious as well as the temporal head of the community. Both parents of a rainmaker should "have rain," though individuals with rain descent on the male side only have attempted to set up as rainmakers. They are not confined to any particular clan, but vary in different localities. Yet the clan gains prestige from his membership and his seat is looked upon as the headquarters of the clan. This tends to a territorial grouping of clans. A male rainmaker succeeds to the office on the death of his father, but a female cannot perform rain ceremonies until she is married to a rainmaker. A pool, Itaraba, has a sacred character and is associated with a semi-mythical rainmaker who is said to have lived five generations ago. In this pool live the crocodiles who are the deceased rainmakers of the Igago clan. A gourd of its water plays an important part in the rainmaking ceremony.

GYPSY MARRIAGE IN ENGLAND.—Mr. T. W. Thompson, who has been engaged in investigating gypsy marriage customs for some years, publishes in the *Journal of the Gypsy Lore Society*, Series 3, Vol. 5, Pt. 1, the results of a detailed analysis of a number of records of marriages contracted in some of the leading gypsy families in the nineteenth century. From these it is deduced that descent in the direct line and common parentage are bars to matrimony, notwithstanding a case of marriage to a granddaughter, and one of a half-brother and sister. There has been a number of cases of marriage between uncle and niece, and aunt and nephew, the latter less frequently, and usually uncles have preferred their brothers' to their sisters' daughters. The mating of first cousins has been exceedingly common in some families, and first cousins marry more frequently than second cousins. There is also a marked preponderance of ortho-cousin over cross-cousin marriages, which reflects a definite tendency towards marriage within the family circle. On the other hand, certain southern groups seem to show a preference for cross-cousin marriage, and generally with daughters of a mother's brother rather than a father's sister. It is suggested hypothetically that the Indian proto-gypsies possibly practised a two-clan exogamy, such as actually exists among Indian nomads classed as 'gypsies,' and that on quitting India they had a marked tendency to wed near kindred. Further, that while sojourning on the upland stretches between India and Armenia under the influence of Iranians and Arabs, they weakened the hold of exogamy and strengthened the tendency to alliances between close blood relatives. Polygyny occurs sporadically and the marriage of two or more brothers to two or more sisters is specially common. Further, a polygynist's wives have more often than not been sisters. Formerly it may have been usual to wed a deceased wife's sister and for a young widow to wed a brother-in-law; also it may not have been permissible to wed a younger sister before an elder. In addition to the sororate and the levirate there is evidence for the custom which exists among the Santals of India by which a man might cohabit with his wife's sisters before their marriage.

THE INSECT FAUNA OF THE DUTCH EAST INDIES.—Two recent supplements to *Treubia*, the official zoological journal of the scientific institutes at Buitenzorg, are of special interest to entomologists. The supplement to vol. 6 (April 1926) is devoted to an extensive monograph of the Tabanid flies of the Dutch East Indies by Dr. J. H. Schuurmans Stekhoven, jr. This work forms a bulky volume of 552 pages with 18 excellent three-colour process plates of representative species. The fact that certain Tabanids play a significant part in the transmission of the disease known as 'surra' has evidently prompted the large amount of study and collecting that has been entailed in the production of this important monograph. It is probable that *Tabanus striatus* is the most prevalent mechanical transmitter of that disease in the East Indies, but it is very uncertain whether or not other species and genera of these blood-sucking flies may also be implicated Altogether 266 species of the family are fully described in this work, and many are new to science. The supplement to vol. 8 (July 1926) consists of a very detailed study of the immature stages of Malayan Thysanoptera by Mr. H. Priesner. This work forms, unquestionably, one of the most careful and accurate accounts of the post-embryonic forms of those insects that has so far appeared anywhere. The abundance of material at his disposal has enabled the author to construct family, generic, and specific keys to the identification of both primary and secondary larvæ, while his descriptions are greatly enhanced in utility by the 16 plates illustrating numerous structural features.

THE RESPIRATORY EXCHANGE OF THE MUSSEL.—In a very interesting paper in the *Biochemical Journal* (vol. 20, No. 4, 1926, p. 289) Mr. J. R. Bruce describes an apparatus by means of which he studied the gaseous metabolism of a stock of common mussels, *Mytilus edulis*, L., kept in a large concrete tank at the Marine Biological Station, Port Erin. For the experiments, equal samples were taken from the stock at fifteen roughly equal periods between March 1925 and April 1926; oxygen was determined by Winkler's method and carbon dioxide by an indicator method elaborated by the author. It was found that the oxygen requirements rose and fell in close agreement with the rise and fall of the temperature during the year, and also, though to a slighter extent, depended on the oxygen pressure. By making corrections for variations in these two factors, a third variation in oxygen intake was made evident which followed closely the reproductive cycle, there being an increase of 30 per cent. per unit weight of wet tissue between July and March, the period in which the reproductive reserves (largely glycogen) are being built up after the depletion consequent on the spawning of the previous spring. A point of the greatest interest is furnished by the disparity between the respiratory quotients at different periods, it being at its lowest in June and July and rising to a maximum in March. This is apparently associated with the changing chemical composition of the tissues during the period when glycogen is being stored, the drop from March to May corresponding to the period of fat formation preliminary to spawning in May.

THE MECHANISM OF GEOTROPIC CURVATURE.—We are still 'in the dark' as to the mechanism which is responsible for the different geotropic curvatures manifested by shoot and root, and recently another

suggestion has come from Polish sources. F. Tondera directs attention to the early work of Kraus, who showed that the amount of water in the tissues on the upper and lower side of a horizontal axis may be different, and suggests that the gravitational influence on sap distribution will be different upon the cortex of a root, from which water is moving inwards to the stele, and the cortex of the shoot, which is evaporating water and receiving a fresh supply moving outwards from the stele. He concludes that as a result the gravitational effect upon a horizontal root may reinforce and increase the natural sap movement on the upper side of the root and the lower side of the shoot, thus causing downward (positive) geotropic curvature in the first case and upward (negative) curvature in the second. His paper in the *Bulletin International de l'Académie polonaise des Sciences et des Lettres*, 8 B, 1925, contains very little experimental evidence; but the theory recalls in some respects the suggestion recently put forward by Ricôme in the *Rev. Gén. de Botanique*.

THE ROCKS OF JAN MAYEN.—The first comprehensive collection of rocks from the hitherto little known island of Jan Mayen was made by Mr. J. M. Wordie in 1921. This material has now been studied petrographically by Dr. G. W. Tyrrell, and the results, together with seven new analyses, are recorded in the *Trans. Roy. Soc. Edin.* (vol. 54, Pt. 3, No. 19, Oct. 2, 1926). The most abundant rocks appear to be trachybasalts with subsidiary trachytes and ankaramite (ultrabasic olivine basalt), and they occur as lava-flows or small intrusions. Trachyandesites and plateau-basalts are also known, but so far only as blocks and pebbles in a volcanic conglomerate. The only previous analysis of first-class importance was made by Dr. H. F. Harwood of a trachybasalt described by Prof. A. Holmes in 1918. The new analyses now recorded show that the suite as a whole is of mildly alkalic character with titanium dioxide ranging up to nearly four per cent. Holmes's deduction of a richly titaniferous belt in the Brito-Arctic Province stretching from Greenland to the Hebrides thus receives further support. The original magma appears to have been of trachybasaltic composition, differentiation having produced sub-magmas of trachytic and ultrabasic extremes. The specimens of plateau-basalt seem to be more ancient than the exposed lavas and they probably represent the underlying basement of the island.

SPANISH PETROLOGY.—The Iberian Peninsula consists structurally of three main tectonic features: a central plateau of pre-Cambrian and Palæozoic rocks which were extensively invaded by granites towards the close of the Carboniferous; a southern Betic Cordillera of folded rocks; and a similar northern folded belt forming the Pyrenees and Cantabrian Mountains. Hitherto little has been known of the chemical characters of the Carboniferous granites, but in a recent paper this deficiency is made good by Dr. H. S. Washington (*Journ. Wash. Acad. Sci.*, Sept. 19, 1926). All the specimens studied, of which four have been analysed, are simple biotite granites of approximately average composition, the uniformity in this respect being especially noteworthy. The later igneous rocks of the folded and faulted borders are strikingly different, as they include a wide variety of alkaline, mostly soda-rich, types. It is pointed out in a comparative survey that a similar contrast between granitic horsts and alkaline peripheral regions is shown by many other areas, such as the Canadian, Brazilian, and Fenno-Scandian shields. The distribution of soda rocks around older granites is regarded as unfavourable to the hypothesis that they are derived from basaltic magmas by assimilation of limestones.

WEATHER IN SAMOA.—The report of meteorological observations for 1923 made at the Apia Observatory has recently been received. Magnetic, meteorologic, and seismic observations are given in detail. Magnetic disturbances were not numerous during the year, and those which occurred had little effect upon the declination. The mean air temperature for 1923 was 26°·08 C., while the normal for the years 1890–1923 is 25°·78 C. The total rainfall in 1923 was 3772·6 mm. and the normal is 2688 mm. The abnormal rainfall was largely due to the unusual precipitation during March, when rain was general throughout the Samoan Islands; at Alsisa the fall for the month was 117·82 in. (2993 mm.). This unusually heavy precipitation was the result of a circular storm which originated to the south-west of Samoa and was considered by residents to have been the most severe in twenty-five years. It caused general damage to roads and public works and resulted in considerable reduction of the copra output for the year. Of 119 earthquakes 79 were local and had their epicentre within 100 km. of the observatory; six earthquakes were reported as felt by people living in Apia and vicinity. Between June 1 and December 31 eighty-one balloons were sent up, and thirty-nine of these were followed to a height of 5 kilometres or more. The greatest altitude observed was 21 kilometres, on December 19. Grateful acknowledgment is expressed of substantial grants from the Carnegie Institution of Washington and from the British Admiralty.

INVAR STEEL BALANCE BEAMS.—The issue of the *Proceedings of the Physical Society of London* for August 15 contains a paper by Mr. J. J. Manley on the properties of a precision balance with beams of invar steel, which was shown by Messrs. Oertling at the Exhibition of Apparatus held by the Physical and Optical Societies in January last. The great rigidity of the beam reduces the bending under load and gives a sensitivity independent of the load. The small coefficient of expansion of invar was not found to make the resting point of the beam independent of temperature, and Mr. Manley attributes this to relative movements of the knife edges themselves. The magnetic field has its effect on the beam, but any error due to this may be eliminated by using Gauss's method of double weighing. In the discussion of the paper, Mr. Gould stated that the effect of temperature changes on the invar steel balance of the National Physical Laboratory was of the same order of magnitude as that found for balances with gun-metal beams as usually made.

THEORY OF AIRSCREWS.—Recent developments in vortex theory in its application to airscrews has enabled the behaviour of a propeller under normal working conditions to be examined, but the theory breaks down in the vortex ring state and in part of the windmill brake state. Some recent empirical extensions of the theory based on general theoretical arguments have provided some information regarding the general nature of the characteristic curve. These are embodied in a report by H. Glauert (Aeronautical Research Committee, R. and M. No. 1026, H.M. Stationery Office, 3*d*. net). The experimental data are analysed to determine the form of the characteristic curve for those regions for which the vortex theory is inapplicable or inaccurate. An empirical form of the characteristic curve has been determined fitting the experimental data and connecting up with the theoretical curves in the propeller and windmill brake

state, but its precise form will remain somewhat uncertain until further experiments are available from an open jet tunnel. Further developments along these lines are clearly indicated in the near future.

SUPRACONDUCTIVITY. — W. Meissner, *Zeit. für Physik*, vol. 38, p. 647, 1926, has recently examined the low-temperature resistance of single crystals of cadmium, gold, and zinc, and of very pure specimens of iron, nickel, platinum, and silver in the form of wires. Although measurements were made at temperatures so low as 1·3° absolute, no indication of the phenomenon of supraconductivity was found with any of these metals. It thus appears that supraconductivity may only be exhibited by a particular group of metals, although it is still possible that at temperatures lower than 1·3° absolute the above metals may exhibit it.

THE MOLECULAR WEIGHTS OF THE PROTEINS.—Analytical and physical-chemical methods indicate that the proteins have very large molecular weights; *e.g.* the smallest, of egg albumin, is approximately 34,000. Recent work on the lowering of the freezing-point of phenol had yielded values between 200 and 600, and it was suggested that these values represent the true molecular weights of the units of a large aggregate which is stable in water but dissociates in phenol. This hypothesis does not agree with analytical evidence, and it is disproved by some experiments of E. J. Cohn and J. B. Conant, described in the July issue of the *Proceedings of the American National Academy of Science*. They found that the freezing-point depression depended on the method employed to dry the protein, and they therefore made use of the system phenol + anhydrous calcium chloride + hydrated calcium chloride. This has a sharp melting-point unaffected by small amounts of water and by the proteins, and it is concluded that no evidence exists for dissociation into units of low molecular weight.

MOISTURE AND SURFACE ACTION.—The current number of the Royal Society's *Proceedings*, **112**, A 762, contains a communication by Prof. W. A. Bone, embodying the principal results of an inquiry, begun in 1908 and continued up to the present date, to determine whether or no moisture have any specific influence upon the combustion of carbonic oxide at a heated surface. The surfaces tried were: 1. Refractory firebrick at 500° C. 2. Granular nickel oxide at 200°. 3. Granular copper oxide at 210°. 4. Gold gauze at 240°. 5. Silver at 360°. 6. Porous porcelain at 500°. The experiments have been carried out with the exceptional care and caution characteristic of all Prof. Bone's work. It appears that the immediate consequence of progressive drying is always to increase the effect of the surface, presumably by removing the film of water molecules by which action is retarded. The ultimate effect, which is usually observed only after a prolonged drying, is to diminish greatly or even stop combustion. Although the ultimate effect of drying the metallic surfaces was practically to stop combustion, on readmitting moisture the activity of the surface was in time restored. The effect on porcelain was peculiar: ultimately not only was the influence of the catalyst greatly diminished but also it was not regained on reintroducing moisture.

A WIDE-FIELD BINOCULAR MICROSCOPE.—The advantages of binocular vision in microscopical work has led to an increased use of the binocular instrument, which consists of two juxtapositioned microscopes complete in themselves, by means of which the object is seen with a true stereoscopic effect. The introduction of a Porro erecting system to each of the two body tubes gives the further advantage that the image is viewed in its true position and not inverted or reversed. We have recently seen a specimen of a wide-field binocular microscope of this type which has been put on the market by Messrs. Bausch and Lomb, Ltd., of 37 Hatton Garden, London, E.C. The instrument is provided with 2 pairs of eyepieces and 3 pairs of objectives, by means of which magnifications varying from 7, with a field of view of 25·4 mm., to 30, with a field of view of 8 mm., can be obtained. Each objective is provided with centering screws, and each pair is mounted in a substantial base. The achromatic eyepieces have a very high eye-point, which permits prolonged observations to be made without undue fatigue. The microscope may be detached from its horseshoe base and placed directly on any surface which it is desired to examine. It may also be mounted on the end of a counter-balanced horizontal arm, which is capable of swinging round a vertical rod attached to a solid base or clamped to a bench. By means of these attachments, the microscope may easily be brought into position over a large area under examination. The instrument is thus adaptable to a great variety of circumstances and its range of usefulness for examining specimens under comparatively low magnification is almost unlimited.

HEAT CONDUCTION IN STEEL.—It is so generally believed that a fine-grained metal is essentially isotropic, that a paper by C. Benedicks, H. Bäckström, and P. Sederholm on "Anomalies in Heat Conduction as investigated in Spherical Steel Specimens," read at the Stockholm meeting of the Iron and Steel Institute, is of more than usual interest. The variation in the temperature gradient of uniformly heated steel spheres in different directions is so great as 1 : 8·5; the electrical resistivity, however, showed variations in different directions not exceeding the ratio 1 : 1·05. These variations in the thermal conductivity, of quite a different order of magnitude from those in the electrical conductivity, are probably connected with irregularities in the macrostructure. The thermal conductivity of a solid metal must represent two independent phenomena, (1) purely thermal, and (2) thermo-electrical. The latter involves eddy currents having such directions as to facilitate heat transfer by the Thomson effect. This part of the heat conductivity must be high for a metal possessing (*a*) a high electrical conductivity, and (*b*) a high Thomson coefficient. If a considerable part of the heat conductivity of, say, carbon steel is due to an inner thermo-electrical heat transfer, even small heterogeneities will thus be able to exert considerable influence on these thermo-electric currents, and may easily direct them into special preferential paths. From a practical point of view, there are two items to be specially considered. On one hand the transfer of heat in a massive steel piece will cause temperature irregularities of a possibly unfavourable character, especially as regards corrosion. On the other hand, the total heat transfer increases considerably with increasing dimensions of the metallic object on account of this electrical heat convection. In spite of the scarcity of available data, it seems justifiable to range the added dissolved elements in steel in the following order, so far as their influence on the thermal conductivity is concerned: Nickel, manganese, hardening carbon, aluminium, silicon, indicating that the thermal conductivity of iron is lowered least by 1 *atomic* per cent. of nickel, more by magnesium, and so on. Cementite carbon exerts only a slight influence.

The State and Industrial Research Associations.[1]

By J. W. WILLIAMSON, Secretary, British Scientific Instrument Research Association.

1. WHEN in 1916 the Government of the day set aside a sum of 1,000,000*l.* to be expended in promoting scientific and industrial research, the Committee of the Privy Council for Scientific and Industrial Research, on the advice of its Advisory Council, decided that the sum should be expended in grants in aid to industrial research associations to be established for the purpose of conducting research on a co-operative basis. There were those who suggested that the best way of ensuring an extensive application of scientific research to industrial problems was to subsidise existing research agencies, whether in the universities and technical colleges or elsewhere; or to establish and endow in the country one or more research institutes after the type, say, of the Mellon Institute of Industrial Research in the U.S.A.

I think it will be granted by most, if not by all, of the members of this Conference that the decision actually taken was the wisest course; for one thing, because it was the only scheme which promised to secure the continuous co-operation in research of the industries presumed to be in need of research, and to get science domiciled in those industries. The experience of the last eleven years goes to show that it is only through some such agency as the industrial research associations that in many industries, though perhaps not in all, a real fusion of scientific knowledge and industrial experience and—what is equally important—a working co-operation of the scientific workers and the manufacturers can be effected.

2. There was, however, one principle laid down by the Committee of the Privy Council for the promotion of Scientific and Industrial Research, the body responsible for the administration of the million fund, which needs special examination to-day. It was stated, almost as though it were axiomatic, that the Government grant to the research associations, as and when they were established in accordance with the scheme, must be limited to a definite period, after which the associations must be independent of State financial aid. The period originally chosen was a period of five years, afterwards extended, for many research associations, to ten years.

If, as I am inclined to think, the limitation of the Government grant to a definite period of time was a policy deliberately adopted as being based, or assumed to be based, on certain accepted principles of political economy or in accord with recognised limits of State action, then I submit that experience has shown this policy to be of doubtful wisdom.

3. It is important at the outset to be quite clear as to the function of Government in this particular field of industrial research. It all depends whether the persuasion of the industries as to the value of research is put in the first place and the carrying out of industrial research in the second; or whether the extension of industrial research is put in the first place and the persuasion of the industries as to its value in the second. The first view leads directly to the principle of grant for a limited period; the second view implies some continuity of grant.

It is noteworthy that in regard to what is called 'pure' scientific research the Government adopts the second view. The grants to universities and kindred bodies, largely intended for 'pure' scientific research, are regarded as permanent in character. There is no suggestion that they should be limited to a period sufficient to persuade any persons or bodies of the value of 'pure' scientific research. It is the same with regard to education grants generally. No responsible person to-day suggests that Government grants for education should be continued only so long as may reasonably be necessary to persuade parents generally of the value of education. In these instances the Government regards it as a primary and paramount duty to ensure that, in one, 'pure' scientific research is carried out, and, in the other, that education is given. The appreciation by the sections of the community concerned of the value of pure research or of education is a secondary, though an important, consideration. It is worth remark here that much of the work of the research associations belongs to the categories of pure research and education.

Moreover, in certain fields of industrial research, as, for example, fuel, food, and forest products, the Department made no question that it was properly the duty of the State to finance wholly such 'national' researches. There was not the slightest squeamishness about expending the taxpayers' money on such researches; and rightly so, for the taxpayer, *quâ* citizen, is an ultimate beneficiary of the results of such research.

4. In that region of industrial research assigned to the research associations, however, the emphasis was the other way. The policy was designed apparently with the main object of convincing manufacturers of the value of scientific research by subsidising the research associations for such a period as could reasonably be estimated to be needed to bring conviction. In so far as it succeeded in that period in convincing the industries that it was worth their while to bear the whole burden of research the scheme succeeded; in so far as it failed to do this the scheme itself failed.

It was probably felt that to commit the State to a permanent subvention—or at least a subvention not limited in time—of industrial research, in those particular fields of industry covered by the research associations, would come too near to subsidising those manufacturers who were members of the associations at the expense of the rest of the community. I do not seek to impugn the validity of such a principle or to weaken the force of such a healthy feeling, especially in these days, but I think that in this case certain factors have been overlooked, or at least have not been taken fully into account.

5. In the first place, it has to be recognised that it is impossible by scientific research to benefit the particular manufacturers who are members of the research association related to a given industry without conferring benefits, though to a less degree, on other manufacturers in the same industry who are not members of the association, and without benefiting also the community as a whole by the increased efficiency of the industry concerned, directly attributable to the research work done. I am not here hinting at any leakage of confidential information, though it is generally agreed that the period during which information of value can be kept confidential is limited. I am referring to those general processes of industrial diffusion which are always in operation. New ideas have a way of getting into the air. It is a well-known experience that increased efficiency on the part of some firms in an industry has stimulating effects on, and tends to raise the efficiency of, the rest of the firms in

[1] A paper entitled "Should the Government Grant to Research Associations be limited to a Period of Years?" read at a Conference of Research Associations on July 22.

that industry. To carry the matter further, the raising of the standard of efficiency in one industry has inevitably beneficial reactions on many other industries. These consequences are not limited in time but are continuous, and, I submit, there is ample justification, on purely business grounds, for asking the taxpayer to contribute continuously, so that this fertilising stream of research may continue to irrigate the particular fields of industry concerned, to the taxpayers' ultimate benefit.

6. In the second place, it has to be remembered that in many cases the contribution of the manufacturer to the research association of which he is a member is only a part of the contribution which he makes to scientific and industrial research. Many of the manufacturing firms have research departments of their own. In some cases the sums annually expended to maintain and develop these private research departments are much greater, even by many times, than the annual subscription to the research association. Moreover, and this is especially important, the work of the research associations has tended, and will tend more, to stimulate further expenditure on these private research departments. I may mention, for example, that one firm, a member of the research association with which I am connected, testified, after only two years' experience as a member of the association, that the work of the association had given them increased confidence in their own research work so that they had doubled their annual expenditure under that head.

No doubt other research associations could bring forward similar testimony. This consideration may not apply as yet, in the same degree or to a like extent, to all the industries covered by the research associations; it is perhaps only well marked at present in those industries which have always had intimate relations with science. But the important point to be borne in mind is that, if the research association scheme is to develop all its capacities, such an experience must ultimately be a common experience in all the industries that support co-operative research. If and as the research associations become stable and vigorous institutions in our industrial organisation, the manufacturers will be led to increase the quota of their contributions to research, notwithstanding that, so far as the actual subscriptions to the research associations are concerned, they might continue to be on a pound-for-pound basis.

7. There is, therefore, no need for those who are responsible for directing the national policy as to research associations to feel that, if the Government continues indefinitely to support the research associations on, say, the pound-for-pound basis, they are subsidising one section of the community without ensuring collateral and proportionate benefits to the community as a whole. Nor need they fear that the continuous grant of the Government's annual pound will result in the manufacturers restricting their expenditure on research to an equal amount. The grant in aid would be dynamic. For every pound expended by the Government to subsidise the research associations on, nominally, a pound-for-pound basis, there would be a steadily increasing expenditure by the industries on research, both absolutely and relatively to the grant in aid.

It is by that method and along those lines that the industries can be best persuaded, *ambulando*, to increase continuously their expenditure on research, and thus to realise in substance the whole object of the research associations scheme. I submit, from the considerations already advanced and from others which will follow immediately, that to rely on the continuity of grant to bring about naturally and, as it were, automatically increased expenditure by industries on scientific research, is likely to be more effective in the long run than the method now adopted of giving grants for a limited period on a descending scale, so as at the end of the period to throw on the industries concerned the whole financial burden of supporting the research associations.

8. There is another aspect of the question which must make us doubt whether the proposal to cease grants to the research associations after a limited period is wise in the national interest. At present, and so long as Government makes grants in aid to research associations, Government has full knowledge of all that the research associations are doing; it has wide powers of regulation and control; it has numerous and recurring opportunities of co-ordination; it has powers to act, in the national interest, so that important results of research may not be confined too exclusively to any one industry where they are of actual or potential value to other industries; and, generally, through the Department of Scientific and Industrial Research, it acts as the focus and centre of the work of all the research associations.

The Department of Scientific and Industrial Research has shown, by sympathy and insight, how it is possible to reconcile the exercise of these powers of control, regulation, and co-ordination with the freedom and elasticity necessary to the research associations individually if their work is to be of productive value. If and when Government grants to research associations cease, these functions of Government must cease too, or at least be so curtailed as to lose their virtue, the consequences must be that the direct advantages now accruing to the Government services by the present *liaison* between Government and the research associations will be lost; the advantages to the nation as a whole, resulting from the power of the Government, through the Department of Scientific and Industrial Research, to secure correlation and co-ordination in important areas of industrial research, will disappear; and even the researches into 'national' problems, such as fuel, food, and forest products, must lose something when contacts between the Department of Scientific and Industrial Research and the research associations are broken. The very structure of our industrial system may be profoundly modified by the work of the research associations and the Government, by cutting itself adrift from these developments, be ignorant of their character and scope and be powerless to influence them.

It is worth notice here that the late Prof. Alfred Marshall, the distinguished economist, raised a cognate argument in his "Industry and Trade," first published in 1919. Referring to the research associations, and after pointing out that they are "wholly constructive," he says:

"But the experience of the ages shows that associations set up for constructive purposes are in danger of being turned to destructive ends: and therefore it may perhaps be to the public interest that some limited contribution should be made from public funds to the support of such associations, partly in order to facilitate the intervention of public authority in case an association should develop anti-social tendencies."

I have not time to examine the interesting implications of this passage, and I must be content to let the quotation speak for itself.

9. Another serious consequence of a divorce of the Government from the research associations, such as must necessarily follow from a discontinuance

of grants in aid, would be the weakening of the principle of co-operation. The research associations scheme is a scheme based on the conception that in scientific research, no less than in trade, there is a vast area in which the work needed to be done can be done effectively only by co-operation. One of the strongest arguments for such co-operative research is that, by its means, researches of vital importance to the respective industries can be undertaken, though they may be of a nature and extent which would make it impossible for any individual firm to undertake them. It is true that, theoretically, the research associations would still be free to undertake such researches even if Government grants ceased and relations with the Department of Scientific and Industrial Research were severed. In practice, however, there can be little doubt that the loss of the Government grant and the severance of relations with the Department of Scientific and Industrial Research would tend to discourage the research associations from undertaking these larger researches into problems not, at first sight, promising immediate benefits to the industry. When the industry has to find all the money for co-operative research, there will naturally be a tendency on the part of the industry to concentrate more and more on research work deemed likely to bring immediate or early benefits to the industry, and to postpone to a never-coming to-morrow those wider investigations which might not seem to promise results of immediate industrial value. It is because the continued association of the Government with the research associations helps the research associations to develop to the fullest extent all the capacities of co-operative research—because, shortly, the co-operative research is not fully co-operative without the co-operation of the Department of Scientific and Industrial Research — that the policy of putting a definite term to grants in aid is, in the national interest, mistaken.

10. The Advisory Council in its report to the Committee of the Privy Council for the year 1916–17 (Cd. 8718, p. 16) stated that there seemed to be room in the industrial world for three methods of financing research. "There is research which the individual firm finds it remunerative to undertake at its own expense. Secondly, there is research which is financed on a co-operative basis; and lastly, there is research which must be financed by the State if it is to be done at all." I submit that, in the national interest, the phrase "financed on a co-operative basis" should be interpreted as including the continuous financial co-operation of the State.

I do not pretend in this paper to have done more than to have touched lightly a few of the points that must arise in a discussion of this important matter. I hope, however, that I have said enough to show that the principle of limiting State aid to research associations to a definite and comparatively short term of years is neither axiomatic nor sacrosanct, but, judged from the national interest, and even by that criterion alone, of dubious value.

Sir Charles Parsons and the Steam Turbine.

THE presentation of the Kelvin Medal to Sir Charles Parsons, and the delivery of the James Forrest Lecture on "Radio Communications" by Senator Marconi, took place on October 26 at the Institution of Civil Engineers. The assembly was the largest ever seen at the Institution; and among those present was the Italian Ambassador. In presenting the medal on behalf of the Kelvin Medal Award Committee, Sir William Ellis, the president of the Institution, referred to the work of Sir Charles Parsons in the fields of scientific inquiry and the applications of thermodynamics, remarking that the medal commemorated the achievements of Lord Kelvin in those branches of science which are especially applicable to engineering. Reference was made to the scientific environment in which Sir Charles Parsons was brought up and to the work of his father, the Earl of Rosse, who in 1845 completed the famous reflecting telescope at Birr Castle, and later Sir William Ellis sketched the progress of the steam turbine with which the name of Sir Charles Parsons is so closely associated.

The acknowledgment of the gift of the medal by Sir Charles Parsons was followed by some reminiscences of great interest. He touched upon his boyish attempts to construct models of such materials as were available—a far better thing for a boy than playing with mechanical toys. One of his early inventions was a sounding machine with a glass tube closed at the end, somewhat similar to that of Lord Kelvin, but, said Sir Charles humorously, "I believe Kelvin's invention was made independently." Sir Charles also reminded his hearers of his experiments in making diamonds, which, however, when tested, proved not to be diamonds at all. He still thought something might be done in that direction. When engaged with the steam turbine, the financial and commercial difficulties were greater than the scientific and mechanical, and he recalled with pleasure the favourable opinion of the turbine expressed by Lord Kelvin on more than one occasion. It was a notable day in the history of the turbine when the turbo-alternator set supplied to Cambridge in 1892 showed an economy superior to the reciprocating engines of that time.

Sir Charles Parsons was born on June 15, 1854, being the fourth son of the third Earl of Rosse. A glimpse of his early surroundings can be obtained from the "Reminiscences" of Sir Robert Ball, who in 1865 became tutor to Sir Charles and his two brothers. After being privately educated he entered St. John's College, Cambridge, and graduated in 1876, being eleventh wrangler. Four years were then spent at the famous Elswick Works, where he came under the influence of Lord Armstrong, and in 1883 he became junior partner in the firm of Clarke, Chapman, Parsons and Co., of Gateshead, where he began his life's work on the steam turbine.

Many patents for rotary engines were taken out during the nineteenth century, but modern turbine work begins with those of 1884. First came the patent of the Swedish engineer, Gustav de Laval, for an impulso turbine, and this was followed by those of young Sir Charles Parsons. Of the patents of April 23, 1884, No. 6734 was for "improvements in electric generation and in working them by fluid pressure," and No. 6735 was for "improvements in rotary motors actuated by elastic fluid pressure, and applicable also as pumps."

The pioneer Parsons turbine constructed was a double-ended parallel-flow machine, running at 18,000 revolutions per minute, driving an armature only $2\frac{5}{8}$ inches in diameter. This little machine was used in the Inventions Exhibition of 1885, and is now at the Science Museum, South Kensington. By 1889, 300 turbo-generators had been constructed, the largest being 75 kilowatts. Soon after this the firm of C. A. Parsons and Co. was founded, followed a few

years later by the Parsons Marine Steam Turbine Co. The year 1887 saw the construction of the first compound turbine; the year 1892 that of the first condensing turbine. From the 75-kilowatt set of 1889 the turbine gradually grew in size, sets of 3000 kilowatts being made in 1902, while to-day there are machines in use of 60,000 kilowatts. The development of the marine turbine is represented by the engines of H.M.S. *Hood*, of more than 150,000 horse power. The first turbine-driven vessel was the *Turbinia*, and this was followed by the destroyers H.M.S.'s *Cobra* and *Viper*, the cruiser *Amethyst* and the battleship *Dreadnought*, and other vessels for commercial purposes.

The work of Sir Charles Parsons during the last forty years has often received acknowledgment. He has been a fellow of the Royal Society since 1898, and is an honorary doctor of science of six universities. From the Royal Society of Arts he has received the Albert Medal; from the Institution of Electrical Engineers, the Faraday Medal; and from the Franklin Institute of America, the Franklin Medal. In connexion with the award of the last, it was remarked that "it is no exaggeration to say that the work of Sir Charles Parsons has halved the cost of producing electric power, and reduced in still greater proportion the capital cost of generating machinery."

The Magnetic Storm and Aurora of October 14-15, and Associated Solar Activity.

THE magnetic storm which was recorded in NATURE of October 23, p. 603, was accompanied by a display of the aurora which, owing to cloudy skies over a large part of Great Britain, was not seen generally. It is therefore of added interest that Mr. W. B. Housman, of Seaton, West Cumberland, was able to secure eight photographs of the phenomenon, four of which are reproduced herewith (Fig. 1).

It will be recalled that at Greenwich the commencement of a magnetic disturbance of moderate intensity was recorded on October 14 at 20 hr. This disturbance, which lasted for about 12 hours, was followed on October 15 at 19 hr. by another of considerable magnitude, the magnetograph traces showing a total displacement of more than 1° in declination. The two upper photographs of the aurora were taken at 1 h. 30 m. on October 15 during the precursory disturbance, and the lower photographs show the aurora on the evening of the same day at 22 hr., that is, about three hours after the commencement of the major disturbance. The photographs were taken with a camera with an aperture of 2 in. and focal length of 4 in., the exposures being from 10 to 15 minutes. In the upper photographs, taken with the camera pointed to left and right respectively of the centre of the auroral light, the constellation Lyra is seen on the left, and on the right the brilliancy of the aurora practically absorbs all the star trails, while the Scotch coast, 20 miles distant, is revealed by the light. The two lower views show the western extremity and the north-eastern region of the aurora on the following evening. Some details of the photographs are of course lost in reproduction.

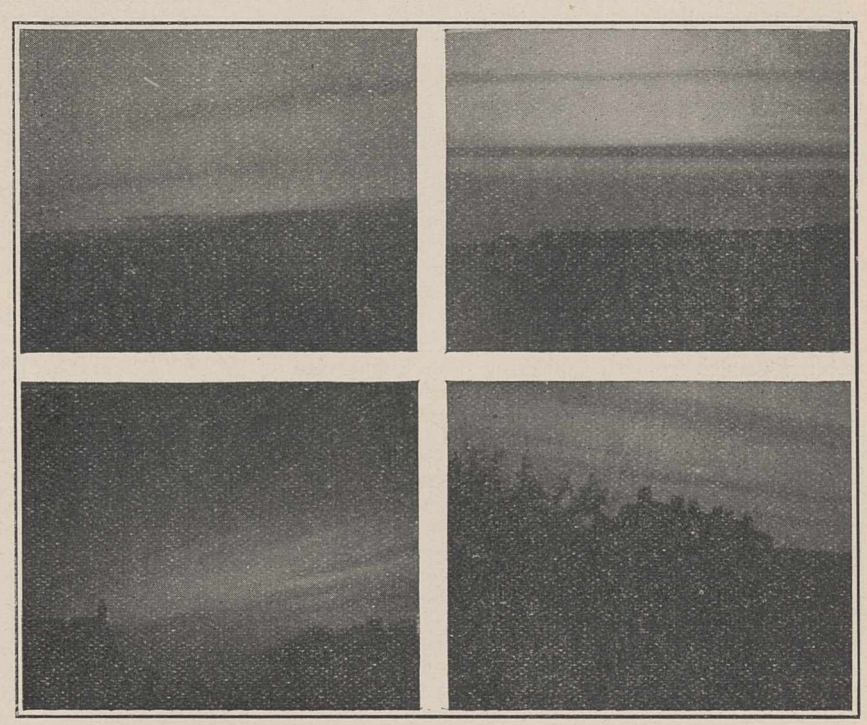

FIG. 1.—Auroræ of October 14-15, 1926. From photographs by Mr. W. B. Housman.

Mr. Housman's remarks on the phenomenon may be quoted in full: "In all views taken, and particularly in these four, dark bands are to be seen running concentric with the auroral arc of light. They were noted visually, and are even more pronounced photographically, their position and persistent continuance suggesting a connexion with the aurora itself. The colours seen in this display were very beautiful. On October 14, 23 h. 30 m., G.M.T., the arch frequently shone with a rich crimson glow, and on October 15, about 22 hr. G.M.T., the N.E. end was quite a bright green. Orange and pale straw colour also appeared in the arch at different places simultaneously. On the night of October 15-16 the auroral green line was seen in a pocket spectroscope all over the sky except in the south-east, where moonlight was strong for a time."

It is known that there is a definite tendency for auroræ, as well as magnetic storms, to occur at intervals of about 27 days—the same interval in which the spot producing zones of the sun make one rotation as seen from the earth. Mr. Housman mentions that the recent aurora is apparently a return of a fine display seen on September 15; a recurrence of the phenomenon should therefore be looked for about November 11. Mr. Evershed in a letter to NATURE of December 29, 1921, p. 566, describes a sequence of disturbances lasting for six months, the mean period being 27·3 days. It is perhaps of interest to mention that at the time when the magnetic storm was most intense there were

no indications, judging from the reception of the Annapolis time signals registered at Greenwich, that conditions for radio transmission were in any way abnormal.

As stated in NATURE of October 23 last, there were, at the time of the magnetic storm, four large spots on the sun's disc, none of which, however, from its telescopic appearance suggested any unusual activity. From a discussion of the occurrence of a number of magnetic storms, Mr. E. W. Maunder found that the average position of spots, which were apparently related in some way to the disturbances, was about 14° west or 1 d. 2 h. past the sun's central meridian at the time of their commencement (*Monthly Notices, R.A.S.*, **64**, 206). This would indicate, in the present instance, the group of spots with central meridian passage on October 13·7.

Mr. A. A. Buss states that this group showed pronounced spectroscopic activity, and particularly so on October 13, when observations at 13 h. 30 m. indicated that very brilliant eruptive prominences were being shot out in different directions from the immediate vicinity of the chief spot. Considerable line of sight motions in the spectrum line $H\alpha$ were also observed by Mr. Buss in connexion with the spot of central meridian passage, October 16·7. Another fact, probably merely a coincidence, but not to be entirely overlooked, is that the time interval between the preliminary and great magnetic disturbances is roughly equivalent to the difference in longitude between the leading and following spots of the third group with central meridian passage, October 11·2.

The recent magnetic storm is the fourth to be recorded at Greenwich during the present year. That of January 26-27 was described at the time as being the largest magnetic disturbance for five years. The progress of the sun's periodic activity may be readily gauged from the following table giving mean daily areas of sunspots, corrected for foreshortening and expressed in millionths of the sun's visible hemisphere. The year 1917 was the maximum for the last cycle.

Year.	Area.	Year.	Area.
1917	1537	1922	252
1918	1118	1923	55
1919	1052	1924	276
1920	618	1925	829
1921	420	1926	still increasing.

During the last eighteen months there have been 19 unusually large spots which have been recorded naked-eye spots in our astronomical columns. Two of these have coincided with two of the four magnetic storms. Three of the remaining large spots have coincided with moderate or active magnetic disturbances. Coincident with the few days near the central meridian passage of the remaining 14 spots, the magnets have shown slight or no disturbance at all. It is in connexion with the anomalies met with in the attempt to correlate magnetic storms with particular solar disturbances that the work of the Mount Wilson observers on sunspot polarities, and also that of solar spectroscopists in general, is of much importance.

University and Educational Intelligence.

CAMBRIDGE.—The following re-appointments have been made: Dr. C. G. Lamb, Clare College, to be reader in electrical engineering, and Mr. P. Lake, St. John's College, to be reader in geography; Mr. W. E. Johnson, King's College, to be Sidgwick lecturer in moral science, and Dr. H. Lamb, Trinity College, to be Rayleigh lecturer in mathematics.

At the recent matriculation, 1650 freshmen were matriculated.

For the sixth year in succession, Trinity College announces the offer of a Research Studentship open to graduates of other universities who propose to come to Cambridge in October next as candidates for the degree of Ph.D. The value of the studentship may be so much as 200*l.* a year if the pecuniary circumstances of the successful candidate require so large a sum. Applications must reach the Senior Tutor not later than July 1, 1927. The College also offers, as usual, Dominion and Colonial Exhibitions to students of Dominion and Colonial Universities who wish to come to Cambridge next October as candidates for the degree of B.A., M.Litt., M.Sc., or Ph.D. These exhibitions are of the titular value of 40*l.* but their actual value is such sum (if any) not exceeding the titular value as the College Council may from time to time hold to be justified by the exhibitioner's financial circumstances. If the financial need of an exhibitioner cannot possibly be met by payment of the full amount of his titular emolument, the Council may award him an additional payment. Candidates must apply through the principal authority of their university, and applications should reach the Senior Tutor (from whom further particulars may be obtained) by July 1, 1927.

EDINBURGH.—Dr. David Bain has been appointed lecturer in technical chemistry in succession to the late Mr. Allin Cottrell, and Mr. J. Evans Gordon lecturer in the Department of Agriculture.

LEPLAY House Educational Tours Association has organised a Christmas vacation tour to Rome, which is open to all interested in archæological, historical, and sociological subjects. There will be a special course of lectures on ancient and modern Rome, and visits will be paid to museums, art galleries, etc., under the guidance of experts. The party will leave London on December 27, and return to London on January 11. Full particulars may be obtained from Miss Margaret Tatton, Leplay House, 65 Belgrave Road, Westminster, S.W.1.

THE "Leicester, Leicestershire and Rutland University College," Leicester, offers in its prospectus for 1926–27 full preparation for the Arts, Science, Commerce, Law, and Music Degrees of the University of London. Although founded so recently as 1921, it had last year 126 (including 68 full-time) students, all preparing for degree examinations, and it is already able to point to a long list of academic honours obtained. In the session 1925–26 departments of chemistry and physics were inaugurated. During the first term of the current session a "co-ordinating course," consisting of one lecture by each lecturer in turn on biology, chemistry, classics, English, French, geography, history, mathematics, physics, is being given experimentally. Several important public lectures are announced. Hostel accommodation within the College precincts is available for women students, the fee for residence being 60*l.* per annum. The inclusive fee for tuition for any stage for a first degree in Arts or in Science is 25*l.* per annum. Such low fees are made possible by a substantial income (6000*l.*), from endowment. The College is not on the University Grants Committee's list of universities and university colleges, but it has received a grant from the City of Leicester. Should the scheme for an East Midlands University, mentioned in the article which appeared in our issue of October 16 on "English Provincial Universities," come to fruition, this college, as well as the Technical College, Leicester, would no doubt be a constituent part.

Societies and Academies.

SHEFFIELD.

Society of Glass Technology, October 20.—J. W. **French**: Glass annealing. In any discussion of annealing the first question is the rate at which heat is dissipated by glass at the various temperatures of the annealing process. The other conditions determining the magnitude of the stresses that may be established in glass during the cooling process are: (2) The thermal expansion in contraction of the material; (3) thermal conductivity; (4) cohesion of the material; (5) the viscosity of glass; (6) the existence of a surface layer having properties different from those of the underlying material; (7) homogeneity of the glass; and (8) the form and dimensions of the glass. From the optical glass point of view, annealing means—(1) the raising of the temperature to a point just above that of the softening point of the hardest glass in the charge, and (2) the cooling of the plant at a rate which will not at any one point be sufficient to reintroduce stresses in any of the glasses.—E. A. **Coad-Pryor**: The economics of the annealing process. An account was given of experiments on which the Engineering Department and the Research Laboratories of the United Glass Bottle Manufacturers, Ltd., had been recently engaged at Charlton. In order to get the information on which to design a lehr on a sound theoretical basis, it was necessary to know the amount of heat taken into the lehr by the bottles and the heat lost through the lehr walls. Eventually heat was supplied to the lehr by means of the slats of the conveyer. During most of the period of testing, the lehr was running at about one-third of its maximum speed. The annealing was good throughout. When it was speeded up to its maximum rate, about 10 inches a minute, the annealing remained excellent, even on quart bottles. This speed represented an output of 450 gross of quarts per day, or about 40 tons of glass. The lehr was fitted with a number of curtains to restrict draught up the tunnel. Once the curtains were adjusted to the correct setting, no further adjustments were required.—F. A. **Hurlbut**: A suggested improvement in the design of lehr conveyer.—E. **Meigh**: A new type of "fireless" lehr.

PARIS.

Academy of Sciences, September 27.—Henri **Jumelle**: Ravenea, Madagascar palm trees. There are seven species of Ravenea in Madagascar, of which detailed descriptions are given.—Jacques **Chapelon**: The emptying of a reservoir.—H. **Pécheux**: Researches on the dielectric constants of petrols and paraffins. Determinations of the dielectric capacity and its temperature coefficient for nine hydrocarbons ranging from petroleum spirit (density 0·655) to hard paraffin wax.—A. **Travers** and **Malaprade**: The constitution of the molybdates. The acid molybdates can be interpreted as being derived from two ions only, the tetramolybdic ion ($4MoO_3.O$) and the normal ion (MoO_4).

October 4.—A. **Desgrez**, L. **Lescœur**, and Mlle. S. **Manjean**: The influence of a current of inert gas on the decomposition of sulphide solutions. Application to mineral waters. Studies on the rate of removal of hydrogen sulphide by hydrogen from solutions of the gas alone, of sodium hydrogen sulphide, and of sodium sulphide, and of mixtures of these. The results find an application in the analysis of mineral waters containing sulphides.—Léon **Guillet**: The influence on the mechanical properties of copper and aluminium alloys of reduction of section produced by forging at a high temperature.—Maurice **Gevrey**: Certain properties of harmonic functions and their extension to the solution of linear partial differential equations.—Pierre **Humbert**: The equation of the prepotential plane.—Paul **Urysohn**: An example of an integral function taking on its circle of convergence an *ensemble* of non-measurable *B* values.—N. **Gunther**: An application of the universal functions of A. Korn.—A. S. **Besicovitch**: The fundamental geometrical properties of plane *ensembles* of linearly measurable points.—Alfred **Rosenblatt**: Certain irrotational movements of viscous liquids.—R. **Forrer**: The structure of the atomic magnet. The rotation and reversal of the multiplet.—**Verney**: An apparatus for the automatic control of furnaces. A description of an electrical apparatus by means of which a furnace can be made to follow any desired time-temperature curve.—Pierre **Bedos**: Some new reactions of the oxide of cyclohexene. Alkyl iodides react with cyclohexene oxide in sealed tubes at high temperatures (150°-190° C.), giving the addition compound, alkoxy-2-iodo-1-cyclohexane. A similar reaction is given by the acyl chlorides and bromides, esters of the orthochlor (brom) cyclohexanol being formed.—J. **Orcel**: The thermal analysis of the chlorites.—Mlle. Marcelle **Philibert**: The opening of a special effusive *bouche* in the crater of Vesuvius.—Henri **Leenhardt**: Placosaurus.—Mme. Anna **Drzewina** and Georges **Bohn**: The antagonistic action of metallic silver and tin on living beings. The destructive action of metallic silver on Convoluta is reduced by the presence of metallic tin.—E. **Aubel**: Methylglyoxal considered as an intermediary in the course of the degradation of glucose by micro-organisms.—Constant **Mathis**: The virulence to man of the Spirochæte of the shrew mouse.—Auguste **Lumière** and Mme. J. **Enselme**: The suppression of anaphylactic shock by anæsthesia of the endo-vascular nerve terminations.—Charles **Lebailly**: Experiments on the virus of foot-and-mouth disease.

ROME.

Royal Academy of the Lincei.—Communications received during the vacation.—Gino **Fano**: Variety of binary forms of the seventh order.—Guido **Fubini**: Projective properties of surfaces of constant metric curvature.—Ferruccio **Zambonini** and Guido **Carobbi**: Presence of sodium and potassium fluosilicates among the products of the present-day activity of Vesuvius. In addition to ammonium silicofluoride, which occurs as cryptoalite, as a product of fumarolic activity on Vesuvius, and to the potassium salt, found as hieratite on both Vesuvius and the Island of Vulcano, malladrite, which is sodium silicofluoride, has now been detected on Vesuvius. Indications of the presence of further silicofluorides among the products of Vesuvian fumaroles have been obtained.—Ferruccio **Zambonini** and Silvia **Restaino**: Cerous-thallous sulphates. Investigation of the system, cerous sulphate—thallous sulphate—water demonstrates the existence of a third double sulphate, $Ce_2(SO_4)_3$, $4{\cdot}5\ Tl_2SO_4$, hitherto unknown.—Luigi **Rolla** and Lorenzo **Fernandes**: The element of atomic number 61. Fractional crystallisation of the double salts formed with thallous sulphate by the sulphates obtained from commercial didymium oxide leads to fractions which, by study of their X-ray absorption spectra, are shown to contain the element of atomic number 61.—Giuseppe de **Lorenzo**: The *Elephas antiquus* of Pignataro Interamna in the valley of the Liri.—B. **Longo**: First results of the seeding of the 'flowerless' apple (*Pyrus apetala*, Munchh.).—Arnaldo **Masotti**: Uniform rotation of a pair of thin round cylinders in an indefinite perfect liquid.—Ubaldo **Barbieri**: Astronomical determination of latitude and azimuth made at Monte Settepani

in 1911.—Maria Luigia **Pagliarulo**: Rotatory and refractive dispersion of aqueous solutions of dextrorotatory tartaric acid. The curves of refractive dispersion for tartaric acid solutions appear perfectly normal, but the derived curves similar to those previously employed with asparagine solutions exhibit a change of direction corresponding almost exactly with the maximum of the rotatory dispersion curves.—G. **Scagliarini**: Analogy of behaviour and isomorphism between cerium and thorium. The behaviour of the mixed oxides of the rare earth metals does not support the hypothesis that, in such oxides, ceric oxide forms part of a saline oxide. It is hence probable that the cerium is present in a condition of amorphous solid solution and that its solubility in acids depends on its condition of extreme subdivision. It may be, however, that when dissolved in other oxides, ceric oxide does not undergo that process of polymerisation which renders it insoluble when it is calcined either alone or in homogeneous mixture with other oxides. The same holds in the case of thorium dioxide. Further, in agreement with the positions of the two metals in the periodic system, the acetylacetonates of thorium and cerium are completely isomorphous.—G. **Scagliarini** and M. **Monti**: Additive compounds of halides of tin and titanium with organic bases (ii.). Stannic and titanic halides form additive compounds with hexamethylenetetramine together with one or more molecules of a solvent such as chloroform, bromoform, dichloroethylene, tetrachloroethane, etc. The composition of the complex compound obtained varies with the concentrations of the metallic halide and organic base in the solvent, and the colour of the product is usually deeper when the halide or the solvent preponderates over the base. Werner's theory does not furnish a satisfactory interpretation of these compounds.—Luigi **Mazza**: Products formed during the working of lead accumulators. Examination by means of the Debye-Hull method shows that the products formed during the charging and discharging of lead accumulators include lead, both in powder and in masses, lead sulphate, lead dioxide, various mixtures of these compounds, and other substances.—G. **Resegotti**: Crystallographic study of certain aromatic nitroderivatives. 5-Methyl-2:6-dinitromethylhydrazobenzene crystallises in the prismatic class of the monoclinic system: $a:b:c=1\cdot27507:1:1\cdot37644$, $\beta=93^\circ\ 30'\ 30''$; 5-methyl-2:4-dinitromethylhydrazobenzene: $a:b:c=0\cdot81915:1:0\cdot96209$, $\beta=93^\circ\ 37'$ and α-methyl-α-phenyl-2:4-dinitro-5-chlorophenylhydrazine: $a:b:c=2\cdot8747:1:1\cdot4563$, $\beta=128^\circ\ 3'$, also crystallise in the prismatic class of the monoclinic system.—M. **Sella**: Further facts relating to the migration of the tunny, ascertained by means of fish-hooks.—Antonino **Pais**: Influence of a hormonic stimulus, directed towards the testicles and ovaries, on the characters of the descendants

WASHINGTON, D.C.

National Academy of Sciences (Proc., vol. 12, No. 9, September).—G. A. **Miller**: Postulates in the history of science. Such postulates might make for progress. Postulate (*a*): in a modern work on the history of science, technical terms should be given only their modern meanings. Then the numbers which Napier first called logarithms are not logarithms in the modern sense, but serve some of the purposes of modern logarithms and were influential in their development. Postulate (*b*): a scientific concept must be clearly understood before its history can be presented satisfactorily.—H. J. **Ettlinger**: On the zeros of functions associated with a linear system of the second order.—Harry Merrill **Gehman**: Concerning irreducibly connected sets and irreducible continua.—Karl T. **Compton**: Interpretation of deviations from Ohm's law. Bridgman has recorded small deviations from Ohm's law when currents of the order of 10^6 amp. per cm.^{2} traverse gold or silver films. Applying Thomson's doublet theory of conduction leads to improbable values for the magnitude of the atomic doublet. The experimental evidence is, however, consistent with the classical free electron theory.—R. C. **Gibbs** and H. E. **White**: Rubidium- and cæsium-like doublets of stripped atoms. Extrapolation of data available made possible the identification of various doublets of ionised rubidium, strontium, yttrium, zirconium, and cæsium, barium, lanthanum, cerium, præseodymium. They are relatively intense lines in the spark spectrum.—Walter A. **MacNair**: The fine structure of certain lines and energy levels of cadmium. Two different quartz Lummer-Gehrcke plates crossed with a quartz prism or grating spectrograph and a water-cooled cadmium arc were used.—F. A. **Saunders**: On the spectrum of argon.—A. Keith **Brewer**: Ionisation in reacting gases. The change of rate of thermionic emission and of chemical action with temperature follows the same general law. The rate and temperature of emission in certain oxidations are interdependent; above a certain point, a difference in the temperature and rate of emission of oppositely charged ions occurs. This suggests a selective force of the metallic surface.—Herbert W. **Rand** and Amy **Browne**: Inhibition of regeneration in planarians by grafting: technique of grafting. Two planarians are narcotised with chloretone. A piece of tissue is excised from one, the lateral nerve cord being severed. The animal is placed on an acid-free gelatin strip made by pouring the hot solution on to a glass slide and cooling The head is then removed from the other individual, immediately inserted at the wound in the first animal and kept in position by strips of gelatin. After the graft had become established, the head of the stock was removed. Regeneration of the head or the stock would occur in a normal worm, but the presence of the graft sometimes inhibits it.—H. W. **Rand**, J. F. **Bovard** and D. E. **Minnich**: Localisation of formative agencies in Hydra. A double-headed animal is produced by grafting a new head on to the side of the stock and the stock head is then removed. Sometimes regeneration of the stock head occurs; otherwise the stump remaining is absorbed. A headless graft does not inhibit regeneration.—H. W. **Rand** and Mildred **Ellis**: Inhibition of regeneration in two-headed or two-tailed planarians. Animals with duplicated head or tail were produced by splitting a portion of one worm longitudinally. Removing one head or one tail led in some experiments to regeneration of the lost member, but in other cases the 'dominance' of the remaining head or tail inhibited regeneration.

VIENNA.

Academy of Sciences, July 8.—K. **Fritsch**: Contributions to our knowledge of the Gesneriaceæ—(ii.) The American species of the genus Klugia.—V. **Cordier**: The action of bromine on urea and guanidine derivatives.—H. **Müller**: Attempts to find radioactive products of the atomic disintegration by α-rays.—M. **Blau** and E. **Rona**: Ionisation by H-rays.—R. L. **Hasche**: The method of counting scintillations.—E. **Lieben** and D. **Laszlo**: The relation of creatin to albumin and carbohydrate metabolism.—J. **Pollak** and E. **Gebauer-Fülnegg**: New *o*-azo compounds.—K. **Ohara**: The use of ash for the determination of woods.—J. **Koller**: A new synthesis of conine. The synthesis of *p*-meth-oxy-ephedrine and of *m*-methoxy-*p*-oxyephedrine.—G. **Sachs** and M. **Ott**: Notes on the preparation and analysis of some products of methylation of thiosalicylic acid.

Official Publications Received.

BRITISH AND COLONIAL.

Queensland Department of Mines: Queensland Geological Survey. Publication No. 277: Geological Reconnaissance between Roma, Springsure, Tambo and Taroom (The Carnarvon Ranges and Buckland Tablelands). By Dr. H. I. Jenson, assisted by J. R. T. Dunlop. Pp. v+215. (Brisbane, Qd.: Anthony James Cumming.)

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 37, Part 3. Pp. 251-345+plates 10-16. (London: Edward Stanford, Ltd.) 5s.

Report on the Administration of the Meteorological Department of the Government of India in 1925-26, and a Note on the Long-Established Observatories of Madras and Bombay. Pp. 21+6 plates. (Simla: Government of India Press.)

Photographs of Eminent Chemists. (Published by the Chemical Society.) R. W. Bunsen, Emil Fischer, A. W. von Hofmann, D. I. Mendeleeff, L. Pasteur, Sir William Perkin, Sir William Ramsay, Sir Henry Roscoe. Size of photograph, 8 in.×6 in. (approx.); size of mount, 15 in.×11 in. (London: Gurney and Jackson.) 3s. each; 22s. the set.

Records of the Survey of India. Vol. 19: The Magnetic Survey of India, 1901-20. Prepared by Lt.-Col. R. H. Thomas and E. C. J. Bond. Pp. ix+67+121+6 plates+9 charts. (Dehra Dun: Survey of India.) 4 rupees; 6s. 9d.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1925-26. Pp. 38. (London.)

Proceedings of the Royal Society of Edinburgh, Session 1925-1926. Vol. 46, Part 3, No. 25: On Bernoulli's Numerical Solution of Algebraic Solutions. By Dr. A. C. Aitken. Pp. 289-305. 1s. 6d. Vol. 46, Part 3, No. 26: On a Polarised Light Quantum. By J. M. Whittaker. Pp. 306-313. 9d. Vol. 46, Part 3, No. 27: Bothrodon pridii, an Extinct Serpent of Gigantic Dimensions. By J. Graham Kerr. Pp. 314-315. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted at the Meeting of the Administrative Council on October 20th 1926. Pp. 6. (London.)

University College of North Wales. Calendar for Session 1926-27. Pp. 461. (Bangor.)

Proceedings of the Cambridge Philosophical Society. Vol. 23, Part 4, October. Pp. 337-491. (Cambridge: At the University Press.) 7s. 6d. net.

FOREIGN.

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin." Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 9, Livraison 1-3, Août. Pp. 292+5 Tafeln. (Buitenzorg.) 7.50 f.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 534: Effect of Concentrated Loads on the Length of Measuring Tapes. By Lewis V. Judson. Pp. 383-393. (Washington, D.C.: Government Printing Office.) 10 cents.

University of Colorado Bulletin. Vol. 26, No. 6, General Series No. 231: Catalogue, 1925-26, with Announcements for 1926-1927. Pp. 421. (Boulder, Colo.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 68: Notes on the Aphididæ of Egypt. By W. J. Hall. Pp. viii+62+3 plates. (Cairo: Government Publications Office.) 5 P.T.

Bulletin of the Peking Society of Natural History. Technical Series, No. 1: A Tentative List of Chinese Birds. Part 1: From Colymbiformes through Coraciiformes. Compiled by N. Gist Gee, Lacy I. Moffett and G. D. Wilder. Pp. viii+144. (Peking.)

University of Illinois Engineering Experiment Station. Bulletin No. 155: The Cause and Prevention of Embrittlement of Boiler Plate. By Prof. Samuel W. Parr and Frederick G. Straub. Pp. 62. (Urbana, Ill.) 35 cents.

University of California Publications in American Archaeology and Ethnology. Vol. 19, No. 2: Pomo Folkways. By Edwin M. Loeb. Pp. 149-409+3 plates. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 41: Statistics of City School Systems, 1923-24. Pp. 181. 25 cents. Bulletin, 1925, No. 44: Land-Grant Colleges, Year ended June 30, 1925. By Walter J. Greenleaf. Pp. vi+70. 10 cents. Bulletin, 1926, No. 10: Accredited Higher Institutions. Compiled by Ella B. Ratcliffe. Pp. vi+105. 15 cents. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 336: Tides and Currents in Delaware Bay and River. By Lt. L. M. Zeskind and E. A. Le Lacheur. (Special Publication No. 123.) Pp. iv+122. (Washington, D.C.: Government Printing Office). 25 cents.

Proceedings of the American Philosophical Society held at Philadelphia for Promoting Useful Knowledge. Vol. 65, No. 2. Pp. 67-140. (Philadelphia, Pa.)

Department of the Interior: U.S. Geological Survey. Bulletin 783-B: Mineral Investigations in Southeastern Alaska. By A. F. Buddington. (Mineral Resources of Alaska, 1924-B.) Pp. ii+41-62+3 plates. Bulletin 783-C: Geology and Oil Developments of the Cold Bay District, Alaska, by Walter R. Smith; A Ruby Silver Prospect in Alaska, by S. R. Capps and M. N. Short. (Mineral Resources of Alaska, 1924-C.) Pp. iii+63-95+plate 4. Bulletin 783-D: The Nixon Fork Country and Silver-Lead Prospects near Ruby. Papers by John S. Brown. (Mineral Resources of Alaska, 1924-D.) Pp. iv+97-150+plates 5-6. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Professional Paper 139: Geology and Ore Deposits of the Ducktown Mining District, Tennessee. By W. H. Emmons and F. B. Laney, with the active collaboration of Arthur Keith. Pp. vi+114+23 plates. (Washington, D.C.: Government Printing Office.) 35 cents.

State of Illinois Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 16, Art. 2: Recent Insecticide Experiments in Illinois with Lubricating Oil Emulsions. By S. C. Chandler, W. P. Flint and L. L. Haber. Pp. 99-126. (Urbana, Ill.)

Journal of the College of Science, Imperial University of Tokyo. Vol. 44, Art. 6: On some Remarkable Relations between the Yearly Variations of Terrestrial Phenomena and Solar Activities. By Torahiko Terada. Pp. 20. 0.80 yen. Vol. 44, Art. 7: On some Fossil Shells from the Island of Saishû in the Strait of Tsusima. By Prof. Matajiro Yokoyama. Pp. 9+1 plate. 0.75 yen. Vol. 44, Art. 8: Die Hydroidenfauna der japanischen Region. Von Prof. Dr. E. Stechow. Pp. 28. 0.75 yen. Vol. 45, Art. 1: Mollusca from the Coral-Bed of Awa. By Prof. Matajiro Yokoyama. Pp. 62+iii+5 plates. 2.20 yen. Vol. 45, Art. 2: Tertiary Mollusca from Dainichi in Tôtômi. By Prof. Matajiro Yokoyama. Pp. 18+2 plates. 1.25 yen. Vol. 45, Art. 3: Molluscan Remains from the Lowest Part of the Jô-Ban Coal-Field. By Prof. Matajiro Yokoyama. Pp. 22+5 plates. 1.35 yen. Vol. 45, Art. 4: On the Classification of Fusulinidae. By Yoshiaki Ozawa. Pp. 26+4 plates. 1.30 yen. Vol. 45, Art. 5: Molluscan Remains from the Uppermost Part of the Jô-Ban Coal-Field. By Prof. Matajiro Yokoyama. Pp. 34+6 plates. 1.75 yen. Vol. 45, Art. 6: Paleontological and Stratigraphical Studies on the Permo-Carboniferous Limestone of Nagato. Part 2: Paleontology. By Yoshiaki Ozawa. Pp. 90+14 plates. 3.60 yen. Vol. 45, Art. 7: Molluscan Remains from the Middle Part of the Jô-Ban Coal-Field. By Prof. Matajiro Yokoyama. Pp. 23+3 plates. 1.00 yen. Vol. 45, Art. 8: On the Stereochemical Configurations of Cobalt Complexes with Anomalous Co-ordination Numbers. By Kichimatsu Matsuno. Pp. 16. 0.60 yen. (Tokyo.)

Geologische Rundschau: Zeitschrift für allgemeine Geologie. Herausgegeben von der Geologischen Vereinigung. Sonderband. Festschrift zum 70 Geburtstag Gustav Steinmann, dargebracht von seinen Schülern. Pp. v+660+23 Tafeln. (Berlin: Gebrüder Borntraeger.)

Catalogue méthodique des livres de médecine. Août 1926. Pp. 136. (Paris: Masson et Cie.)

Diary of Societies.

SATURDAY, NOVEMBER 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—Diseases of the Outer Ear:—Dr. D. McKenzie: Introductory Remarks.—Dr. A. M. H. Gray: Common Affections of the Skin of the Outer Ear.—F. C. Ormerod: Intractable Dermatitis of the Pinna and External Auditory Meatus Secondary to Chronic Suppuration of the Middle Ear.—F. J. Cleminson: Deafness Associated with Fragilitas Ossium.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. E. M. Walker: The Study of History (1).

MONDAY, NOVEMBER 8.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Principal A. P. Laurie and J. Milne: The Evaporation of Water and Salt Solutions from Surfaces of Stone, Brick, and Mortar.—Prof J. H. Ashworth and Miss Janet C. W. Bannerman: A Tetracotyle in the Brain of the Minnow.—Prof. D. Waterston: Development of the Hypophysis Cerebri in Man, with a Note upon its Structure in the Human Adult.—Dr. A. G. Cannon and Miss S. M. Manton: On the Feeding Mechanism of a Mysid Crustacean, *Hemimysis Lamornae*.—Dr. E. Ghosh: On the Anatomy of the Mastacembelidae of Bengal with Notes on their Habits.—Sir Thomas Muir: The Theory of Persymmetric Determinants from 1894 to 1919.—S. C. Chakrabarti: A Factorable Continuant.

BIOCHEMICAL SOCIETY (in Chemical Department, St. Thomas's Hospital Medical School), at 5.—J. Needham: The Rhythm of Chemical Differentiation in Avian Embryos.—E. M. Goldblatt: Some Observations on Acidosis and Alkalosis.—W. J. Griffiths and Prof. H. MacLean: The Part played by Regurgitation in Gastric Digestion.—J. Lowndes: Estimation of Cystine in the Modified Van Slyke Method of Analysis of Proteins.—Prof. R. H. A. Plimmer: Changes in the Amino Acids in the Proteins of the Hen's Egg during Development.—J. L. Rosedale: The Amino Acids of Flesh.—H. W. Dudley, O. Rosenheim, and W. W. Starling: Spermidine, a Hitherto Undescribed Base occurring in Animal Tissues.—W. J. N. Burch: Hydrolysis of Phosphoric Esters.—Prof. R. H. A. Plimmer and W. J. Burch: The Action of Ethyl Metaphosphate on Alcohols, Ammonia, and some Amino Compounds.—J. G. Davis and W. K. Slater: Aerobic and Anaerobic Metabolism of the Cockroach.

INSTITUTE OF CHEMISTRY (Bristol Section) (at Bristol University), at 5.30.—R. Pilcher: Alchemists and Chemists in Art and Literature.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—J. E. Southcombe: Recent Research on Friction and Lubrication.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—D. J. Bolton and others: Discussion on the Economics of Lamp Choice.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—L. C. Grant: High-Power Fusible Cut-outs.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—S. Mavor: The Applications of Machinery at the Coal Face.—L. Miller: The Design of Storage-Battery Locomotives for use in Coal Mines.—R. Nelson: Electricity in Mines—a Short Survey.

CERAMIC SOCIETY (at Central School of Science and Technology, Stoke-on-Trent), at 7.30.—F. L. Bolt: Systems of Oil Firing and their Possible Applications to the Potteries.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Discussion on Die-Casting.

SURVEYORS' INSTITUTION, at 8.—D. Watney: Inaugural Address.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Roy Chapman Andrews: The Work of the Central Asiatic Expedition in Mongolia (Second "Asia" Lecture).

MEDICAL SOCIETY OF LONDON, at 8.30.—Dr. J. Parkinson and A. J. Walton: Discussion on Sternal Pain.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Botany School, Cambridge), at 8.45.

TUESDAY, NOVEMBER 9.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Shadwell: Medicine in Ancient Assyria (FitzPatrick Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. G. W. C. Kaye: The Acoustics of Public Buildings (Tyndall Lectures) (2).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Dr. F. Mollwo Perkin: Oil Fuel and other Fuels from Carbonisation Processes.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—W. J. Guthrie: Some Notes on Reduction Gear.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—T. H. B. Scott: Presidential Address.

INSTITUTE OF CHEMISTRY (Glasgow Section), jointly with Society of Chemical Industry (Glasgow Section) (at 39 Elmbank Crescent, Glasgow), at 7.—Dr. T. Gray: An Apparatus for the Supply of Gas at Constant Pressure.—Dr. W. B. Davidson: Gaseous Fuels.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at Broadgate Café, Coventry), at 7.30.—J. E. Southcombe: Recent Research on Friction and Lubrication.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow), at 7.30.—W. L. Winning: Chairman's Address.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—A. C. Mitchell: Heavy Timber Construction in Harbour and Dock Works.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—A. A. Pearson: Mushrooms and Toadstools.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.—Dr. J. H. Burn: Some Methods of Biological Assay.

ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.—Prof. G. M. Robertson: An Analysis of the Decrease in the Number of Deaths from General Paralysis in England and Wales.

INSTITUTION OF MECHANICAL ENGINEERS (South Wales Branch) (at Swansea).—Prof. F. Bacon: Chairman's Address.

WEDNESDAY, NOVEMBER 10.

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—J. R. Beard and T. G. N. Haldane: The Design of City Distribution Systems, and the Problem of Standardisation.

ROYAL SOCIETY OF ARTS, at 8.—Sir Thomas H. Holland: International Interests in Raw Materials.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (at Chemical Society), at 8.—H. Willshaw: Moulding and Vulcanisation of Rubber Articles.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Prof. Spearman: The International Symposium on Shape Qualities.

INSTITUTION OF MECHANICAL ENGINEERS (at Sheffield).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

THURSDAY, NOVEMBER 11.

ROYAL SOCIETY (jointly with the Royal Astronomical Society), at 4.30.—Discussion on the Results of the Recent Eclipse Expedition.

LONDON MATHEMATICAL SOCIETY (Annual General Meeting) (at Royal Astronomical Society), at 5.—Prof. A. L. Dixon: Interpolation Forms in the Algebra of Invariants (Presidential Address).—Award of the De Morgan medal to Prof. A. E. H. Love.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. A. Shadwell: Medicine in Ancient Assyria (FitzPatrick Lectures) (2).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—E. W. Hey Groves: Reconstructive Surgery of the Hip Joint (Bradshaw Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir T. W. Edgeworth David: Antarctic Exploration Past and Future (2).

INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.—Prof. S. P. Smith: An All-Electric House.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—C. Beck: An Accurate Method of Ascertaining the Focal Point of an Optical System.—J. W. T. Walsh and W. Barnett: The Effect of Slightly Selective Absorption in the Paint used for Photometric Integrators.

INSTITUTION OF THE RUBBER INDUSTRY (Manchester Section) (at Manchester).—W. N. Burbridge: Rubber Softeners.—E. A. Harlston: The Effect of Solid Compounding Ingredients as Softeners.

INSTITUTION OF MECHANICAL ENGINEERS (at Leeds).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

FRIDAY, NOVEMBER 12.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir James B. Brunyate: The Report of the Indian Currency Commission.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. R. Pike: On the Chromospheric Currents above a Sunspot.—Prof. E. A. Milne: The Reflection Effect in Eclipsing Binaries.—Prof. A. S. Eddington: Note on Dr. Pokrowsky's Proposal for Determining the Angular Diameter of a Star.—L. Berman: The Orbit of Σ 73=β 482.—Royal Observatory, Greenwich: Stellar Parallaxes.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.1), at 5.—Dr. A. I. Simey and others: Discussion on Suggestions as to the Modification of the Rules Usually Observed in the Management of Infectious Diseases in Boarding Schools.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—A. Dewhurst: A Rapid Bolometer.—Dr. E. Griffiths and J. H. Awbery: Hygrometry.—Dr. Smithells and Mr. Avery: The Effect of Working on Tungsten.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—Resumed Discussion on Sir Theodore Morison's Paper, How should an Engineer be trained?

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—L. J. T. Wheatley: Estimating.

INSTITUTE OF METALS (Swansea Local Section), (at University College, Swansea), at 7.15.—J. H. Wells: Zinc Smelting and Recovery of its Bye-Products.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Annual General Meeting.

INSTITUTE OF METALS (Sheffield Local Section), (at Sheffield University), at 7.30.—H. Brearley: Ingots and Ingot Making.

RAILWAY CLUB (25 Tothill Street, S.W.1), at 7.30.—W. J. Thorrowgood: Light Signalling.

PHILOLOGICAL SOCIETY (at University College), at 8.—T. Lewis: Origin of Welsh Institutions.

INSTITUTION OF MECHANICAL ENGINEERS (at Glasgow).—Prof. E. G. Coker: Elasticity and Plasticity (Thomas Hawksley Lecture).

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section), (at Manchester).—W. H. Cantrill: The Application of a Coat of Paint; its Composition, Manipulation, and the Factors governing its Efficiency and Permanence.

SATURDAY, NOVEMBER 13.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. E. M. Walker: The Study of History (2).

PHYSIOLOGICAL SOCIETY (at London School of Medicine for Women).

PUBLIC LECTURES.

SATURDAY, NOVEMBER 6.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. Daryll Forde: Weather Forecasts and the Weather.

SUNDAY, NOVEMBER 7.

GUILDHOUSE (Eccleston Square), at 3.30.—Dr. W. H. Eccles: The Influence of Wireless on Modern Life.

MONDAY, NOVEMBER 8.

UNIVERSITY OF LEEDS, at 5.15.—Prof. T. R. Merton: The Spectra of Mixed Gases.

UNIVERSITY COLLEGE, at 5.30.—Prof. G. E. Moore: Universals and Particulars. (Succeeding Lectures on November 15 and 22.)

TUESDAY, NOVEMBER 9.

MANCHESTER ROYAL INFIRMARY, at 4.15.—Dr. W. E. Gye: An Outline of the Knowledge gained by the Experimental Study of Cancer (Lloyd Roberts Lecture).

UNIVERSITY COLLEGE, at 5.30.—Dr. J. H. Jeans: Recent Developments in Cosmical Physics.

WEDNESDAY, NOVEMBER 10.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. Winifred Cullis Industrial Psychology applied to the Home.

THURSDAY, NOVEMBER 11.

BIRKBECK COLLEGE, at 5.30.—Dr. F. W. Aston: Atoms and Isotopes. (Succeeding Lecture on November 18.)

COLLEGE OF NURSING (Henrietta Street, W.1), at 5.30.—Dr. W. M. Feldman: The Contribution of Physiology to Social Hygiene.

KING'S COLLEGE, at 5.30.—Dr. A. Scott: The Restoration and Preservation of Museum Objects.

SATURDAY, NOVEMBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: The Life of a Sea-Urchin.

SUNDAY, NOVEMBER 14.

GUILDHOUSE (Eccleston Square), at 3.30.—Dr. E. E. Fournier d'Albe: Eyes and Ears of the Future.

CONGRESSES.

NOVEMBER 15 TO 18.

INTERNATIONAL CONFERENCE ON BITUMINOUS COAL: New Developments in Utilisation (at Pittsburgh).—Dr. F. Bergius: The Transformation of Coal into Oil by Means of Hydrogenation.—Prof. F. Fischer: Liquid Fuel from Water Gas.—Dr. C. H. Lander: The Present Status of Low Temperature Distillation of Coal in England.—Dr. R. Lessing: Coal and its Mineral Matter.—G. M. Gill: English Developments in Carbonisation of Coal in Gas Works.—H. Neilsen: The L. and N. Process.—General G. Patart: The Production of Methyl Alcohol from Coal.—M. R. Campbell: Our Coal Supply, its Quantity, Quality, and Distribution.—A. C. Fieldner: The Practical Value of Fundamental Research on Coal.—J. M. Weiss: Coal Tar Disposal.—C. J. Ramsburg: A Continuous Water Gas Generator.—Prof. S. W. Parr: Fundamental Studies on Coal as Related to Carbonisation Problems.—C. V. McIntyre: Development in Low Temperature Distillation of Coal at Fairmont, W. Va.—W. E. Trent: Some New Uses for Pulverised Coal.—Dr. W. H. Fulweiler: Utilisation of Bituminous Coal in the Manufacture of Water Gas.—Dr. H. C. Porter: Economic Aspects of the Pre-treatment of Coal for Smokeless Fuel.—H. Kreisinger: Powdered Fuel for Power Purposes.—R. M. Crawford: The Recovery of Phenols from Fuel Tars.—H. A. Brassert: Utilisation of Heat in Modern Steel Plants.—Dr. L. C. Jones: Coal in Relation to the Production of Fixed Nitrogen.—O. P. Hood: Smokeless Fuel.—Dr. W. P. Runge: The McEwen-Runge Process for the Low Temperature Distillation of Coal.—S. R. Church: The Utilisation of Coal Tar Products.—E. Piron: The Piron Coal Distillation Process.—O. Monnett: The Smoke Problem of Cities.—I. F. Laucks: The Greene-Laucks Process.

NOVEMBER 16.

NATIONAL CONFERENCE ON MILK IN RELATION TO PUBLIC HEALTH (at King George's Hall, Caroline Street, W.C.1).