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CONTENTS.

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Administration and Research in India.

WHATEVER may be the outcome in the immediate future of the political situation in India, and however it may be affected by the Round Table Conference now sitting in London, it must be remembered that pledges have been given which would result in the exercise of the effective power of government passing in an increasing degree into the hands of the Indian people. This is not the place, even if it were not too late, to enter into argument as to the wisdom of the course that has been adopted in handling Indian affairs; it is the outcome of a policy which was initiated long ago. Enlightened according to the ideas of its day, that policy, nevertheless, failed to appreciate the essential quality of the problem and the conditions which governed its solution.

Under our dominion in India, the administrative, executive, and judicial functions were long solely in the hands of British officials. In the native States with princely rulers, native institutions functioned under the supervision of a British political officer, whose duty it was in case of need to exercise a firm, if tactful, restraining influence over the head of the State. In both cases, control was vested in men trained in the traditions of a great service, men who looked for no material gain from the position they held. Nevertheless, however sympathetically exercised, this control was an alien control, the control of a foreign aristocracy in a conquered land—a condition with which India had been familiar from her earliest historic times.

With the spread of humanitarian and democratic ideals in the nineteenth century, as the Empire expanded, there grew up the conception of a tutelage of the backward races by the white man. To some this meant no more than the preservation of the *Pax Britannica* and an autocratic, if just and benevolent, rule which eliminated the more objectionable features of native custom, but on the whole left it very much where it was. The line of demarcation between the ruler and the ruled was rigorously observed. This was, on the whole, the point of view of Mr. Rudyard Kipling and on broad lines that of the Indian civilian. It did not preclude, and indeed more often than not was accompanied by, a very considerable understanding of native customs and ways of thought, as well as appreciation of their bearing upon the problems of government.

On the other hand, a more widely held, if perhaps less well informed, opinion regarded it as incumbent

upon the white man to raise the status of the native in the scale of civilisation and to train him to a point at which he would be capable of taking a part in the civic life and government of his country. However this aim is to be regarded as an ideal, there can be no two opinions, in the light of experience, as to the means adopted for its attainment. The end in view was to be attained by education—education, that is, on the European model—and a share in representative institutions when the time was ripe and the native had reached the necessary standard of civic responsibility. Hence we find the children of West Africa on their way to this desirable goal reciting in English lists of the capes and rivers of Great Britain!

In India the opportunity was readily grasped by certain classes of the population. Converts—too often solely *ad hoc*—thronged the missionary schools; universities, with curricula framed on English lines, flourished in the various provinces; and Indians were admitted to the Civil Service, the Bar, and the Bench. Gradually representation was introduced in the local and central councils, though tempered by an official British element; "India for the Indians" then became the cry of the political agitator. Home Rule was admitted as a not unreasonable claim.

The peculiar conditions of India have served to disguise the fact, which soon became apparent in dealing with the backward races in our other dependencies, that training upon European lines and through institutions other than those of the people themselves was not suited to their needs. India has a civilisation of her own with a long history behind it. For centuries her culture has attained high development on its own lines in the arts, in literature, in philosophy, and even in a science of its kind. Those of the Indian peoples to whom this culture was native were intellectual, intelligent, and of a singular flexibility of mind. They rapidly assimilated European ideals and methods of education, at least superficially. Their success in law, in medicine, and in some branches of science has been conspicuous both in their own universities and in those of Europe.

The undoubted intellectual ability and adaptability of a certain section of the population and the clamour of agitators who loudly proclaim their hostility to a 'foreign' rule have led many into thinking not only that India is capable of self-government, but also that Indian rule for India will bring peace and an absence of friction in the work of administration. In truth, all that will have been done will be to take the administration from one race and hand it over to another which will not necessarily stand in much closer relation to the population of its jurisdiction than the European. The educated Indian in number represents an exceedingly small percentage of the total population.

The problem of the government of India, the real India, remains unchanged. India is still not one, but many. The lack of unity arising from differences of caste and of race will still be there. The multiplicity of creeds will persist, even though Hinduism may seek by the imposition of an official pantheon and a common name to mark off its millions, with their varied beliefs and their local godlings, from Mohammedan and Parsi. The customs and modes of thought of the peasant population, the wild tribes, the hill men, the nomads, and the outcasts may well be as strange to the educated Indian as they are to the English civilian fresh from his university. In the recent examination for the Indian Civil Service, it would appear that of the twenty-four successful candidates from all parts of India, the big majority were Hindus. In a country so vast as India and varying so profoundly in custom and sentiment, in what respect does any one of these when outside his own district, his own race, and his own creed hold the advantage over the English civilian? Differences of caste, of race, of religion, and of culture will still have to be bridged. Sympathy informed by knowledge will be no less an essential of good and efficient rule.

The mass of the Indian peoples is indifferent to politics; its vital interests are moulded by its religious beliefs. Whatever may be the form of constitution ultimately adopted, in the last resort its efficiency, in view of the peculiar character of Indian conditions, will rest on the relations of the district official with the people under his jurisdiction. It should be unnecessary to labour the point that this depends upon an intimate knowledge of racial character and religious and social customs. This goes deeper than the broad distinction between Mohammedan and Hindu, or even the major differences within the latter group.

It has frequently been pointed out that the intimate knowledge such as is here held necessary demands intensive study. In the records of the Indian census, in the pages of Risley, of Crooke, and of the many others who have written on the customs and beliefs of the peoples of India, is much invaluable material to form the groundwork of such study; but none would deny that in the collection of information bearing on the ethnology

and culture of the Indian peoples much still remains to be done. Whatever change may be brought about in the government of India, this work should be continued.

There can be no question that the Indian university will have an increasingly important charge in the future of the country. With it will lie a great part in educating the administrator and in preparing him for the performance of his function in the government of his country. In the past, it must be admitted, the curricula of the universities have in too great a degree looked to western culture for inspiration. It is true they have not neglected Indian studies; but even in these, especially in earlier days, they have fostered the literary and speculative bias of the native of India, and especially of the native of Bengal. In Indian studies, literary and textual criticism of the Indian classics, philosophy, epigraphy, and the study of literary historical sources have prevailed, to the almost entire exclusion of the problems and conditions of the living India.

In another column we refer to the records of research which have been carried out at the University of Allahabad in recent years. It is there pointed out that great stress is now laid on research in university work. These records indicate the importance which, to-day, is attached to practical work in the natural sciences. On the other hand, in the more specifically Indian side of the work research is almost exclusively literary. Without in any way attempting to minimise the importance of these studies in their bearing upon the history and culture of India, it is permissible to suggest that the universities have a great field for research at their doors. The ethnology, the social anthropology, and the economics of the Indian peoples are matters of vital importance which call for investigation. These are fields to which the natives of India themselves have paid too little attention. Among them it is true there are a few now living who have earned a world-wide reputation by their devotion to anthropological studies; of some whose activities have recently turned in this direction it would not be too harsh to say that their theories have been coloured by their political prepossessions. In view of the practical importance of these studies for the future good government of India, the universities would do well to encourage research in the laboratory and in the field. Incidentally, by so doing they would effect a valuable and much-needed contribution to the advancement of anthropological knowledge at large.

Physics and Reality.

The Mysterious Universe. By Sir James Jeans. Pp. ix + 154 + 2 plates. (Cambridge: At the University Press, 1930). 3*s*. 6*d*. net.

WHY do we call the universe mysterious? Is it because we know so much about it or so little? The impression left by Sir James Jeans's fascinating book is that it is because the interpretation given appears more fantastic than that which is interpreted. Perhaps the only true mystery is one which is not destroyed by solution.

We exist as the result of an accident to the sun some 2000 million years ago. The stage thus being set, the actors unaccountably appeared and began to interrogate their surroundings. To primitive man simple things were obviously regular, while complex things were apparently capricious. Caprice was more impressive than monotony, and the universe was thought of as anthropomorphic. As time passed, more attentive observation caused a continuous transfer of phenomena from the category of caprice to that of regularity, and the universe was accordingly reinterpreted as a machine. In these last days the machine has broken down, and left a thought-form which is the present physical conception of the ultimate nature of the world and appears to bring us back to caprice, rechristened 'indeterminacy', as the original source of events.

Such is the panorama of scientific history which Sir James Jeans shows us. With a wealth of apt illustration he traces its course, showing in detail how the relativity and quantum theories have led up to the present position, and in conclusion describes his philosophy of the universe as a thought in the mind of a controlling mathematician who has no perceptible emotion, morality, or æsthetic appreciation.

It is admirably done. Despite a few infelicities—the result, apparently, of undue haste—we know of only one book on the same themes which deserves comparison with it. It is difficult to conceive of a more excellent account of the recent developments of physics for the general reader. Most readers, however, will be chiefly interested in the summing-up, and this we find not so admirable. Sir James's review of mankind's successive attitudes towards the universe is too summary to include transition stages, and one of these seems to us, in view of recent developments, to be of the greatest significance. Let us try to indicate it by presenting two different points of view taken in scientific work and thought.

The intellectual habit of the Middle Ages was one of brilliant but unbridled ratiocination based on arbitrary elements of thought. The battle which, in the seventeenth century, was fought and apparently won by the pioneers of modern science was for the exclusion from philosophy of all data which were not directly derived from observation. Galileo and Newton regarded with a not unnatural horror the introduction of hypotheses to correlate observations, and, with as much consistency as is possible to human beings, they preached and practised a philosophy from which hypothetical causes of phenomena were rigorously excluded.

Time passed, and the scientific description of Nature on the new principles went steadily on. But one momentous day something new occurred. The little imp which is always ready to suggest unorthodox devices to the eager investigator whispered in someone's ear: "You want to correlate observations unconfused by arbitrary ideas based on imagination or dead authority? Very good; but the refusal to be dominated by imaginary notions does not require you to abstain from leading them in chains. Why not invent existences—call them 'parameters' if you like, as the mathematicians do—to serve as connecting links between observed phenomena? You may find that one or two such existences will suffice to correlate whole masses of observations which otherwise would remain independent and disconnected, and lead to the discovery of who knows how many new phenomena. You will have sacrificed no principles and betrayed no trust." So it was done. Atoms and an ether were conjured up, and all went as the imp had said, with a success indeed far beyond his boldest insinuations. These conceptions in turn gave place to electrons, protons, photons, probability waves, and what not, as the attack grew more breathless, until to-day the most widely diverse of Nature's secrets, in the heavens or under the sea, are strung together by a few 'quantum numbers'.

It is all very wonderful, but in the meantime what has happened? Just what has occurred so often before: the creature has taken control of the creator. The conceptual scheme of physics is no longer merely an instrument by which observations are correlated; it is the 'reality behind phenomena'—or rather our nearest approach to the reality, for the scheme is not yet complete. So that, to reach reality, we have to strip experience of everything that can be seen and felt and enjoyed, until we come down to the inexpressible thought-essence of a hypothetical skeleton.

That, however, is not the worst. Not only must phenomena hide their diminished heads; but, also, they are not allowed even in obscurity to wear their own expression. We observe a determinism in the physical world. The scheme requires that it is a statistical determinism; therefore it is not determinism. We observe that Nature proceeds by laws. The scheme requires that they are laws of chance; therefore they are not laws. Sir James Jeans does not finally commit himself to this view, but that appears to be only because he is not yet convinced that the behaviour of electrons will not later turn out to be determined. The one thing which emerges clearly from all this, is that, if these ideas are generally adopted, the spoils of victory have passed from Galileo to the Aristotelians. Galileo will not have suffered in vain, it is true, for three centuries have acknowledged his triumph; but the future will belong to his enemies.

Let us make our position clear. We do not wish to exclude hypotheses from science—that would be absurd at this time of day—but they must not be allowed to usurp a position to which they have no title. Their function is to facilitate the correlation of phenomena, not to pose as the sole prophets of God. Science cannot remain bound by restrictions which in the stress of battle the seventeenth century pioneers felt bound to impose. It must move, but it should move forwards and not backwards. We do not want the 'problem picture' in next year's Academy to represent the triumphant Aristotelians raising over the prostrate body of Galileo a banner bearing the inscription, 'The Reality behind phenomena is Pure Thought'. Rather would we see the seed which Galileo planted blossoming into a tree, rich beyond his conception indeed, but still bearing seeds of its own kind.

We can follow Sir James Jeans through the maze of present-day physics, and do so gladly, charmed by the facile mastery of his exposition, which is so obviously the child of clarity and depth of thought. But when he attempts to discuss the status of physical conceptions in the world of realities, in an utterance which will be accepted as the authentic voice of science by thousands who seek guidance in matters of philosophy and religion, we feel strongly that he is darkening counsel, not by words without knowledge, but, much more dangerously, by knowledge without equivalent balance of judgment. Physics has much to say at the present time; there is no need for it to speak for other departments of thought and feeling as well.

HERBERT DINGLE.

Lavoisier and the Study of Combustion.

The Eighteenth Century Revolution in Science—The First Phase. By Dr. Andrew Norman Meldrum. Pp. vii + 60. (London, New York and Toronto: Longmans, Green and Co., Ltd., n.d.) 4*s.* 6*d.*

TWENTY-FIVE years ago the author of this book placed chemical teachers and students under a lasting debt by the publication of an essay on "Avogadro and Dalton"—a very careful historical and critical discussion of the standing in chemistry of their hypothesis. Incidentally it was shown that many inaccurate statements on the subject were current at the time in the literature presented to students of chemistry, and a real service was done by putting matters in a clear light.

Dr. Meldrum now reappears, handling in the same thorough way a topic of no less interest to students of chemical history—the work of Lavoisier during the four years 1772–75. These years he calls "the first phase" of the revolution effected by Lavoisier, for they culminated in his realisation of the individuality of oxygen, of its place in the atmosphere, and of the part it plays in processes of calcination and combustion. This is, of course, one of the turning-points of chemical history that no teacher or student can disregard. It also marks a region where there has been strife on matters of credit and conduct, with the importation at times of uncomfortable patriotic fervour, and it is one where there was good occasion for Dr. Meldrum to exercise his powers of elucidation.

The book is based mainly on an intensive study of (1) Lavoisier's Memoirs and Journals (so far as the Journals are accessible through Berthelot's "La Révolution chimique—Lavoisier") and (2) Bayen's and Priestley's publications. The result is a historical analysis of great interest and value, which gives the feeling that the author, with a mind sternly braced against the access of prejudice, has got down as deeply into the facts as available materials allow. Until the Lavoisier correspondence is published, it does not seem likely that we shall get more light on the subject.

What Dr. Meldrum has done is to trace out with minute care the course of Lavoisier's thought, experimental work, and publications from the time (1772) when he was seized with the idea that was thenceforth to dominate him. In the sealed note deposited with the Paris Academy of Sciences in November 1773, Lavoisier records his observation of the increase of weight during the combustion of sulphur and phosphorus and the fixation of "an immense quantity of air". He believes that the same will be found to apply generally to processes of combustion and calcination. The discovery he describes as "appearing to me one of the most interesting of those which have been made since the time of Stahl". How Lavoisier had come to begin his experiments Dr. Meldrum has found no indisputable evidence. He does not mention the view, taken by M. Le Chatelier, that Lavoisier was turned to the study of combustion by having competed in 1766 for an Academy prize on the subject of street lighting. Whatever may have been the stimulus, it is clear the Lavoisier conception of the fixation of air as the general cause of the increase of weight in combustion processes flashed into his mind and became a fixed light that no embarrassments from experiment, no errors in deduction, no hostile criticism could dim.

Dr. Meldrum emphasises again and again the importance of recognising this, in following the course of Lavoisier's work and in trying to understand his relation to those who had been working or were working in the same field. Though at a later date, writing to Joseph Black, he describes himself as having been accustomed to regard Black as his master, there seems no reason to doubt that when Lavoisier made his initial discovery he was unaware of the work of Black, and that he shared abundantly the confusion of mind about gases and the gaseous state that then prevailed and was likely to continue as long as phlogiston held the field. Lavoisier comments on the conspicuous neglect in France of the study of gases. His realisation of the possibility of following processes of gas absorption and gas emission during chemical changes by use of the balance now gave him a fixed principle. When he surveyed the existing records he found only "separate pieces of a great chain". "These authors", he says, "have joined only some links of the chain."

In a memorandum, which Dr. Meldrum gives good reason for dating February 1773, Lavoisier enlarged upon his new ideas and the prospects of discovery which they opened. "The Memorandum", says Dr. Meldrum, "has a note of exaltation and even of inspiration. Nothing like it can be found in Hales, Black, Cavendish, Priestley, Scheele." It may be judged from this how far our author is from any tendency to under-estimate Lavoisier.

Following upon these preliminaries, we are taken through the record of Lavoisier's progress as detailed in the "Opuscules physiques et chimiques", published in January 1774. This part of Dr.

Meldrum's book shows him at his best, and it may be strongly commended to those who are concerned with the teaching of the history of science, where the chief difficulty is to get students to orient themselves into the conditions of a past age and the state of earlier thought. The mere reading of the old masterpieces, such as are published in the admirable series of the Alembic Club, does not suffice to free the mind from astonishment that great men should have been so slow to find the way that now seems so plain, and to have made mistakes that now appear so gross. Nothing, perhaps fortunately, is likely to make the student believe that the same sort of thing is happening with the great men of to-day; but the discussion of Lavoisier's progress, as elucidated by Dr. Meldrum, is as illuminating an example as could be desired of the historian's art applied to scientific discovery.

The concluding chapter of the book is entitled "The Effective Discovery of Oxygen", and here the author is compelled to enter upon the ground where so much controversy has taken place on matters of conduct. We say that Dr. Meldrum has been 'compelled' to enter upon this ground, because it should be clearly understood that the purpose of the book is not controversial. It is to record the history in detail of the first phase of Lavoisier's work—that on combustion—"which led to a revolution in chemistry and even in science", but this necessarily involves particularities relating to the discovery of oxygen.

Dr. Meldrum says in the preface that he presents fresh conclusions on this subject. This does not seem to be quite the right expression, for his 'conclusions' are in essence those which have been reached by others. What Dr. Meldrum does that is fresh is to exhibit in clear detail the course of thought of Priestley and Lavoisier, and to show exactly how Priestley's work helped Lavoisier out of his difficulties.

It is perhaps too much to expect that the book will not be challenged upon its accuracy in some details, and possibly upon some of its conclusions, but we may surely hope that it will not hurt any susceptibilities. On the contrary, it gives a faithful picture of the times and of the confusion of thought on matters that are to-day the schoolboy's elements of chemical knowledge. It shows how easily both discoveries and mistakes of capital importance could be disregarded by the participants, and how far the true history of the modern doctrine of combustion is from being a simple tale that he who runs may read, or one where he can easily apportion praise or blame. A. SMITHELLS.

High Voltage Cables.

(1) *High Voltage Cables: Theory and Practice of their Design and Operation.* By P. Dunsheath. (The Specialists' Series.) Pp. xii+161. (London: Sir Isaac Pitman and Sons, Ltd., 1929.) 10*s*. 6*d*. net.

(2) *High Voltage Cables.* By L. Emanueli. Pp. vii+107+9 plates. (London: Chapman and Hall, Ltd., 1929.) 8*s*. 6*d*. net.

(1) IT seems quite certain that there will be a great demand for high voltage cable for many years to come. In 1924 the consumption of electric energy per head of the population in Great Britain was 100 units. To-day it is more than 150 units, and it is highly probable that by 1940 it will be three times as large. The saturation point is a long way off, and the effect of reducing the number of the supply stations and increasing their size will be to raise continually the pressure of transmission. The demand for high pressure cables, therefore, will go on increasing.

In the book under review, the author first deals with the economic factors that have to be taken into account in high voltage transmission. He next discusses the properties of the insulating materials used in the cables. The question of how the dielectric withstands the electric stress applied to it is still uncertain, but there is no uncertainty about the effect of intersheaths in raising the factor of safety of cables. The chapter on belted, screened, and S.L. cables will be very helpful to students as these types of cable are not yet described in the ordinary text-books. There is also a useful chapter on the current rating of cables and the stability of their dielectrics. The thermal resistivity of a dielectric is defined as the difference of degrees Centigrade required to be maintained between the opposite faces of a centimetre cube of the material so that an amount of heat equivalent to an electrical watt may be transferred continuously across the cube. This definition or something like it is frequently used by engineering physicists, but it seems to us very clumsy and indefinite. Teachers will doubtless improve it. We prefer Fourier's definition. This book is to be commended.

(2) L. Emanueli is the chief engineer of the Pirelli Cable Works in Italy, and he is well known as one of the leading experts on high voltage cables. He has continued the excellent work done by Jona, one of his predecessors. At the Milan Exhibition, so far back as 1906, Jona exhibited cable which had successfully withstood a pressure of 150,000 volts for an hour.

The author in this book points out that the presence of gaseous films and pockets in the dielectric is a frequent cause of breakdown in cables. The presence of highly ionised gas in the small cavities causes distortion of the electrostatic field and a tangential stress is produced above the surfaces of the paper strips. At high stresses gases can migrate through the paper sheets under the action of the ionic bombardment. Thus an ionised path is built up in the direction of the conducting path and breakdown will ultimately result. In the United States there are oil-filled cables operating at 132,000 volts. There is a central duct in the cable which is filled with oil. There are experimental cables also operating at very high pressures in Germany, England, and Italy. In Italy, an oil-filled cable has been operating for a year at 70,000 volts. This book will be of interest to cable engineers.

Our Bookshelf.

Der adsorbierende Bodenkomplex : und die adsorbierten Bodenkationen als Grundlage der genetischen Bodenklassifikation. Von Prof. K. K. Gedroiz. Nach der 2 Auflage des Originals aus dem Russischen übersetzt von H. Kuron. (Sonderausgabe aus den *Kolloidchemischen Beiheften*, herausgegeben von Prof. Dr. Wo. Ostwald.) Pp. viii + 112. (Dresden und Leipzig : Theodor Steinkopff, 1929.) 5 gold marks.

THE translation from Russian into English of a series of pioneering papers by K. K. Gedroiz was in a large measure responsible for focusing attention on the importance of the cation exchange process and the colloidal complex in the interpretation of the properties of soils. A German translation has now appeared of an important paper in which Gedroiz surveys the more recent work, especially in the U.S. Bureau of Soils, the Sudan, and Russia, on the composition and properties of the inorganic colloidal matter of soils, and then attempts to build up a system of soil classification based on the chemical composition of the adsorbing complex. In the present stage of our ignorance of the nature of the soil organic matter, Gedroiz restricts himself to the inorganic colloidal matter. He raises doubts as to the wisdom of the present tendency to identify this colloidal matter with the clay of mechanical analyses, and would prefer to use $0{\cdot}25\mu$ as the upper limit for particle size of colloidal clay instead of 2μ.

After discussing the exchangeable bases responsible for the development of chernozem (or saline) and solontschak and solonetz (or alkaline) soil types, Prof. Gedroiz proposes a method of distinguishing between the acid unsaturated podsol soil and those acid solodi soils derived by breaking down of alkali soils. The so-called amorphous silica soluble in 50 per cent potassium at 100° is greater in the solodi than in the podsol.

Nature Rambles : an Introduction to Country-Lore. By Edward Step. (The "Come-with-Me" Books.) *Winter to Spring.* Pp. vii + 152 + 31 plates. *Spring to Summer.* Pp. viii + 152 + 31 plates. *Summer to Autumn.* Pp. viii + 152 + 31 plates. *Autumn to Winter.* Pp. viii + 152 + 31 plates. (London and New York : Frederick Warne and Co., Ltd., 1930.) 2*s.* 6*d.* net each.

THIS collection of four volumes, divided, as their titles suggest, into the four natural seasons, fulfil one object in making fascinating reading. The author is also to be congratulated on the many splendid illustrations and especially the photographs. Apart from this, the utility of the book is questionable. From an academic point of view, it is practically useless. Besides, a real lover of Nature would prefer to study her along his own lines, rather than along those set out by another. A guide is useful ; but this book can scarcely be recommended as such. Placing observations of this type on an ecological basis demands the consideration of causal relationships between habit and habitat. To know the external morphology of a marsh-marigold and to be able to name it on sight is not so useful as to try to find out why it invariably grows in water-logged soils. The author must plead guilty to omitting this important branch of Nature study.

However, the book justifies itself, in that it will take the town-dweller out into the country-side without even leaving his armchair ; but he who finds it possible would be well advised to get hold of a good 'flora' and 'fauna' and tramp the country himself.

Old Age, the Major Involution : the Physiology and Pathology of the Aging Process. By Prof. Aldred Scott Warthin. Pp. xvi + 199 (11 plates). (London : Constable and Co., Ltd., 1929.) 15*s.* net.

Two years ago, Dr. Warthin, professor of pathology in the University of Michigan, delivered a lecture before the New York Academy of Medicine on the subject of old age and the aging process. The lecture attracted so much attention that Dr. Warthin was induced to extend it into the form of this most interesting monograph.

The curve of the individual human life, he says, shows an ascending portion, the period of growth or *evolution* ; its apex, a relatively short plateau of *maturity* ; and the descending portion, the period of retrogression or *involution*. The involution processes, he contends, are essentially physiological in nature, and old age is to be considered as a normal involution and not as a pathological process. He argues his case as a scientific man addressing scientific men. But he does not disguise his hostility to "modern futilities of life-extension of the individual to extreme limits and of possible rejuvenation", and his hope that on such a scientific foundation as he lays there may be built a working philosophy of life.

We have given a bare indication of the contents of a book which is replete with interest, even to the non-medical reader. The descriptions of the successive stages of human life, down to and including senescence and actual old age, are of value, apart from the main purpose of the book.

Letters to the Editor.

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

The Ether and Relativity.

THE remarkably eloquent Rede Lecture and subsequent small book on "The Mysterious Universe", in which Sir James Jeans seeks to envisage the trend of modern physics in a philosophical direction, will, as is said in the News and Views columns on page 731 of NATURE of Nov. 8, awaken much thought and some disagreement: a result which the conclusion of his preface seems to desire. Certainly he does not scruple to press his conclusions with the utmost boldness wherever they apply, and to display their bearing in many surprising directions. The fact that his contentions about modern physics go far in a direction which specially appeals to me makes me the more critical of what seem their weak points, and a friendly reference may be made to a few places where I join issue with him. He is not an easy person to disagree with, for his knowledge is profound; but one point concerns the meaning and existence of an ether.

As a standard of rest the ether has failed to give any sign, and no experiment made to determine absolute motion has yielded any result except zero. This has been spoken of as a conspiracy, but it may be due to extreme uniformity; it would follow if one and the same perfect substance fulfilled all the functions, while capable of only one speed of transmission, so that differentiation became impossible. I claim that the suggestion is not absence of qualities but perfection. We have had no previous acquaintance with a medium that was "faultily faultless, icily regular, splendidly null", and we are disconcerted; so that (in 1905) we postulate the dictum "Nature is such that it is impossible to determine absolute motion by any experiment whatever", and are tempted to say that any space-filling medium is imaginary.

Sir James Jeans, in his animadversions on the ether of space as a figment of the imagination, quotes with approval a sentence of mine in which I may seem to have given away too much in the effort to secure a kind of general agreement. The sentence quoted runs thus:

"The ether in its various forms of energy dominates modern physics, though many prefer to avoid the term 'ether' because of its nineteenth century associations, and use the term 'space'. The term used does not matter much."

Jeans's comment is:

"Clearly if it is a matter of indifference whether we speak of the ether or of space, of the existence or non-existence of the ether, then even its most ardent devotees cannot claim much objective reality for it."

This use of my admission seems to contain a kind of unfairness. In one of Bernard Shaw's plays, a Roman captain, reasoning with a Christian captive about her prospective martyrdom for not throwing incense on the altar of a heathen god, says, in answer to the plea that she could not sacrifice to false gods:

"Sacrifice then to the true God. What does his name matter? We call him Jupiter. The Greeks call him Zeus. Call him what you will as you drop the incense on the altar flame: He will understand."

That might be quoted as if it were atheism, but it might also be understood as representing a high faith. I wonder that the Christian depicted in the play was able to withstand the argument.

So when I say that for the sake of peace and agreement I am willing to call the ether 'space', or that the name does not matter, I am not implying any disbelief in it, but rather a secure faith which rises above questions of nomenclature. The fact is I am instinctively unwilling or unable to go all the way with Jeans, and to think that nothing exists but mathematical abstractions. The old idea of some kind of a mechanical explanation still has its hold upon me. I have abandoned the old material ether of Lord Kelvin and the nineteenth century, in favour of some hydrodynamic or other perfect mechanism at present unknown. I want a medium with physical properties which can in due time be ascertained and comprehended. I do not suppose that it can be constituted of any kind of matter, or expounded in terms of engineering, and yet I still am unwilling to leave it as a mere abstraction, without properties that can be ascertained; and those properties I at present seek in terms of something physical, responsible for all the activities that have been found existing in space. I am unwilling to shut the door on future discovery, and say that we deal with nothing but abstractions.

Sir James Jeans eloquently contends that the universe is more like a "thought" than anything else, a product of some mind. I have no quarrel whatever with that, but what we know about thought suggests that it requires some physical mechanism to express itself; and that physical though immaterial mechanism is what I seek to understand.

There is one deep-seated contention in which I find myself totally differing from Sir James Jeans, when he says that the theory of relativity not only enables space and time to be unified and treated together in equations and diagrams, but also when he virtually implies that time really *is* one of the dimensions of space. This doubtless was the contention of Minkowsky, who went so far as to say that "space and time separately have vanished into the merest shadows, and only a sort of combination of the two preserves any reality". But it is not in accord with sense or experience to treat time as an actual dimension of space. In the sentence in which Jeans specifically adopts this unification, on page 110, he virtually renders it nugatory by introducing $\sqrt{-1}$ as a necessary factor; having previously taken the velocity of light to be unity. To turn time into space really requires that time shall be multiplied by some velocity and by $\sqrt{-1}$. This is what the four-dimensional mathematicians do, though they did it so long ago that they may have half-forgotten. It is not t, but ict, that is their fourth dimension. With that I have no sort of quarrel. It is equivalent to saying that time is time and not space, that it can be merged with space in an equation, but that it is always kept separate from space, and can be dissected out at the end; for directly the i is removed it reappears as time. The $\sqrt{-1}$ secures it from admixture or confusion.

Jeans treats this unification of time with space as an essential part of the theory of relativity. It seems to me accidental and subsidiary, a practical device rather than a fundamental theory. As to taking the velocity of light as unity, that is another shorthand device, only dangerous if it is forgotten, for neither ingenuity nor habit can really turn a velocity into a pure number. I am willing to grant that an absolute velocity exists, and that space is affected by it; but that very affection makes space something more than geometrical. Space is thereby endowed with a physical quality.

One way of pouring discredit on the ether is to

speak of many ethers; and Jeans goes on to speak of an ether as belonging to each of us, which is indeed nonsense. He elaborates this absurdity on page 104, likening it to the carrying in a shower of rain, not indeed each his own umbrella, but our own rainbow.

All concrete things, in Jeans's philosophy, seem to vanish in a maze of abstractions. Even the waves of which everything is supposed to consist are thought of as abstractions before he has finished, though he has to admit that, as shown on Plate 2, page 42, they are real enough to be photographed. Needless to say, many of his illustrations are helpful; for example, his illustration of the welding together of different dimensions on page 99. Also his parable of the winding river, on page 147, though the moral is that an explorer ought not to be too confident about the direction in which the river is flowing, merely because it happens to be trending in one direction during his particular epoch. The book is full of happy and interesting applications and illustrations, and throughout is absorbingly interesting.

In so far as Jeans exhibits the tendency of modern physics in an idealistic direction, I have naturally no quarrel and welcome his support. Only I do not feel that his contention, that a mathematician alone can hope to understand the universe, is one that will stand scrutiny or substantiate itself. An artist might make another claim. That the Divine Mind can deal with abstractions more fully than any mathematician may be granted, but an Infinite Being has no limitations. His dealing with the abstract does not prevent His also dealing with concrete realities, or cause Him to abstain from attention to the utmost minutiæ. The absence of causation now postulated for the atoms and electrons, because we can only deal with them with any exactness in a statistical manner, is a sign of human limitation, and is not to be thought of as anything ultimate. The 'principle of uncertainty' is not a thing to pride ourselves on, except as a true representation of the present state of our knowledge. The fact that the quantum h enters into it, means that there is more to be discovered. The Divine Artificer does not work with the calculus of probability. The free will of which we have experience is not to be explained as a result of physical indeterminism, though the present appearance of indeterminacy is a sufficient answer to those dogmatists who would wrest the findings of science to make such a thing as freedom impossible. It is useful in so far as it knocks the ground from under their feet, and leaves them without a leg to stand on.

Finally, on the question of the existence of an ether I appeal to the testimony of a greater even than Sir James Jeans. In his book "Sidelights on Relativity", Einstein says, on pages 16 and 17:

"To deny the ether is ultimately to assume that empty space has no physical qualities whatever. . . . Newton might well have called his absolute space 'Ether'."

And on page 23:

"Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable."

I entirely agree; whenever we leave mathematical abstractions and attempt to contemplate what is really happening, or happening in a physical sense, the discontinuity of matter must be supplemented by a continuous medium full of energy; which medium, I venture to say, is used as the instrument for causing and guiding all perceptible motions.

OLIVER LODGE.

Normanton House, Lake, Salisbury Plain,
Nov. 10.

Genetics, Mathematics, and Natural Selection.

IT is a great honour to an author to have his book reviewed by the principal surviving advocate of the theories he has attacked. The only drawback to this honour is that the faculty of criticism, especially perhaps of impartial criticism, is very unequally developed in mankind, and, with the most honourable intentions, many misstatements or other slighter misrepresentations are likely to result. I should like to confine my remarks to six of these from the review of my book in NATURE of Oct. 18, which, I am sure, Prof. R. C. Punnett will be as glad as I to see decently buried. They can all be easily verified.

(*a*) "Dr. Fisher deplores the cleavage between the mathematical and the biological mind".

Actually, I deny the existence of such a cleavage; and that although I am well aware that a few of the more conservative geneticists are feeling sore, and even anxious, about the increasing tendency of biologists to use mathematical methods. Such a feeling may be worthy of biological study, but is assuredly not characteristic of the biological mind, as I have exceptionally good reason for knowing.

(*b*) "the selective value of the mutation is regarded as in arithmetic proportion to its size, a view to which we fancy few biologists will be willing to subscribe."

My book is guiltless of any such assertion as this about mutations; on the contrary, an entire section (pp. 38-41) is given to examining why it is that, with highly adapted organs and organisms, the average selective advantage of mutations *falls off* with increasing magnitude.

As the author of the 'presence and absence hypothesis', it is natural that Prof. Punnett should dislike the theory of dominance I put forward; and as a poultry geneticist, that he should give undue prominence to the guess which, in the light of that theory, I have made as to the dominant genes found in the domesticated races of fowls. Such intensive interest might, however, have been accompanied by a higher level of accuracy:

(*c*) "Hence we must suppose that the mutational changes which give rise to dominant characteristics in domestic poultry show little or no influence in the wild form, that is, are either recessive or nearly so."

This may be Prof. Punnett's own inference; if it is intended to represent mine, as its context suggests, I must quote (p. 61) "not either completely dominant or completely recessive".

(*d*) "The mutant gene for crest must be regarded as having been brought in by the wild cock, in which it behaved as recessive to its uncrested allelomorph."

Nothing resembling this strange theory has been put forward by me.

Readers who remember the argument of Prof. Punnett's "Mimicry in Butterflies" will be interested in the following:

(*e*) "he seems rather uncomfortable about the way he disposes of Marshall, stating that we 'can neither assert that the Müllerian principle will work, nor that it will fail'."

Prof. Punnett must have been reading hurriedly; he has left out "so far as these arguments carry us", from before the passage quoted (p. 153). The arguments in question are Marshall's, and Dixey's answer, which effectively neutralised Marshall's argument.

(*f*) "He strives hard, we think unsuccessfully, to get round it [Marshall's argument]; for in doing so he has to postulate an intermediate state enjoying the advantages of both."

This is one of the postulates of which I say (p. 153) "both are clearly extreme assumptions; neither can be true generally". Naturally, this postulate does

not enter into the argument, only fourteen lines long, which I put forward as definitely disproving Marshall's conclusion.

Finally, I should not like to seem ungrateful for the many kind remarks in Prof. Punnett's review, which, in view of the distaste he inevitably feels for my opinions, whether rightly or wrongly understood, I must regard as extremely generous. I hope, however, it may be possible to correct these misstatements without making Prof. Punnett think, as he seems to fear, that I am trying to 'convert' him to any new ideas, or even that I am here challenging the excellence of his reasons for rejecting them. R. A. FISHER.

Rothamsted Experimental Station,
Harpenden, Herts, Oct. 22.

WITH regard to Dr. Fisher's six charges of misrepresentation I am glad to avail myself of the editor's courtesy and to make a few brief comments. These may conveniently fall under Dr. Fisher's six headings.

(*a*) This seems to me to be a mere quibble. Dr. Fisher states that "the types of mind which result from training in mathematics and biology certainly differ profoundly" (p. viii), and in speaking of a cleavage between them I fail to see that I am seriously misrepresenting him.

(*b*) In discussing the question of a critical point below which a mutational change may or may not have selection value Dr. Fisher writes, "If a change of 1 mm. has selection value, a change of 0·1 mm. will usually have a selection value approximately one-tenth as great" (p. 15)—a statement which seems sufficiently clear to serve as the basis of a "misrepresentation".

(*c*) So far as I am aware, no one has ever described a jungle fowl with a dominant domestic breed character, such as a crest, "not either completely dominant or completely recessive". Indeed, it is difficult to know what meaning to ascribe to the word *completely* when applied to a dominant such as a crest. For in my experience it is easy enough to distinguish between a crested and an uncrested bird, and in this sense the crest is always completely dominant. But the size of the crest may vary greatly, according to the comb factors, and doubtless also to other factors in the genetical make-up of the bird. Perhaps on some future occasion Dr. Fisher will explain to us what he means when he qualifies "dominant" by "completely".

(*d*) On this point I am at a loss to know what to add. For my own sake and for that of the readers of NATURE, I spent many hours in trying to translate Dr. Fisher's rather obscure account into language which should be intelligible to the ordinary geneticist; and now I am told that I have evolved a strange theory which has not been put forward by him. But if the mutant gene for crest did not come in through the wild cock, where did it come from? If it merely 'happened' in the domesticated form, Dr. Fisher's writings do not appear to bring us any nearer to a solution of the appearance of these dominant characters. For my own part, I should greatly welcome a clear account by Dr. Fisher—one intelligible to all of us mere geneticists—of what he considers to be the exact history of the crested gene, and of its manifestations, during the evolutionary history of a domesticated crested breed from the uncrested wild form.

(*e*) The "misrepresentation" here turns upon whether one accepts Dixey's answer as effectively neutralising Marshall's argument. Personally, I do not.

(*f*) On this point it is for the reader to judge between us. R. C. PUNNETT.

The Behaviour of Methane Molecules and Argon Atoms in Collisions with very slow Electrons.

IN a paper by E. Brüche on "Wirkungsquerschnitt und Molekülbau"[1] it is stated on p. 1105 that the curve which shows the variation of the effective cross-section of methane molecules with respect to slow electrons for different velocities of the electrons (we shall call these curves Q-$\sqrt{V}$-curves, since the velocity is given in terms of $\sqrt{\text{volts}}$) is of the argon type, namely, that as the velocity of the electrons decreases from 4 volts to 1 volt (that is, from $2\sqrt{V}$ to $1\sqrt{V}$) the Q-$\sqrt{V}$-curve passes through a maximum and then rapidly sinks to a much lower value. This result was also obtained by R. B. Brode.[2] In a later paper by C. Ramsauer and R. Kollath,[3] Brüche's Q-$\sqrt{V}$-curve is extended to still lower electronic velocities (to about $0{\cdot}39\sqrt{V}$) and is found to pass through a minimum. We have now determined the Q-$\sqrt{V}$-curve for methane by Townsend's diffusion method and have also found that the absolute value of the effective cross-section Q of methane molecules is very low, like that of argon, and that the Q-$\sqrt{V}$-curves of argon and methane closely resemble each other over the range of velocities investigated, which in our case was from $1{\cdot}74\sqrt{V}$ down to $0{\cdot}3\sqrt{V}$. The minimum Q obtained for methane by Ramsauer and Kollath was 4·7 cm.^{2}/cm.^{3} at a velocity of $0{\cdot}62\sqrt{V}$; our value is 4·3 cm.^{2}/cm.^{3} at a velocity of $0{\cdot}52\sqrt{V}$. The minimum in our curve is a little less sharp than in the curve of Ramsauer and Kollath.

The resemblance of the Q-$\sqrt{V}$-curve of methane to that of argon would suggest at first sight that the *molecule* of CH_4 behaves in collisions with slow electrons very much like the *atom* of argon. This is, however, by no means the case, as the following considerations show. It is a great advantage of Townsend's method that it gives information not only about the Q-$\sqrt{V}$-curve but also about the electronic temperature factor k, the drift velocity W in the direction of the electric force Z, and the average fractional loss of energy in collisions between the electrons and the gas atoms or molecules. These data cannot be obtained by Ramsauer's method, which gives the Q-$\sqrt{V}$-curve alone. In Townsend's method the shape of the Q-$\sqrt{V}$-curve for any particular gas is essentially determined by the succession of values of $W\sqrt{k}$ corresponding to successive values of Z/p, where p is the gas pressure. A comparison of the Z/p-k-curve obtained experimentally by us for methane with the Z/p-k-curve previously obtained by Townsend and Bailey for argon[4] shows great dissimilarity. For example, for $Z/p = 0{\cdot}2$ the k-values of argon, neon, and methane are 120, 62, and 4 respectively. The same is true of the Z/p-W-curves: at $Z/p = 0{\cdot}2$ the values of the drift velocity, W, of argon, neon, and methane are in the ratio 3·25 : 5 : 27. It will be noticed that whereas the k-values *decrease* as we proceed from argon to methane, the W-values *increase*. It is due to this compensating effect that the values $W\sqrt{k}$ run fairly parallel in the case of argon and methane.

A still more marked difference between the collisions of electrons with methane molecules and argon atoms is shown by the λ-$\sqrt{V}$-curves for these gases. These curves indicate that of all the gases so far investigated, including inert and non-inert gases, methane and argon occupy the two extreme positions within the region $0{\cdot}3\sqrt{V}$ to $1{\cdot}75\sqrt{V}$: the average fractional loss of energy in the collision of electrons with argon is less than in any other gas over this range. The fact that in the case of methane this loss is greater than for any

other gas and many hundred times greater than for argon, clearly proves that it is wrong to assume that the behaviour of a symmetrical molecule like methane towards slow electrons is fully similar to that of a symmetrical atom like argon, in spite of close resemblances in the Q-$\sqrt{V}$-curves.

Commenting on a recent paper by Brose and Saayman[5] in which Q-$\sqrt{V}$-curves obtained by Ramsauer's and Townsend's methods are compared, Ramsauer, after making friendly acknowledgment of the results obtained by Townsend's method, expresses the view that little credence would have been given to the results obtained by Townsend's method if this had not been confirmed by his own *direct* method. He also suggests that the writers of the paper just quoted convey the impression that their belief in the results obtained was also to some extent contingent on this confirmation.

We cannot agree with this view. The theory of Townsend's experiment is based on the ordinary kinetic theory of gases and no flaw has been detected in the calculation. The fact that k and W have been experimentally proved to depend only on Z/p gives striking confirmation of the theory.[6]

The above remarks concerning methane and argon show that Townsend's method possesses certain very decided advantages and gives considerably more information about the collision of electrons with gas atoms and molecules than Ramsauer's method, which, as in the present case, may easily lead to erroneous conclusions.

HENRY L. BROSE.
J. E. KEYSTON.

Physics Department, University College, Nottingham.

[1] *Ann. d. Phys.*, p. 1065 ; 1927.
[2] *Phys. Rev.*, **25**, 636 ; 1925.
[3] *Ann. d. Phys.*, **4**, p. 97 ; 1930.
[4] *Phil. Mag.*, vol. 54, p. 1033 ; 1922.
[5] *Ann. d. Phys.*, **5**, p. 797 ; 1930.
[6] See also a recent paper by J. S. Townsend, *Phil. Mag.*, **9**, p. 1145 ; June 1930.

Helium Ratios of the Basic Rocks of the Gwalior Series.

IN collaboration with Prof. A. Holmes, I have already published estimates of the ages of the Whin Sill and the Cleveland Dyke based on the helium ratios of these rocks (NATURE, May 25, 1929, p. 794). We came to the conclusion that the method offers great scope for the correlation of fine-grained basic igneous rocks when direct geological evidence is lacking.

I have since undertaken a similar investigation of the basic lavas and intrusions of Gwalior with the intention of testing the effect of texture on the retention of helium and of estimating as closely as possible the geological age of the series. The uranium and thorium determinations were made in the laboratory of Prof. H. Mache at the Technische Hochschule, Vienna. For the determination of the helium contents in these samples, as well as in those of the Whin Sill and the Cleveland Dyke previously mentioned, I am indebted to Prof. F. Paneth, in whose laboratory a special technique for the measurement of very small quantities of helium has been developed (NATURE, June 1, 1929, p. 879 ; Mar. 29, 1930, p. 490). The results, obtained in Prof. Paneth's laboratory by his assistant, Dr. K. W. Peterson, are recorded in the adjoining table. The ' age ' (in millions of years), which is to be regarded as a minimum in each case, is calculated from the formula $8{\cdot}5\text{He}/(\text{U} + 0{\cdot}29\text{Th})$ where U and Th are percentages and He is the volume in c.c. at N.T.P. in 100 gm. of the mineral (A. Holmes and R. W. Lawson, *Am. Jour. Sci.*, April 1927, p. 334).

The four rocks investigated all come from the Morar group of the Gwalior Series and are geologically of the same age. No. 1 is from a fine-grained basalt flow. Nos. 2 and 3 are from sills and are medium-grained

Localities.	Ra$\times 10^{12}$ gm./gm.	U$\times 10^{6}$ gm./gm.	Th$\times 10^{6}$ gm./gm.	He$\times 10^{6}$ c.c./gm.	'Age' in 10^{6} years.
1. Belaki-Bauri .	0·17	0·51	1·7	55	466
2. Santowa Temak	0·18	0·54	1·5	42	369
3. Paniar . .	0·23	0·69	2·4	31	190
4. Dhaneri . .	..	..	..	11	..

dolerites of much coarser grain than the first rock. No. 4 is also from an intrusion, but is very coarse-grained. From these results and those previously published, it is clear that helium is more satisfactorily retained by fine- rather than coarse-grained basaltic rocks. With a coarser grain, fractures tend to develop along the crystal boundaries, where the radioactive elements, and the helium liberated by them, tend to be concentrated. Thus the coarser rocks are more liable to lose part of their helium content than those of finer grain.

The Gwalior Series is included in the Purana group of India and is considered to be of Pre-Cambrian age, and possibly equivalent to the Keweenawan of North America. According to recent opinion, based on fossil evidence from the Suket shales near the junction of the Lower and Upper Vindhyan Series, much of the Vindhyans is now to be regarded as of Cambrian age (*Rec. Geol. Surv. India*, **61**, pt. 1, p. 21 ; 1928). In the Son Valley, acid lava flows are found in the Lower Vindhyans, while in Rajputana the flows are invaded by granites. It seems most probable that this manifestation of acid igneous activity marks the close of an igneous cycle that started with the basic lavas of the Gwalior Series. If so, the latter should be slightly older than the Lower Vindhyans. On the whole, the evidence supports the traditional view that the Gwalior lavas are of late Pre-Cambrian age.

I am indebted to Prof. Holmes for the information that an Upper Cambrian kolm from Sweden (investigated by the American Committee on the Measurement of Geological Time) gives a lead ratio of 0·056, pointing to an age of about 400 million years. No lead ratios are yet available for minerals known definitely to be of late Pre-Cambrian age ; but the thorianites of Ceylon, the pitchblendes of Katanga, and the uraninites of Morogoro are all considered on general grounds to fall somewhere within the Upper Pre-Cambrian, and their ages as calculated from lead ratios are all near 580 million years. The most reliable of the Gwalior rocks (No. 1) gives an age of 466 million years, in reasonable agreement with the geological evidence, with such lead ratios as are available as a check, and with the probability that a little helium may have been lost even from this specimen.

The data so far available have given the following results :

Tertiary . . .	Cleveland Dyke	26 million years.
Late Carboniferous .	Whin Sill	182 ,, ,,
Late Pre-Cambrian .	Gwalior basalt	468 ,, ,,

These encourage the belief that, given suitable material, a method is now available for dating fine-grained basaltic rocks. Even though the ' ages ' may be somewhat too low, and this is particularly to be expected in the case of older rocks, the method is sufficiently sensitive to distinguish the rocks of different igneous cycles, provided that these are not too close.

V. S. DUBEY.

Department of Geology and Mining, Gwalior State, India, Sept. 3.

Passage of an Electric Discharge through Gases.

WHEN an electric glow discharge is passed through a tube containing air at pressures of the order of 5 cm. of mercury, the tube lying in one of the two beams in a Jamin's refractometric arrangement, there is a sudden shift of the interference fringes indicating a decrease of the refractive index of air due to the passage of the discharge. A preliminary announcement of the effect has already been made in the columns of NATURE (vol. 120, p. 880), and a detailed account of the experiments published in the *Indian Journal of Physics*, vol. 3, pp. 425-430.

When the discharge is stopped there is an equally sudden shift of fringes in the opposite direction and of the same extent as before, showing that the air has returned to its original state. The switching on of the discharge also causes a sudden increase in the pressure of the tube as indicated by an attached manometer, the pressure getting back to its original value as soon as the discharge is stopped. There is an exact proportionality between the fringe shift and the pressure change; and since the fringe shift if greater than one fringe width cannot be quantitatively observed on account of the suddenness of the shift, the phenomenon is better studied by observing the changes in pressure.

The investigation, which was confined to air in the above-mentioned paper, has now been extended to hydrogen, oxygen, nitrogen, carbon dioxide, and chlorine with nearly similar results as with air, namely, that for a fixed value of the applied voltage the amount of shift or the increase in pressure varies with the pressure and becomes a maximum for a certain value of the pressure, which is different for different gases and for different voltages. The effect was found to be greatest in carbon dioxide and least in hydrogen. Experiments were also made using ammonia, sulphur dioxide, and helium. In the first two the results were vitiated by the decomposition of the gas taking place under the action of the discharge, whereas in helium the effect was only just noticeable, scarcely measurable.

In all the above investigations, electrodes were, as usual, sealed into the ends of small side-tubes attached to the experimental tube, so that the electrodes were rather far away from the track of the light beam. By pure accident, however, while experimenting with air, it was found that if the electrodes are long, coming up to the periphery of the discharge tube, or rather the light beam, the fringe shift as well as the pressure change could be observed even at atmospheric pressure and when no visible glow discharge was passing. Previously, when the electrodes were fairly far away from the edge of the beam of light, the fringe shift was a maximum at a pressure of about 5 cm. and was not appreciable at pressures below 4 mm. or above 10 cm. Also, in these experiments, a Tesla discharge had no effect upon the fringes. Under the new conditions, however, when the electrodes extend right up to the periphery of the light beam, both the discharge from the induction coil and the Tesla discharge produce a fringe shift even at atmospheric pressure, the effect with the latter being even greater than that with the former. The effect can thus be demonstrated very easily. It is not even necessary to close the ends of the tube to observe the fringe shift.

It is found that at atmospheric pressure the maximum effect is produced when the ends of the electrodes (which are in the form of long, stout wires or needles) are just at the periphery of the beam of light. If the end is moved into the path of the beam itself or moved away from the beam, the effect diminishes, until when it is only a centimetre away the effect disappears. Evidently, although there is no visible discharge, there is an electric field radiating from the tip of the electrode, and the effect is a maximum when the field embraces the greatest possible volume of the air. The conclusion previously arrived at, that the effect is due to a pushing away of the gas from the neighbourhood of the discharge, now receives ocular proof, for if a little lycopodium powder is dusted into the tube, it is seen that as soon as the field is put on, the lycopodium particles fly away from the electrodes.

J. B. SETH.
BAL MOKAND.

Physics Laboratory,
Government College, Lahore.

Properties of Dielectrics in Electric Fields.

IN NATURE of Oct. 25 is a communication from Mr. J. Mazur, under the heading of: "Change of the Dielectric Constant of Ethyl Ether with Temperature". This appears a suitable opportunity for raising a question to which I have previously alluded in several communications to the *Phil. Mag.* and in a long letter in NATURE of April 5, 1924. This is that of the nomenclature of the effects found in dielectrics in the wide range of alternating electric fields which have now for many years become increasingly available.

Let us take as a pertinent example the data given for ethyl ether in Mr. Mazur's interesting letter. An early attempt to find the dielectric properties of ether was made by Hopkinson. He first dried the ether by shaking it up with quicklime, and, using an induction coil to create the field, found K was 4·75. Although, however, there was only a small surface of the ether exposed to the atmosphere, within a few minutes K became 4·95 and thereafter observation became impossible, showing how very rapidly minute traces of moisture absorbed from the atmosphere alter the dielectric properties of matter. The above figure for K, and a slightly lower one due to Quincke, have long been quoted in leading tables of dielectric constants. The above experiments were at room temperatures.

Using a field of high frequency, Mr. Mazur finds for different temperatures the following results:

Temp.	K.	
+ 30·0° C.	4·18	
− 105·4° C.	12·39	
− 117·2° C.	2·3	(melting point)
− 118·9° C.	2·0	

Below this K is constant and is very near N^2 for ethyl ether, which is 1·84 for the D line.

In my letter mentioned above, I showed that at a range of frequencies between 8 and 2000, K for celluloid varied from about 12 to 6 at room temperature, and again, by intensive drying, K could be made to vary from about 8 to 4·8 at a low frequency. Similar examples could be multiplied.

Is it not time that physicists found better names for these varying effects than calling them dielectric constants? Faraday's name, 'specific inductive capacity', was less self-contradictory. Early in the century the term 'dielectric coefficients' came into use where the property was found liable to variation, but seems to have dropped out again, possibly as being too cumbersome.

Of late years numerous connexions between dielectric and other properties have been found, and Debye's theory of molecular polarity is receiving increasing experimental support. For these reasons and others, the confusion and inappropriateness of the present nomenclature in this field, and the doubt

as to what exactly the terms used mean, impedes progress. New and convenient terms are needed for expressing the quantities themselves and a general agreement as to the conditions under which the terms should apply. G. L. ADDENBROOKE.

35 Holland Villas Road,
Kensington, W.14, Oct. 30.

Ball Lightning.

PROF. R. W. WOOD'S letter in NATURE of Nov. 8, p. 723, is a valuable contribution to our knowledge of this type of lightning. His reference to increasing our knowledge by touching the globe perhaps calls for a word of warning. I think that touching the globe would certainly cause a very severe burn and might possibly also kill the experimenter. Many years ago I saw two globes of lightning. They were reddish yellow in colour and appeared to be rotating. One of them struck a building and burst with a loud report, causing the inhabitants to open the windows and look out to see what had happened, but as there was no trace of anything they looked bewildered. The other drifted away.

Prof. Wood quotes an eye-witness who said that the flashes struck in the water, coming nearer and nearer like advancing shell-fire. This reminds me of a typical case published in the *Phil. Trans.* for 1781, p. 42. It is related how the tenant of a large three-story house facing the sea at Eastbourne was standing and looking through the window at an ominous black cloud. He saw several balls of fire drop successively out of the cloud into the sea. Suddenly he was thrown violently backwards by what he described as a flash of fire. Many people outside the house at that instant saw something which in form and flame they all agreed was like an immense 'sky rocket' strike the house. The tenant's clothes were torn, and pieces of metal he had about him were melted. Every pane of glass in the room was completely smashed. On the ground floor the coachman and a footman were killed, and on the top floor a lady and her maid were rendered insensible. All the bell wires in the house were deflagrated.

I have an impression that globular lightning makes a slight noise as it drifts about. It has been compared to the purring of a cat. A. RUSSELL.

Faraday House, W.C.1.

DURING April 1906, a small storm occurred near Piccadilly Circus. There was one ordinary flash; then some little while later, there was an instantaneous globular flash some distance above the roofs of the buildings. The sound was like that of a shell bursting. I did not see any movement of the globe, although I happened to have been looking in the right direction before it appeared. H. SOUTHORN.

245 Upper Richmond Road,
Putney, S.W.15, Nov. 8.

Crystal Structure of the β-Phase of Aluminium-Bronze.

IN the *Memoirs* of the Ryojun College of Engineering, **2**, p. 205; 1929, and **3**, p. 87; 1930, I have confirmed that the eutectoid transformation of aluminium-bronze consists of a stepped change: $\alpha + \delta \rightleftarrows \beta' \rightleftarrows \beta$, and just as it is impossible to suppress, by water-quenching, the change of austenite into martensite in steel, so also it is impossible to suppress completely the change of the β-phase into the β'-phase in aluminium bronze.

In order to determine the crystal structure of the β-phase, it is therefore necessary either to take a powder photogram at high temperature or to retard the change, $\beta \rightarrow \beta'$, on quenching, adding a third element which passes into the solid solution of the β-phase. The latter method was successfully employed by Elis Persson, who suggested that the said phase should have a body centred cubic super-lattice. Extrapolating from the lattice constants of the ternary β-phase of copper-aluminium-manganese alloys, he gave $5{\cdot}833 \pm 0{\cdot}005$ A. for the parameter of the binary β-phase, which contains 12·5 per cent of aluminium (cf. *Zeitschrift für Physik*, **57**, p. 115; 1929).

Recently, by constructing a high temperature camera, I have succeeded in taking a powder photogram of a fine rod of the binary alloy, containing 12·5 per cent of aluminium, at about 650° C., and determined that it belongs to a body centred cubic super-lattice, the parameter of which was found to be $5{\cdot}88_7$ A. at this temperature.

On the photogram obtained from the same alloy quenched from 850° C. in water, the spectral lines belonging to the β-phase appeared very weakly, while the intense lines were found to correspond to a hexagonal lattice, which may be regarded as of the β'-phase. The following lattice constants were obtained for these two phases:

β'-phase: $a = 11{\cdot}13$ A., $c = 6{\cdot}342$ A., $c/a = 0{\cdot}5698$.
β-phase: $a = 5{\cdot}835$ A.

Details of the work will be published in the *Memoirs* of Ryojun College of Engineering.

ICHIJI OBINATA.

Ryojun College of Engineering,
Port Arthur, Oct. 10.

Cage for the Study of Sheep Ticks.

WHILE carrying out work on the life-history of *Malophagus ovinus*, the sheep ked, difficulty was experienced in obtaining an effective cage which could be erected on sheep in the open.

Cages were tried by which pressure of the walls on the body of the sheep was depended upon to provide a close enough fit to confine keds. These were untrustworthy. However, a structure was devised, such that it could be sewn to the skin and lie loosely in the wool, thus preserving normal environmental conditions as closely as possible. This was made by sewing together the short edges of a rectangular piece of muslin 12 in. by 8 in. On one end of the cylinder thus formed the selvage had been retained, so as to afford a suitable hold for the horsehair with which it was attached to the sheep.

Sterilised horse-tail hair was used, enough being collected at one time to provide for several cages, and stored in five per cent phenol.

Preparatory to attaching the cage, wool was clipped away, at the selected site, in the form of a circular track two inches wide leaving a clump of wool about three inches in diameter in the centre.

The cylinder of muslin fitted over the central clump of wool and was hemmed to the skin by means of a double thread of hair. A local anæsthetic (cocaine) was used in attaching one cage, but it was found that if stitching be carried out expeditiously no undue discomfort is caused to the sheep. The wool requires to be washed thoroughly with water to remove cocaine, otherwise death may result to keds.

Closing of the cage was effected simply by drawing the outer edge of the cylinder, bag fashion, and tying with tape. To examine contained keds, the muslin is rolled back in the same manner as a stocking would.

It was found that attachment of such a cage in the region of the hind ribs, half-way down the side, ensured its being covered by the fleece and affording sufficient protection, at the same sime providing conditions favourable to the ked. J. H. TETLEY.

Massey Agricultural College,
Palmerston North, New Zealand, Sept. 26.

Recent Work on Insulin.

CHEMISTRY.

THE purest preparations of insulin so far obtained show the characteristics of a protein and on hydrolysis yield a number of different amino-acids. It is not possible to state that the activity is related to any particular amino-acid or group of acids, although from analogy with other hormones it might be expected that the activity is mediated by a simpler substance than a protein. More recent work on crystalline insulin, first prepared by Abel, has led to the conclusion that the crystals are truly those of the active substance and do not merely contain it adsorbed upon them.

Abel's method of preparing crystalline insulin is laborious and the yield small: C. R. Harington and D. A. Scott therefore sought for a simpler and better method of preparation (*Biochem. Jour.*, vol. 23, p. 384; 1929). They found that the properties of commercial insulin are profoundly modified by the presence in the solution of an active saponin: the saponin appears to sharpen the isoelectric points of the proteins present. If ammonia is added to an acetic acid solution of insulin containing about 1 per cent saponin, a precipitate forms at about *p*H 4·5 and can be removed: it contains about 30 per cent of the weight but only 15-20 per cent of the activity. Further addition of ammonia does not produce a precipitate until *p*H 5·6, although the original insulin is precipitated at about 5·0. This precipitate may be already partly crystalline, and if the process is repeated and followed by recrystallisation at the isoelectric point from a phosphate buffer (without saponin), well-defined and large crystals are obtained. The yield is, however, small, 5-15 per cent of the original material. Saponins vary considerably in their suitability, those with a high hæmolytic power being the more satisfactory. Digitonin may also be used.

These results suggested that the function of the brucine-acetate-pyridine mixture used by Abel is not only that of a delicate buffering system, but also that other physical properties of these substances are involved. The authors found that, for successful results, a definite relationship between the volume of the solution and the liquid-glass interfacial area had to be maintained: success was only obtained with a large volume when it was distributed among a number of small containers, or glass rods were introduced to increase the interfacial area. The crystals are small cubes, which usually stand on one corner, giving a hexagonal outline under a low power, as described by Abel: they are quite uniform and analysis shows them to have about the following percentage composition: carbon 49, hydrogen 7, nitrogen 14, and sulphur 3.

As part of the same research, these crystals and Abel's crystals, two samples of each, one of the latter prepared by Prof. Abel himself, were submitted to thorough physiological assay by Scott, K. Culhane, H. P. Marks, and J. W. Trevan (*ibid.*, p. 397). Scott and Trevan used the mouse convulsion method and Culhane and Marks the rabbit 'cross-over' test of Marks, with slight, and different, modifications of the original method. In the latter, the criterion of activity is the average fall of the bloodsugar over five hours after the injection, expressed as a percentage of the initial value: the test is carried out on two days, the animals being divided into two groups, one of which is given a dose of standard and the other a dose of the preparation under test, on the second day the doses of the two groups being reversed. The total percentage reduction of all the animals on the unknown is then compared with the sum of the reductions on the standard. In all tests the same solution of the international standard insulin powder was used.

The results obtained by all four observers agreed closely: thus for the four preparations, values of 23·6, 22·7, 22·9, and 23·9 units per mgm. were obtained, whilst the results of the four observers were 23·7, 24·8, 24·3, and 20·2 units per mgm. The two lower results were given by the rabbit method, but it is not considered certain that this method really gives slightly lower figures than the mouse method, although such a possibility must be borne in mind. It thus appears that crystalline insulin has about three times the activity of the international standard (8 units per mgm.), and the uniform activity of the four batches strongly suggests that the crystals are those of insulin itself and that the activity is not simply adsorbed on to them. Similar values for crystalline insulin have recently been obtained by Abel and by Freudenberg and Dirscherl.

Insulin is destroyed by proteolytic enzymes, strong caustic alkali, etc.: it is inactivated by formaldehyde and acetic anhydride to a certain extent, and the potency can also be partly restored by treatment with weak mineral acid or weak caustic alkali respectively, as shown by Freudenberg. Jensen and Geiling have confirmed the work on acetyl insulin. In a recent paper, F. H. Carr, K. Culhane, A. T. Fuller, and S. W. F. Underhill (*Biochem. Jour.*, vol. 23, p. 1010; 1929) have described another type of reversible inactivation. When insulin is allowed to stand in solution at room temperature in a mixture of 3 parts of anhydrous ethyl alcohol and 1 part of 3 *N* hydrochloric acid, it slowly loses its activity, complete inactivation occurring in two days. The change in activity might be from 18·0 to less than 0·1 unit per mgm.; it was accompanied by a shift in the isoelectric point towards the alkaline side of that characteristic of insulin hydrochloride (*p*H 5·0). Both changes were accelerated by increasing the concentration of the acid or the alcohol, or by raising the temperature. Reactivation was carried out by adding to a 1 per cent solution of the inactive insulin an equal volume of 0·0842 *N* sodium hydroxide, allowing the mixture to stand at 0° for 17 hours and then acidi-

fying to *p*H 3·5. Complete recovery of potency was obtained and at the same time the isoelectric point returned to about *p*H 5·0. It was possible to repeat the process with little loss of potency at the second reactivation. Inactivation was obtained with other alcohols, but secondary alcohols were less efficient than primary, and with tertiary little if any change was produced: other mineral acids could replace hydrochloric, but no change was produced with acetic in the same time. The inactivation was accompanied by the shift in the isoelectric point whenever comparative estimates of the two changes were made, but the effect on potency was not always tested owing to the tedious nature of the animal assays.

Reactivation of some of these inactive compounds was successfully attempted. The isoelectric point cannot be used as an indication of the absolute potency: thus the glycerol and butyl compounds obtained after partial inactivation were found to have different potencies but the same isoelectric points. The authors conclude that the inactive compounds are insulin esters and that the activity of insulin is dependent on the presence of one or more free –COOH groups. Formaldehyde inactivation indicates that an $-NH_2$ group is similarly essential for its activity.

A. Krogh and A. M. Hemmingsen (*Biochem. J.*, vol. 22, p. 1231; 1928) have investigated the destruction of insulin by heat at temperatures between 50° and 117°. At a constant temperature the rate of destruction was found to be proportional at any moment to the concentration. The velocity constant at 117° was about a thousand times greater than that at 50°. From the results obtained it was possible to calculate the rate of destruction at temperatures below 50°. Thus at 20°, 5 per cent of the activity might be expected to be lost in 9 months and 10 per cent in 1½ years; these figures confirm the known stability of insulin solutions at *p*H 3·5-4·0. In this research the potency tests were carried out on mice or rabbits.

Physiological Action.

Our knowledge of the intimate action of insulin in the body is still very incomplete: it can only be stated that it is concerned with the metabolism of carbohydrates, more especially with the formation of glycogen in the liver, probably aiding its formation from carbohydrate and inhibiting its formation from non-carbohydrate sources, and with the formation of glycogen in muscle and its subsequent oxidation. It tends to shift the metabolism of the body to a predominantly carbohydrate type, but the actual details of its action depend in part upon the conditions prevailing at the moment. Its inadequate functioning appears to be the sole primary deficiency in diabetes mellitus, since Macleod has found that dogs fed on a diet of raw meat, cane sugar, and raw pancreas will live for years when injections of insulin are regularly given (see *Nineteenth Century*, November 1928, p. 674). The raw pancreas in the diet is essential and presumably replaces the external secretion which is also lost after pancreatectomy. In human diabetes this function of the pancreas is usually fairly normal.

One of the lines of investigation of the mechanism of insulin action has been suggested by the observation that glucose cures insulin convulsions. Glucal and dihydroxyacetone, mannose and maltose are also effective, but other sugars and related substances are of little or no value. W. O. Kermack, C. G. Lambie, and R. H. Slater (*Biochem. J.*, vol. 23, p. 410; 1929) have recently shown that hydroxymethylglyoxal not only fails to cure the convulsions, but even exerts a toxic action on mice and rabbits, the symptoms observed resembling those of insulin hypoglycæmia. Again, A. Hynd (*ibid.*, vol. 21, p. 1091; 1927) has found that *d*-glucosimine, *d*-glucose-ureide, *d*-glucosamine hydrochloride, and glutose are ineffective in relieving insulin convulsions in mice: the first compound is also toxic. Hence glucose loses its activity when an NH_2– substitutes an –OH group, when the reducing group is substituted or when a second ring structure is introduced into the molecule.

M. W. Goldblatt (*ibid.*, vol. 23, p. 83; 1929) found that in young rabbits starved for 24 hours small doses of insulin increased the liver glycogen, even when death occurred in convulsions: the muscle glycogen either showed no change or might be decreased when convulsions occurred, but was never entirely absent. Adrenaline relieved or prevented hypoglycæmia and convulsions but did not prevent the rise in liver glycogen due to insulin. Ether anæsthesia, however, both relieved convulsions and prevented the rise in liver glycogen. The author concludes that insulin inhibits glycogenolysis from the liver and that the formation of glycogen is a self-limiting process. Thus, in the fed animal, the liver cannot take up any more sugar so that more is available for utilisation and insulin is less effective in producing hypoglycæmia. This may be contrasted with the view that insulin, by causing the withdrawal of sugar from the blood by the tissues, leads indirectly to glycogenolysis from the liver, the degree of hypoglycæmia depending in part upon the amount of this glycogen available for conversion to sugar. If insulin inhibits glycogenolysis, it must also depress glyconeogenesis, otherwise the glycogen store would continue to increase indefinitely.

S. Soskin (*ibid.*, vol. 23, p. 1385; 1929) investigated by a direct method the possibility of glyconeogenesis occurring from fat as well as from protein, and found that in diabetic dogs, 5 days after withdrawal of food and insulin, the administration of olive or cotton seed oil or butter with a pancreatic lipase extract produced in some experiments an excretion of glucose, over and above that occurring during starvation, which was greater than that obtainable from the glycerol of the fat and the protein simultaneously metabolised: since it presumably could not have come from muscle glycogen (which is not converted into glucose) and the liver glycogen store must have been negligible, fatty acid could have been the

only precursor. However, there were many negative results. It may be that positive results are only obtained when the administration of fat coincides with a temporary increase in the capacity of the liver for glyconeogenesis. It was also noticeable that it was impossible to recover animals with insulin when the experiment had been successful.

Whatever the defect in carbohydrate metabolism in diabetes, it does not apparently concern the actual utilisation of carbohydrate in muscle, in spite of the fact that the rate of withdrawal of sugar from the blood by the tissues is less than usual: thus I. L. Chaikoff and J. J. R. Macleod (*Quart. J. Exp. Physiol.*, vol. 19, p. 291; 1929) found that the response of normal and diabetic dogs to shivering was the same so far as the increased respiratory metabolism and rise in the respiratory quotient were concerned: the protein metabolism was not increased. The quotient fell after ½ hour or so, apparently indicating the formation of carbohydrate from fat.

These short summaries indicate the trend of some of the recent work on insulin and must be taken as covering only a small part of the field; they indicate routes, however, by which the problem of the mechanism of the action of insulin is being approached.

Faraday's Diary.

By THOMAS MARTIN, General Secretary of the Royal Institution.

IT has now been announced that, to mark the forthcoming centenary of the discovery of electromagnetic induction, the Managers of the Royal Institution have resolved to publish a document of exceptional scientific interest and importance, Faraday's "Diary". It may therefore be opportune to give some particulars of the manuscript and of how it came to be written. Scientific men have been aware of its existence for upwards of sixty years, and Bence Jones, Silvanus Thompson, and other writers on the life of Faraday have consulted it for material and have quoted passages from it in their writings; but few of the present generation, to whom the name of Faraday has become a household word, can be fully aware of the nature and extent, the scientific and biographical significance, and the extraordinary interest of these hitherto unpublished papers.

The Managers' Minutes of Nov. 4, 1867, record the bequest by Prof. Faraday to the Royal Institution of six folio volumes of "Experimental Notes", two quarto volumes of similar notes, and some unbound MSS. The actual wording of the bequest (1855) is as follows: "Various philosophical notes of experimental investigation on foolscap paper, paged in series, and partly bound in five volumes, a quarto book of Philosophical Notes, a second larger quarto of similar notes. . . ." At the time of Faraday's death the number of bound volumes had evidently increased to six, and after his death the loose papers were bound up, by order of the Managers, in the same style of binding as that previously used, making folio volumes 7 and 8. These eight folio volumes, together with the two quartos, make up the "Diary" as it exists to-day.

The manuscript extends to more than four thousand pages, covering a period of forty-two years, from 1820 to 1862; and provides, indeed, an almost complete and uninterrupted record of the whole of its author's original experimental work. It is written throughout in his own fine, clear hand, with only occasional lapses into illegibility, and with a very few inclusions of matter written by others, but which is nevertheless related to his work.

A very noticeable characteristic, on turning the pages, is the extremely orderly and methodical way in which the notes were kept, very different from the untidiness of the experimental notes of his predecessor at the Royal Institution, Humphry Davy. Every page of Faraday's "Diary" is dated and every paragraph is numbered. No paper is wasted, every sheet being completely filled with writing, and a very large number of the paragraphs are illustrated, always towards the right-hand margin of the sheet, by freehand sketches in ink. These sketches are roughly drawn, with boldness and economy of line, but many of them are very striking, and give an impression of the apparatus they represent which is entirely adequate for the purpose and far more pleasing than that of the more formal diagrams which accompany the published papers.

In the earlier parts of the "Diary" the numbering of the paragraphs is begun afresh in several places, but from the beginning of folio volume 2 an unbroken sequence is preserved almost to the end, the numbered paragraphs in this series running to over 16,000. The numbers are constantly used for reference to earlier observations. It will be recalled that a similar sequence of numbers runs through the published "Experimental Researches in Electricity", although it should be mentioned that there is no correspondence between the numbers in the "Diary" and those of paragraphs in the published works which describe the same observations. Many, perhaps most, of the pages and separate paragraphs have a pencil line drawn through them, vertically down the middle of the page; and it seems to have been Faraday's practice to cross through in this way matter transferred to or made use of in the preparation of his published papers.

The manuscript is not a diary in the commonly accepted sense. It is not a journal or daily record of events, but a laboratory note-book. It was evidently its author's custom to keep it written up from day to day, as his experiments proceeded.

Its contents are entirely scientific, and although it contains observations made outside the laboratory, these are generally such as have a bearing on his work, as when, for example, during the progress of some experiments on the crispations or undulations caused by vibration on the surface of a liquid, he saw one wet day a brewer's dray rumbling over the cobbles, and noticed that the rainwater collected in the tops of the empty butts was thrown up into heaps very like his crispations.

Most of the work was carried out in his laboratory at the Royal Institution, but from time to time observations elsewhere are described, as when in 1831, in the course of the experiments on induced electric currents, he worked "at Mr. Christie's" with the Gowin-Knight magnet of the Royal Society; and later, when he obtained leave of the King and stretched a wire across the Round Pond in Kensington Gardens, with plates in the water, to test some ideas on the possibility of induction by the earth's magnetic field, hoping to observe effects due to the diurnal rotation of the earth.

The entries in the "Diary" describe, with every detail of importance or which may conceivably have any bearing on the result, the apparatus he used and the modifications he made in it from time to time as the experiments proceeded. The effects he expected to find and the observations he actually made were set down with the utmost care and precision, and when the results were not in accordance with his anticipations or appeared to be due to defects in the arrangement of the apparatus, they were nevertheless recorded with the same care as when his best expectations were realised. His extraordinary skill and ingenuity as an experimenter and his perseverance in the face of disappointment are constantly brought home to the reader, who may see how he followed, day after day, the same line of thought and tried first this and then that modification until he was satisfied that the effect he was looking for was or was not there and had exhausted every possibility.

Although the "Diary" is a laboratory book containing particulars and sketches of apparatus and numerical and other data to be transcribed, an aid to memory to be drawn upon in the subsequent preparation of his papers, it is more, much more, than a dry record of facts. From its form and from the care with which it was preserved it is evident that he intended it as a personal record of his work to be kept and referred to. The pages are interspersed with little characteristic passages which serve as windows into the mind of the man, and give to the manuscript a personal character and spontaneity which is absent from his formal papers. His enthusiasm for discovery is evident if only from the extent and variety of the work which is recorded and the persistence with which he works at a problem until experiment has given the answer to his speculations. The originality, the fertility and resourcefulness of his scientific imagination are shown at every turn, in the nature of the problems he sets himself to resolve, the apparatus he devises to test his theories, the points he notes down as worthy of further investigation. Frequently the pages describing a particular research will end in two or three paragraphs in which he poses new problems, fresh ideas for research which have been suggested by the work that has gone before.

The pages are full of titbits of laboratory information which throw light on the apparatus and methods of a hundred years ago and will delight the heart of the chemist or physicist of to-day. He insulated the wire of the coils he used in his famous experiments on induced electric currents by interposing twine between the turns of bare wire and separating the layers by strips of calico. Many of his galvanometers he made himself, in the roughest and simplest way. He used the tall glass jar from a "guinea and feather fall" in which to construct a delicate instrument for detecting induced currents. "White of egg", he notes down, "is a very good thing for crispations." He constantly remarks on the wonder and beauty of the effects he obtains. He cannot keep the note of elation from his voice as he underlines and doubly underlines the significant observation in some particularly satisfactory trial, and concludes the description with the words "Very good experiment".

The "Diary" shows, as no other document could do, the gradual unfolding in Faraday's mind of the ideas which led him to his great discoveries. In his series of communications to the Royal Society the matter of his notes was rearranged and expanded, the phrasing made more formal, the descriptions amplified, and the conclusions stated. Reference to many of the unsuccessful attempts was omitted. In the "Diary" the experiments are recorded in the order in which they were actually made. Step by step his progress can be traced. The entries are often brief and without regard for grammar, but it is not difficult to supply the deficiencies and to read between the lines. His thoughts, the movement of his ideas towards the conclusions which he reached and published, may be inferred from the nature of his experiments and the order in which he made them. Probably no other man of science of comparable eminence has left a personal record which is at once so complete and so enlightening, so invaluable a key to the development of a great scientific mind.

The first volume of the manuscript is the smaller of the two quartos, a small green-covered notebook. This was used from September 1820 to December 1823. Faraday's scientific work in these early years (he was twenty-nine years of age in September 1820) was largely chemical and analytical, including the investigation of new compounds of chlorine and carbon, but the volume contains also a few important electrical experiments. The entries for September 1821, for example, record his well-known first experiments on electromagnetic rotations, which led to the misunderstanding with Dr. Wollaston. That for Christmas Day 1821 describes how he first succeeded

in making a wire carrying an electric current rotate under the influence of the earth's magnetic field alone. The second, larger, quarto volume covers the period December 1823 to November 1832. Its contents are also largely chemical, and it contains the record, in May 1825, of the discovery and analysis of bicarburet of hydrogen (benzene).

The second quarto is no more than two thirds filled. Evidently in 1831 Faraday decided to keep his notes on loose sheets of foolscap paper, and from that date onwards (there is some overlapping between the second quarto and the first folio) the "Diary" is on sheets of this character which have been afterwards bound up into volumes. The slim folio volume 1 (February 1831 to June 1832) must be one of the most significant, as it is certainly one of the most interesting scientific manuscripts in existence, for besides some experiments of a miscellaneous character, it contains substantially the record of the work communicated to the Royal Society in the first and second series of the experimental researches in electricity, embodying the discovery of electromagnetic induction. The induction of an electric current in a coil of wire was first successfully obtained, by 'make' and 'break' of the current in an adjacent voltaic circuit, in the famous ring experiment on Aug. 29, 1831.

It is impossible, within the limits of a short article, to give even a summary of the contents of the "Diary". Moreover, one at least of the published volumes will be available, it is hoped, in time for the Faraday Celebrations in September 1931. The notes are carried on from 1831, through the eight folio volumes down to the year 1862, when his powers were failing and his experimental work was at an end. An entry for Mar. 12, 1862, records an experiment which seems to be the last he ever made. He was hoping to obtain an effect of magnetism on light. He failed to find it. It was not the first time he had made this experiment unsuccessfully; but his scientific intuition was not at fault, for others have since found the effect that he was seeking.

Obituary.

Prof. Adolf Engler.

THE death of Heinrich Gustav Adolf Engler, aptly described as the *Altmeister* of systematic botanists, on Oct. 10, in his eighty-seventh year, removes a prominent and striking personality from the botanical world. 'Engler's System' is a phrase familiar to all students of the science, and has been in recent years a subject of warm discussion among those interested in phylogeny and more especially in the 'natural' arrangement of the families of flowering plants. In his student days, Engler came under the influence of the great German systematist Eichler, whose 'System' was a definite attempt to arrange plant-families in series advancing from the more primitive to the more highly specialised; the simplest type of flower was regarded as the earliest and advance implied an increase in number of parts and specialisation of structure. Engler's 'Syllabus', which was a modification of Eichler's system, has been widely used in systematic works and a large proportion of Continental and American 'floras' follows his arrangement. The criterion of primitiveness has been challenged by the school which regards the simplest types of flowers to be reduced and not primitive forms, but in the recently published edition of his 'Syllabus' the veteran botanist vigorously defends his position and suggests that the less-known parts of the African continent may conceal forms which will provide links in support of his theory.

The 'Syllabus' was the basis of arrangement of "Die natürlichen Pflanzenfamilien", a systematic description of the families and genera of plants, initiated by Prof. Prantl and Prof. Engler in 1887 and carried to completion by Engler after Prantl's death early in the progress of the work. The "Pflanzenfamilien" had a wider appeal among botanists than the more erudite and more strictly technical "Genera Plantarum" of Bentham and Hooker. The distribution of the work of compilation among a large number of botanists led to a certain inequality of treatment; but it went far beyond any previous production as a revision of the families and genera of all the groups of the vegetable kingdom. A new and enlarged edition is in course of publication, and of two large volumes issued during the present year under his editorship, Engler was also the author of the greater portion of one and of part of the other, a tribute to his remarkable virility and continued power of work.

A still more ambitious production was the "Pflanzenreich", begun, with Engler as editor, in 1900: a series of complete monographs of the families of flowering plants; a large number of volumes have already appeared.

Engler was in the prime of life when in 1889 he went from the University and Garden of Breslau to Berlin, as professor in the University and Director of the Botanic Garden and Museum. His first scientific post was under Prof. Nägeli in Munich, and his earlier work dates from that University and Botanical Museum and Garden.

One of his early interests was the Saxifrages, on which he published a monograph in 1872. He also contributed (1878–82) monographs of several families to Martius's monumental "Flora Brasiliensis"—which was continuing under Eichler's editorship. Among these was the Aroids, a family Engler made specially his own, and monographed in de Candolle's "Monographia Phanerogamarum", where he elaborated an arrangement of the genera on genetical lines. A developmental study of world floras found expression in his "Versuch einer Entwicklungsgeschichte der Pflanzenwelt seit der Tertiärperiode" (1879–82); and the series of volumes entitled "Die Vegetation der Erde" organised by the late Prof. Oscar Drude and himself in 1895 continues to provide authoritative accounts by experts of the

vegetation of specific areas of the earth's surface. German overseas expansion found in Engler a helpful exponent in organising the botanical exploration of the German spheres of influence in tropical Africa and New Guinea, and in the collation and publication of the results.

In 1881 Engler founded his "Botanische Jahrbücher", a medium for the publication of communications on taxonomy, plant-geography, and plant-history. The increasing importance of the Berlin Garden and Museum under his directorship as a centre of taxonomic work was reflected in the growth of the publication, which still appears regularly.

A conspicuous monument of the abundant energy and organising power of Adolf Engler is the fine Botanic Garden and Museum which he planned at Dahlem, outside Berlin, to replace the former restricted quarters in the city. Here in the open country he was able to develop his ideal, and the Berlin-Dahlem establishment holds a high place among the botanical institutions of the world. Here he continued to work after his retirement, and here, we gather from an appreciation by his pupil and successor, Prof. Ludwig Diels, he found his last resting-place. Few men have equalled his output of botanical work or exercised directly or indirectly a greater influence on the development of the branches of botany to which he devoted sixty years of unremitting and fruitful labour.

A. B. R.

Mr. B. B. Woodward.

Bernard Barham Woodward died on Oct. 27, aged seventy-seven years. He was the only son of Bernard Bolingbroke Woodward, Librarian of the Royal Library, Windsor, and of his second wife, Emma, daughter of Mr. George Barham of Witherdale Hall, Suffolk. He was grandson of Samuel Woodward, the Norwich geologist and archæologist, and nephew of S. P. Woodward, the well-known author of "The Manual of the Mollusca", and of Dr. Henry Woodward, Keeper of Geology in the British Museum (Natural History). He was educated at Merchant Taylors' and University College schools, but his education was interrupted by the early death of his father, and he started life as a clerk in Messrs. Robarts, Lubbock and Co.'s bank.

In 1873 Woodward was appointed Curator to the Geological Society, and was responsible for the removal of the Society's collection from Somerset House to Burlington House and its rearrangement in the new premises. In September 1876 he entered the Printed Book Department of the British Museum, and on Oct. 13, 1881, he was transferred to the new Natural History Museum at South Kensington and was placed in charge of the General Library there, being promoted first-class assistant on Aug. 22, 1887. He retired on July 21, 1920, but was further retained until the beginning of 1922 to carry on the work of the Library Catalogue. He was twice married, his second wife dying in 1904, but leaves no children.

With the scientific environment of his youth it is no wonder Woodward formed a collection of shells when he was ten years of age, and though in early manhood an ardent geologist, serving five years as secretary of the Geologists' Association, all through his long life malacology was his favourite study. Apart from a few popular articles, his first serious contribution was on the Pleistocene Mollusca of the Barnwell gravels in 1888, and from then forward, although hampered with ill-health, he was the author or joint author of a very large number of papers dealing with many aspects of malacology, published in the *Annals and Magazine of Natural History*, the *Journal of the Linnean Society*, the *Quarterly Journal of the Geological Society*, the *Proceedings* of the Zoological and Malacological Societies, the *Essex Naturalist*, *Geological Magazine*, and in many scattered reports on archæological excavations.

Woodward was responsible for the Molluscan portion of the "Zoological Record" from 1893 until 1896, whilst the articles on the non-marine mollusca of the various counties in the Victoria County Histories are from his pen. He was author of "The Life of the Mollusca", 1913, "Catalogue of the British Species of Pisidium", 1913, and joint author of "The Synonymy of the British Non-Marine Mollusca", 1926, the two latter being published by the Trustees of the British Museum. In his official capacity, he was responsible for the formation of the finest natural history library in the world, whilst his "Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History)", five volumes, 1903–15, and supplement, 1922, will always remain as a permanent memorial to his knowledge and painstaking accuracy. This scientific knowledge was always at the service of all students, and he contributed many paragraphs upon malacological papers to the columns of Research Items in Nature. His death is mourned by a large circle of friends.

Dr. Ludwig Moser, director of the Institute for Analytical Chemistry at the Technical High School in Vienna, and president of the Verein Oesterreichischer Chemiker, died on Sept. 26 after a motor accident in which his wife was also killed. We learn the following particulars from the *Chemiker-Zeitung*: Born at Vienna in 1879, Moser studied under Vortmann at the Technical High School, and after spending some time in industrial work was appointed assistant to Vortmann. In 1920 Vortmann retired and Moser succeeded to the chair. He reorganised the Institute, which was transferred to new premises, and a department was devoted to micro-chemical analysis. Moser was an untiring investigator, and up to the time of his death more than ninety publications had appeared under his name, many of which related to the rare earths. He also published volumes on the estimation of bismuth and on the preparation of pure gases. At the time of his death he was engaged on the manuscript of a "Lehrbuch der analytischen Chemie", which is not more than half completed.

News and Views.

DR. F. G. BANTING, of Toronto, has been made an honorary fellow of the Royal College of Surgeons of England; he is the first member on whom the College has conferred the honorary fellowship. It will be remembered that about nine years ago Dr. Banting, working with C. H. Best, obtained pancreatic extracts which were active in reducing the symptoms of diabetes in depancreatised dogs: their reinvestigation of the problem of the hormone of the pancreas led directly to the preparation, by J. B. Collip, of purified extracts, suitable for the treatment of human diabetes. The modern treatment of diabetes by insulin dates from this work of Banting's, and although insulin cannot be described as a cure for the disease, yet it has brought immense benefit to numerous patients. In fact, the diabetic, whether child or adult, can face the chances of life to-day almost as well as the non-diabetic. Lord Moynihan, at a meeting of the Council of the Royal College of Surgeons on Nov. 13, when the honour was conferred, pointed out that the discovery of insulin was the first piece of really scientific research in the realm of medicine contributed by the British Dominions. The work was of a physiological character bearing on the practice of surgery, though in itself something entirely outside the surgeon's craft; but its value deserved the recognition of surgeons.

H.R.H. THE PRINCE OF WALES, in honouring the recently incorporated Association of Scientific and Technical Institutions by his presence at dinner in the Guildhall on Nov. 13, once again directed timely attention to the national and imperial significance of a policy of co-ordination and co-operation in the exploitation of material and intellectual resources. Eight years ago His Royal Highness gave support and encouragement to the movement of which the present scheme, which involves the establishment of a central building for the use of the constituent and associated societies, is a logical development. A movement had, he said, been inaugurated which, if steadily supported and wisely guided, may confer benefits upon industry as a whole, both in Great Britain and in the Empire, the extent of which we can only dimly foresee. The time has long passed when any one industry, or any one branch of science, can hope to develop to its full stature without an intimate knowledge of what is going on in other departments of human activity; to say that further research is urgently necessary in almost every branch of industry and science is almost a truism. The Prince congratulated the presidents and councils of the constituent bodies on their foresight and wisdom, expressing his confidence that the outcome is bound to have a favourable effect on the course of wages and of industry. Other speakers at the dinner, at which Sir Ernest Rutherford presided, were Sir John Cadman, Sir Robert Horne, Dr. G. C. Clayton, Sir Auckland Geddes, Sir William Larke, and Mr. Eric Macfadyen, and it was announced that Mr. Robert Mond had made a gift of £10,000 to the Association. The registered office of the Association is Burlington House, Piccadilly, London, W.1, whence a copy of the Memorandum and Articles of Association and information concerning the conditions of individual life-membership may be obtained.

THE Imperial Conference which ended last week is the first over which a Labour Prime Minister of Great Britain has had the privilege to preside. It was not unreasonable to hope, therefore, that this Conference might be distinguished from previous ones by a departure from orthodoxy in its approach to the problems of Imperial co-operation in the development of that large portion of the earth's surface which is comprised by the British Commonwealth of Nations. Yet it must be confessed that the only distinctive feature about this Imperial Conference has been the obvious marked cleavage of opinion on most of the subjects under discussion between the representatives of the Dominions on one hand and those of Great Britain on the other. Little that is tangible has emerged from some weeks of labour. It has been suggested that the comparative failure of the Conference was due to lack of preliminary preparation on the part of Great Britain, and that on no subject on the agenda did Great Britain give a clear lead to the Dominions; and it must be confessed that the criticism appears to be justified. The best and most obvious way to stage Imperial economic discussions is to have prepared beforehand a survey of the methods by which the Imperial Government seeks to achieve economic unity. In this connexion it is disappointing to find how little prominence was given to a proposal, which has authoritative adherents in this and other parts of the Empire, for the creation of an Imperial Secretariat with functions similar to those of the League of Nations Secretariat. Such a secretariat would act as the supreme co-ordination body for the various Imperial bureaux already in existence. It would ensure continuity between the four-yearly Imperial Conferences; and it could, if it were properly supported, present to each Conference an adequate survey of the resources, actual and potential, of the Empire as a whole, without which all talk of the rationalisation of Empire industries is vain.

FROM our point of view, however, the most disappointing feature of the Conference has been the scant attention which appears to have been given to the relation between scientific research and the developments of the material resources of the Empire, and education. It may be that the present Government considers that all that is necessary in connexion with scientific research has already been said or done by previous Conferences. But previous Conferences have scarcely ever considered the influence of Great Britain as a cultural centre, and the means by which the various parts of the Empire can take advantage of the facilities available here for higher education and training. It is a fact perhaps not generally

known that the United States deliberately offers attractions to educationists in British Dominions, while Great Britain has hitherto had little to offer them. The incorporation of a scheme of educational studies in the University of London is now an accomplished fact, and it is, therefore, a pity that no attempt was apparently made to arouse any enthusiasm among the Dominion Premiers for this new link in the chain of Imperial co-operation.

A MOST valuable collection of records and publications on amentia has been presented to the Library of the Royal College of Surgeons of England by Dr. Thomas Brushfield, who was formerly Senior Medical Officer of the Fountain Hospital for Imbeciles at Tooting, under the Metropolitan Asylums Board. The records comprise the detailed histories which Dr. Brushfield compiled of all the children who came under his charge from his appointment in 1914 until his retirement in 1927, with photographs of the children taken on admission and after treatment. The histories are classified by the types of amentia—mongolism, cretinism, microcephaly, and so on—and Dr. Brushfield has preserved elaborate details not only of each child's physical condition and family history, but also of the mental tests employed in each case and of the progress of such as were fit to attend school. All these records are fully indexed, and numerous tables have been drawn up summarising and analysing the material from various aspects. These histories and statistics, covering so long a period from the time when the particular study of mentally deficient children was only beginning, are all the more valuable because they have not been continued on any such a scale as was undertaken by Dr. Brushfield. He has presented them to the College Library so that they may be readily accessible for any research worker in this subject, for whom they ought to prove of inestimable value, as there is no comparable collection of similar material available.

BESIDES his first-hand records, Dr. Brushfield has also presented his very large collection of papers and cuttings on amentia, gathered from all over the world. These will be kept together in connexion with Dr. Brushfield's own records, and the donor has prepared a full index to them. The papers cover not merely the varieties of amentia, but whatever may possibly bear on the subject, and there are numerous entries in the index under such headings as birth, encephalitis, endocrines, skulls, etc. To complete the usefulness of the collection, Dr. Brushfield has compiled a bibliography of books and articles issued up to the present, of which there is no copy in his collection, on all the subjects covered by his index. He further very generously proposes to keep this bibliography up-to-date and to incorporate into the collection whatever publications he may continue to collect. It is most sincerely to be hoped that there may be workers who will be glad to avail themselves of this carefully prepared material, and that some of them will care to continue the collecting of this special literature, which Dr. Brushfield has so industriously and disinterestedly begun.

THE tsetse flies of Africa appear to be immune from all ordinary methods of control, and the problem is being approached from many aspects. Mr. Harris, who is a Government entomologist working in the Zululand Game Reserve, some years ago came to the conclusion that these insects seek their prey entirely by sight. According to the *Times* of Nov. 14, he gave a demonstration of his recently devised tsetse trap before a number of entomologists and provincial authorities. The trap takes advantage of the fact that the insect is attracted to roughly shaped dummy animals, that it usually attaches itself to the abdomen, and reacts to contrasts of light and shade. It consists of a wooden frame supported on legs and covered with hessian, except at the bottom, and has a gauze panel at the top. Its rough resemblance to an animal appears sufficient to attract the insects in considerable numbers. They settle on the lower part of the trap, and coming within the hessian walls, they are attracted by the light showing through the gauze above, and so enter the trap proper. In the demonstration 18 of these traps were set up, and at the end of a day they were found to contain 1393 flies, of which 942 were females. The fact that such a trap will remain in good order for 18 months, and requires little supervision, suggests that the method is one of sufficient promise to merit its being tested out for a prolonged period.

LEAFLET No. 31 of the Astronomical Society of the Pacific deals with the near approach of Eros, which will be the closest recorded approach to the earth of any planet. The asteroid or minor planet Eros, although normally more remote than Mars, has such a large eccentricity (0·223) that on Jan. 30 next it will approach within 16,000,000 miles of the earth. This will give astronomers the best opportunity they have ever had of measuring the actual distance of a planet, and for several years preparations have been made for the campaign that has now begun. The scale of the solar system is accurately known from mathematical considerations and the observed periods of the planets, so that a knowledge of the distance of any one of these bodies furnishes the distances of all of them. The sun, Venus, and Mars, which are our closest neighbours, are so large and bright that sufficiently accurate measures of their positions are not possible. Eros combines the double advantage of a closer approach than any other body, and of presenting a beautiful stellar image that can be accurately measured on a photograph. During the forthcoming close approach Eros will suffer large perturbations by our system. From these it will be possible to improve our knowledge of the mass both of the earth and of the moon; in fact, the value that will be obtained for the latter will probably be more accurate than any now available. Even at its brightest, Eros is only of the seventh magnitude, so is not visible to the naked eye, although it can easily be seen in a small telescope.

THE elm disease, which is now known to be caused by the fungus, *Graphium ulmi*, first appeared in Holland and Belgium in 1919 and has since spread over most of western Europe. The first definite case recorded in England was at Totteridge, Herts, in the

autumn of 1927, but there is little doubt that the disease was present in the Isle of Wight and probably also in other districts some years prior to that date. From 1928 onwards the Forestry Commissioners have carried out annual surveys, the main findings from which are as follows. The disease has increased steadily each year both as regards rate of spread and intensity of attack and now occurs over the greater part of England. The disease varies greatly in intensity in different districts, but, as a whole, the proportion of trees attacked is quite small and usually less than 5 per cent of the diseased trees have been actually killed. Locally, however, the death-rate may be quite considerable and the disease assume an epidemic character. The rate of attack also is very variable and apparent recovery may take place, for certain trees in which the disease was found in 1928 recovered the following year and are still quite healthy. There appears to be a close connexion between the disease and the elm bark beetle, *Scolytus destructor*. There can be little doubt that the beetle helps to spread the disease by boring infected trees, and the only control measure suggested is that dead elm trees should be removed as promptly as possible, as they provide breeding ground for the bark beetle.

PROF. C. C. J. WEBB'S Hertz Lecture before the British Academy (from the *Proceedings of the British Academy*, vol. 16. London: Oxford University Press, 1930. 1*s*. 6*d*.) is a consideration of the thesis that our knowledge of one another, that is, our recognition of one another as 'selves' or 'persons', is a primary and fundamental form of knowledge, not derivable from or subordinate to our recognition of selfhood in ourselves, or our perception of an external world of things. The lecture falls into two parts. First it is shown that knowledge of others cannot be reduced to an inference from knowledge of self and knowledge of things—since all such inferential accounts presuppose the mutual recognition which they are designed to explain. Moreover, it is held that the development both of self-consciousness and of external perception involves the implicit recognition of the distinction between self and others; so that indeed, of these three forms of knowledge, the apprehension of other selves is "in all probability the first to predominate in human experience". Prof. Webb, therefore, is disposed to hold that however intimately all three forms of cognition may be interconnected in the mode and order of their psychological development, each is logically independent, and that no one of them could be derived from any combination of the others.

THE second part of Prof. Webb's lecture draws out the implications of this result especially in the sphere of religious experience. For that experience, though it may arise through any of the three forms of awareness, is always essentially an *intercourse*—a 'social' experience—and may therefore be held to claim the authenticity which has been shown to belong to our recognition of others as 'socii'. Our knowledge of the object of religious experience differs, of course, profoundly from our knowledge of other selves: but Prof. Webb holds—supporting his argument by a comparison of his own view with Prof. Alexander's—that these differences are not such as to invalidate the claim here advanced. This bare synopsis indicates only the course of a brilliant lecture. Both parts of it raise difficulties. But suggestion is the business of the lecture form: and this certainly is an admirable example of philosophical thinking and expression.

WE have received from the authorities of the University of Allahabad the first four volumes of "Allahabad University Studies", in which are published the results of research work carried out by members of the various departments of the University in the period 1925–1929. In a prefatory note to the first volume the Vice-Chancellor, Dr. Ganganatha Jha, explains that although research work has been carried on at Allahabad since the seventies of the last century, no attempt has previously been made to place the results on record or to assist in their publication, excepting only in *Indian Thought*, a quarterly journal of Oriental research conducted for a time by the late Dr. Thibaut and himself. With the recent reorganisation of the University on a unitary basis, and in view of the stress now laid on research, the authorities have thought it desirable that members of the University should have a vehicle of publication of their own. This object is eminently praiseworthy, provided the editorial board ensures that the standard maintained is worthy of an institution of university rank.

IT is unfortunately the case that too many educational institutions in outlying parts of the world are prone to issue publications which swell the already overwhelming volume of scientific literature with contributions which are little more than academic exercises. Some of the contributions to the Allahabad volumes are not above criticism in this respect. It is a danger to which the study of English in India is particularly exposed. This must be inevitable in a subject which looks to European rather than Indian culture for its inspiration. On the other hand, Mr. F. J. Fletcher, Principal of Agra College, has written an excellent study of George Bernard Shaw and the place of his writings in the development of modern English society, which is admirable as an analysis and to the Indian student should be an illuminating introduction to certain aspects of English culture. It might, however, have appeared more fittingly in a 'Review'. Although, taking the four volumes as a whole, the various departments of university studies, science, law, philosophy, history, and so forth, are well represented, it is to be noted that while it is as a record of research bearing upon specifically Indian studies that these volumes should have a special interest, these subjects, well represented in the first two volumes, dwindle sadly in number in the two later.

DR. A. P. LAURIE delivered a lecture on photomicrography applied to the work of Rembrandt and his school, at the Royal Academy of Arts, on Nov. 12. Painters such as Rembrandt, who showed their brushwork, had each their own 'hand-writing' with the brush, and can thus be identified. By taking prints,

cutting them up, and placing them one on another, it is possible to make a very close and accurate study of such individual characteristics. Another purpose served is the revelation of weakness in drawing. A magnification of two diameters has been found to be best for Rembrandt and his school. Long experience and special skill are required to obtain photographs which are strictly comparable. It is also necessary to have records from undoubted pictures of the painter's work throughout his career, and also that of members of his school, as a dossier for testing the authenticity of a given picture. Dr. Laurie illustrated Rembrandt's brushwork throughout his career, and the brushwork of his school, by means of a series of lantern slides. While putting forward his opinion with due caution and diffidence, Dr. Laurie said he believes that pictures painted by Carel Fabritius, Flinck, Bol, and possibly Drost, will be found among 'accepted' Rembrandts; that there was a period during Rembrandt's successful time at Amsterdam when he was turning out pictures with the help of his pupils; and that in the first half of the eighteenth century there was a very skilful forger of 'Rembrandts' in his later style. On the other hand, probably no painter of his time has left so many examples as Rembrandt of his personal individual handiwork.

IN *World Power* for October it is pointed out that France is now divided approximately into fifty regions each one of which is surrounded by a triangular or a quadrangular grid of wires at very high pressures, fed by about fifty steam or hydroelectric stations. It is noteworthy that the Paris area is connected only to Caen and the Massif Central. During the War, it was considered advisable to equip Paris with powerful steam stations situated on the Seine and supplemented by a supply from the Massif Central hydroelectric stations. Now that the coal mines in the north have been practically reconstructed, interconnexion will very shortly be made between them and Paris. Future increases in the electric demand will be met by stations near the northern pit-heads. The western regions, and Brittany in particular, have a very poor electric supply. It has been suggested that this might be remedied by the installation of powerful tidal power stations. Another suggestion is to plunge tubes in the sea near Brest which will utilise, in the method proposed by Claude and Boucherot, the temperature difference between surface water and deep water for the generation of electric energy.

ONE of the tallest concrete buildings in the world, A Noite, has been erected in Rio de Janeiro. It has 25 floors and is more than 410 feet in height. The *Westinghouse International Journal* for October calls it a beautiful building in a beautiful city and says that it rivals the famous Sugar Loaf Mountain on the other side of the bay on which Rio is situated. Judging from the photograph shown of this beautiful city, taken from the air, we can scarcely endorse the praise given to the building. For a building of this height, a very elaborate lift installation was a necessity, as a very speedy, efficient, and accurate service has to be maintained. The Westinghouse Electric International Co. has installed its inductor control system, the operation of which is almost entirely mechanical. Stops from outside the lift are registered on a signal panel. When a car approaches within 25 feet of a landing stage where a call has been registered, both an audible and visible signal warns the operator to centre the switch. The lift-car is thus placed under the control of the inductor and automatically slows down, making a level, even stop at the floor with a minimum time lost in deceleration. If the lift-car happens to be fully loaded, the operator simply passes the floor and the call is automatically transferred to the next car. The speed of the cars is 700 feet per minute and each can carry a load of 2500 lb. There are four entrances to the lifts and they have now been working for several months very satisfactorily under heavy traffic conditions.

IN Germany the protection of birds is generally controlled by the Imperial Law of 1888, which details in a schedule, not the birds to be protected, as does British law, but the harmful species which may be destroyed. In Prussia, however, there have existed old codes in the various provinces of the State, often at variance with each other. The announcement is now made from Berlin (by Science Service, of Washington, D.C.) that new and uniform laws for birds and wild flowers have been enacted by Prussia. During the proper open seasons the following birds may now be hunted in Prussia: wild ducks, wild geese, most of the quail family, sandpiper, curlew, snipe, gulls, terns, and pigeons. Thirteen 'outlaw' species are listed which may be killed without restriction at any time, including several hawks, all crows, sparrows, grebes, and herons. All the remainder of the birds are given the benefit of an absolute closed season, although certain, like ospreys and kingfishers, that are given protection generally, may still be shot if necessary for the protection of fish-ponds. No more bounties will be paid for the destruction of predaceous birds; bird-lime and traps for catching or injuring birds are prohibited; and birds must not be hunted by the aid of artificial lights. Further, certain wild animals which destroy birds but also prey upon rodents to an even greater extent, notably the wild cat, pine marten, and mink, are given absolute protection. The new list of prohibited plants contains thirty names, mostly of species which have been subjected to destructive collecting by dealers.

SEVERE winters in Great Britain are not common, but when they do come, havoc usually results in many domestic water-supply systems. A public service has therefore been rendered by the Royal Institute of British Architects by the production of a small pamphlet entitled "Report on Damage to Plumbing Work caused by Frost" (R.I.B.A., 9 Conduit Street, W., 1930. 3*d*.), which shows those who have interests in property what should be arranged to prevent damage. Initiated by the Science Committee of the R.I.B.A., the suggestions are the result of the deliberations of a conference which included representatives from the Ministry of Health, the L.C.C., and a number of other bodies representing various interests. These

suggestions include plumbing matters dealing with the location of pipes and provision of stop-cocks, instructions to householders upon precautions to prevent freezing in water systems, and hints upon hot-water boilers in connexion with frost stoppages.

THE next annual Congress of the Royal Institute of Public Health will be held in the City of Frankfurt-on-Main on May 19–24 (Whitsuntide), at the invitation of the German Government, the Municipality, and the University of Frankfurt. The Congress will be presided over by the Marquess of Reading. The inaugural meeting will be held on the morning of May 19, and the scientific work of the Congress will be conducted in English in the following sections: Section I., State medicine and municipal hygiene; Section II., architecture, housing, and town planning; Section III., industrial hygiene; Section IV., women and children and the public health; Section V., tuberculosis; Section VI., pathology, bacteriology, and biochemistry. Educational visits will be paid to the chief places of interest in the city of Frankfurt, including the new housing developments. Some of the chief spas and health resorts of the Rhine and adjacent districts will be visited, including Wiesbaden, Homburg, Nauheim, Kreuznach, and Münster-am-Stein. On May 23, a whole day's visit will be made to Heidelberg. Delegates are being invited from the governments, municipalities, universities, and other public bodies of Great Britain and Ireland and the British Dominions, as well as from continental and foreign countries.

AT the anniversary meeting of the Mineralogical Society, held on Nov. 4, the following officers were elected:—*President*, Sir John S. Flett; *Vice-Presidents*, Dr. G. F. Herbert Smith, Prof. C. Gilbert Cullis; *Treasurer*, Mr. F. N. Ashcroft; *General Secretary*, Mr. W. Campbell Smith; *Foreign Secretary*, Dr. J. W. Evans; *Editor of the Journal*, Dr. L. J. Spencer.

SIR VENKATA RAMAN, Palit professor of physics in the University of Calcutta, has been awarded the Nobel Prize for Physics for 1930, for his work on the scattering of light and the discovery of the Raman effect; and Prof. Hans Fischer, director of the Institute for Organic Chemistry of the Technical High School, Munich, has been awarded the Nobel Prize for Chemistry for 1930.

THE July-September number of *The World's Health* (Vol. 11, No. 3), the organ of the League of Red Cross Societies, is a British Empire number, and contains a history of the Red Cross in Great Britain by Sir Arthur Stanley, a review of Red Cross problems in India by Norah Hill, and a description of the Red Cross clinic for rheumatism in Peto Place, Regent's Park, London, by R. H. P. Orde.

MESSRS. Dulau and Co., Ltd., 32 Old Bond Street, W.1, have just issued Catalogue No. 178 of nearly 1500 second-hand works relating to botany and gardening, many formerly the property of the late Sir George Watt; also Catalogue No. 179 giving the titles of upwards of 1100 works on the subjects of conchology, entomology, geology, ornithology, and general zoology. Both catalogues can be had free upon application to the publishers.

A NEW part—No. 3—of "An Illustrated Catalogue of a Valuable Country Library" has just been published by Messrs. Henry Sotheran, Ltd., 43 Piccadilly, forming No. 820 of "Sotheran's Price Current of Literature". Nearly 3000 works are listed, many of which relate to science and travel. As is usual with the catalogue of which this forms a part, the list is enriched by numerous bibliographic notes which should be of interest and value to collectors and librarians.

THE Bulletin of the Royal Academy of Denmark for 1929–1930 (*Oversigt Kgl. Danske Videnskabernes Selskabs Forhandl.*) contains a complete list of the Academy's publications from its foundation in 1742 to June 1930. This, which is compiled by Asger Lomholt, is arranged under authors and then chronologically. Most of the papers can still be purchased in separate form or in the relatively small parts of the *Oversigt*; the price of each is quoted. The List should therefore be of value to librarians, bibliographers, and booksellers. This part of the *Oversigt* costs 4 kroner (about 4*s*. 6*d*.).

IN the annual report for 1929 of the South African Institute for Medical Research, Johannesburg, recently issued, the director, Sir Spencer Lister, summarises the routine and research work of the Institute. It has been ascertained that in pneumonia and pneumococcic meningitis the strains of the pneumococcus causing these diseases are constantly changing; also, that some of the pneumonic infections occurring among the native mine labourers of the Witwatersrand goldfields seem to be caused primarily by a filterable virus followed by a secondary pneumonic infection. As a result of experimental work, it has been found that nine species of fleas are capable of transmitting plague under laboratory conditions. Dr. Pirie has prepared a pathological report on 600 cases of tuberculosis occurring among native miners, and Dr. des Ligneris has continued his investigations upon cancer, employing Rous's fowl sarcoma for the experimental work.

WE have received the first number of the second volume (March 1930) of the "Index to the Literature of Food Investigation", compiled by A. E. Glennie for the Department of Scientific and Industrial Research (H.M. Stationery Office, 1930). The arrangement is similar to that in the previous numbers, each title being accompanied by a few lines indicating the nature of the work reported and the conclusions reached. The index is preceded by a brief review of noteworthy developments during 1928–29, which is provided with its own bibliography of 79 references. It is proposed to give such a review with the first number of each volume. This summary is useful as a means of keeping in touch with the more important advances in the subject, on which a large number of papers are published annually: thus, upwards of 800 papers are summarised in the present half-yearly list. The review deals with the freezing or chilling of meat, the smoking of fish, disease in fruit, corrosion in tins, and some engineering problems; to some of

these subjects reference has already been made in our columns.

DURING the last few years Messrs. Thomas Murby and Co. have become known as publishers of books on geological subjects. Their geological supplies department, or at least the extent of its resources, is perhaps less familiar. A catalogue which they have recently issued can be consulted with profit by teachers and students who may from time to time desire to purchase apparatus and materials for geological work in the field or laboratory. Hammers, collecting bags, map cases, and clinometers are represented in great variety. Collections of rocks, minerals, ores, crystals, thin sections, and fossils are available, specially selected in several cases to illustrate standard text-books on mineralogy, petrology, and palæontology, together with card trays, cabinets, and slide boxes suitable for the storage or display of specimens. Petrological microscopes by well-known makers are supplied, and all the accessory apparatus required for petrographic methods. Crystal models and structural models of considerable interest for teaching purposes have recently been introduced. Intending purchasers of geological materials and accessories such as those mentioned should consult Messrs. Murby's catalogue.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant lecturer in geography at University College, Nottingham — The Registrar, University College, Nottingham (Nov. 26). A lecturer in elementary general chemistry at the National Bakery School, Borough Polytechnic—The Principal, Borough Polytechnic, S.E.1 (Nov. 28). A resident clinical pathologist at the Manchester Royal Infirmary—The Chairman of the Medical Board, Royal Infirmary, Manchester (Nov. 29). An assistant lecturer in geography at the University College of Hull—The Registrar, University College, Hull (Nov. 30). A whole-time head of the Aristotle Road, Clapham, Junior Commercial and Junior Technical Evening Institute—The Education Officer (T.7), The County Hall, Westminster Bridge, S.E.1 (Dec. 1). An assistant anatomist in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, 72 Strand, W.C.2 (Dec. 17). A full-time pathologist at Napier Hospital, New Zealand—The Managing Secretary, Hawkes Bay Hospital Board, Napier, New Zealand (Jan. 10). A male assistant in the sheep department of the Rowett Research Institute Experimental Stock Farm—The Secretary, Rowett Research Institute, Bucksburn, Aberdeen.

Our Astronomical Column.

A Study of Spectroheliograms. — An important contribution to the study of the sun's atmosphere by means of spectroheliograms, which record the sun's surface in monochromatic light at different levels from the photosphere to the top of the chromosphere, is given by L. D'Azambuja in *Annales de l'Observatoire de Paris*, Section d'Astrophysique, à Meudon, Tome 8, Fas. 2. Hitherto most spectroheliograms have been obtained in the hydrogen light ($H\alpha$) and in that of ionised calcium (H and K), though Deslandres in 1894, Hale and Ellerman in 1903, and Fox in 1905 first respectively recorded the sun's surface in the light of other elements. D'Azambuja's present research is concerned chiefly with such elements as magnesium, iron, calcium (neutral), sodium, and strontium, that are characteristic of the lower chromosphere or reversing layer. For this work a powerful spectroheliograph such as that at Meudon is essential, and it was possible to study the changes as the narrow selecting slit was set respectively at the middle and at the edge of the spectral line used. As is well known, there are significant differences (explicable as being mainly due to difference of level in the sun's atmosphere) between spectroheliograms taken in the light which comes from the narrow central portion of the $H\alpha$, H, or K lines and those obtained when the edges of the lines are likewise isolated. A comparison of these established differences with those observable in the case of the lines due to lower-lying elements, together with a knowledge of the curves of intensity of the lines, forms the basis of the present discussion.

The memoir also contains results relating to the infra-red lines, $\lambda 8498$ and $\lambda 8542$, of ionised calcium. The possibility of obtaining spectroheliograms with these lines was indicated by C. R. Davidson at Greenwich in 1927, when he measured their intensities relative to those of H and K in the spectrum of the chromosphere. Using hypersensitised neocyanin plates, D'Azambuja has successfully obtained spectroheliograms in these radiations. The memoir, which contains excellent illustrations, whilst presenting new results, is a valuable book of reference to the work of others in this line of solar research.

Identity of a Minor Planet.—M. Delporte detected an interesting object at the Uccle Observatory on Sept. 29. He was doubtful whether it was a comet or minor planet, but there is now little or no doubt of its planetary nature. The following orbit is given in *Circular* 364 of the Berlin Recheninstitut by A. Kahrstedt :

M	327°·21	
ω	57·92	1930·0
Ω	1·01	
i	22·29	
e	0·2975	
Period	3·538 years	
q	1·631	

It seems very probable that the object is identical with 330 Adalberta, discovered at Heidelberg in 1892, but not seen since that year.

The following observations were then obtained (*Astr. Nach.* 3319) :

Heidelberg M.T.	Apparent R.A.	Apparent Decl.
1892 Mar. 18d 11h 23·0m	11h 57m 2·90s	0° 6′ 19·6″ N.
,, 20 11 40·0	11 54 28·30	0 8 34·3 S.

It was only by a curious chance that this object received a number and a name. Another planet discovered on 1892 Mar. 19 received the designation 330 Ilmatar ; this was afterwards found to be identical with 298 Baptistina, and the planet of Mar. 18 was given the number 330 in order to fill the gap.

If the new object is Adalberta, the period must be about 3·613 years, if 11 revolutions were completed between 1891 and 1931 ; or 3·31 years if 12 revolutions were completed. Prof. J. Comas Sola announces the discovery at Barcelona of a planet of mag. 10·7 in Pisces, but gives no position : it may be the Delporte object.

Research Items.

Burial Customs of the Akaju, Southern Nigeria.—Burial customs of the Akaju tribe, Ogoja division, Southern Nigeria, are described by Mr. C. B. G. Watson in *Man* for November. Guns are fired to announce the death, and for the next two days relatives spend their time collecting food and palm wine. On the third day the corpse is dressed in a new loin-cloth, woollen cap, and shirt or singlet, and is hung in a hammock in the yard of the house. A fire is lit beneath it, the smoke serving in some degree as a preservative. The fire is tended by the wife, or in the case of a woman by women of the same age grade or by her fellow-wives. A man is kept thus for from fifteen days to thirty days according to his wealth, a woman for ten days. On one day a man of the same age grade wearing a special cap dances round the corpse. In the grave, which is oblong with a special recess for the head, the body is placed in a sleeping posture on its side, looking westward if a man, eastward if a woman. Money may be placed in the grave, a hoe is placed on a man's head, a machete may be placed on his chest, and a gun with the trigger removed by his side. No pottery or eating utensils are buried in the grave or broken at its side. After interment, no further ceremonies take place.

Price of Potatoes.—In "Factors Affecting the Price of Potatoes in Great Britain" (University of Cambridge, Department of Agriculture, Farm Economics Branch, Report No. 15), R. L. Cohen attempts to explain the fluctuation in potato prices during the forty-five years for which data are available. Total production tended to fall until 1898, and has since risen, on the average, until the present time. The more recent increases may largely be attributed to higher acreage being put under potatoes on account of the unprofitable nature of other crops, but the interests of neither producer nor consumer would appear to have been served by this heavier production. The analysis of data shows that, generally speaking, imports move in the same direction as prices, and are consequently a result more than a cause of price changes. The chief cause of fluctuation in home production is the variability of yield per acre. Variations in yield are so irregular that farmers cannot contrive to alter their acreage in compensation in order to attempt to stabilise yields, which would have a steadying effect upon prices. It is very desirable that correct information as to the season's production should be spread among British farmers with the view of price adjustment, to prevent foreign producers getting the benefit of high prices at times of shortage, while home growers are still receiving the lower rates of times of plenty. Further benefit would be derived if the fluctuations in growers' prices could be rendered more comparable with those of retail prices, as this would not only tend to stabilise rates from year to year, but also would result in a larger aggregate sum being received by the farmer for his potatoes.

Surface Precipitation Reaction of Living Protoplasm.—In the *Proceedings of the American Philosophical Society*, vol. 69, 1930, L. L. V. Heilbrunn has a very concise statement of his suggested explanation of the astonishing increase in viscosity in living protoplasm that may take place under various conditions, and which is so closely associated with the phenomenon of its 'stimulation' by various external agents. He shows that the films which immediately form at the surface of the extruded protoplasm, when a living cell is burst open in water, only form in the presence of calcium, and that, under certain conditions, similar small films, around vacuoles, form in the protoplasmic mass. This suggests an analogy with the clotting of blood; in the first stage of this process, calcium reacts with blood platelets, thrombin is produced, and this substance can produce clotting even in the absence of calcium. Similarly in the surface precipitation of the protoplasm exuding from a burst egg of the sea urchin, in the first stage an interaction occurs between pigment and calcium and a substance is produced which can bring about the precipitation in the absence of calcium. In the protoplasm, as in the case of the blood, one problem is to explain why this precipitation does not occur until external conditions alter. The reason appears to be, in part, that the calcium inside the living cell is not free, but is bound chemically. Immediately it is freed, on 'stimulation', the precipitation reaction occurs throughout the mass and a great increase in viscosity occurs.

Haploid Plants and Animals.—Prof. R. Ruggles Gates and Miss K. M. Goodwin publish a very valuable review of this subject, with comprehensive bibliography, in the *Journal of Genetics*, vol. 23, 1930. In the plant, the sporophyte generation is occasionally produced with the number of chromosomes characteristic of the sexual cells prior to fertilisation. The authors describe a new case of such a haploid plant in *Œnothera* and pass in review other cases previously described in this genus and in seven other genera of flowering plants. The haploids are smaller than the normal diploids, with smaller cells, and are almost completely sterile. Such plants have appeared (*a*) after crossing, especially with a distantly related species; (*b*) after subjection to cold at the time of fertilisation; and (*c*) (in the tomato) "spontaneously". In the case of animals, many more experimental methods appear to have been employed to bring into being such haploid organisms, but such animals usually either fail to reach maturity or double their chromosomes during development. In certain species of animals, of course, haploid males are the rule, and the authors discuss the theoretical difficulty thus created, as, from the known facts as to the part played by chromosomes in the determination of sex, one set of chromosomes with one '*x*' body might be expected to carry female characters.

Tung Oil.—Tung oil is an essential raw material of present-day varnish manufacture, and its unique properties as a drying oil render it indispensable for certain types of varnish. It is also now widely used as an ingredient of certain types of paint media and in the manufacture of electrical insulating varnishes. The demand for tung oil, the possible extension of this demand, and the increasing areas being planted with the seed of *A. Fordii* both in the United States and in the British Dominions, Protectorates, and Colonies has led to the Imperial Institute preparing a memorandum on "The Production of Tung Oil in the Empire", with the co-operation of the Tung Oil Sub-Committee of its Advisory Committee on Oils and Oil Seeds, which is issued by the Empire Marketing Board. The memorandum sums up the history of tung oil under sources of production, its cultivation in the Empire and in the United States, and comments upon the further developments in the Empire. It then deals with methods of cultivation, growth of trees and yield, plantation costs, and utilisation of the nuts. Tabular statements show the exports (amounts and prices) of tung oil from China for the years 1924–28, roughly averaging £3,000,000 per year; the imports into the United States of America for the same years, which reached the £3,000,000 mark in 1929; and the

imports into Great Britain for the same period, the amount in 1929 amounting to a value of £273,350. On the subject of the future outlook, the memorandum states that the increased production will naturally tend to reduce the price, but the reduction should not be so great as to render the cultivation unprofitable. There will always be a demand for tung oil, as it is a raw material essential in some industries, and should always command a higher price than linseed oil.

An Amœba Growing in Cultures of a Yeast.—Aldo Castellani has observed the presence of an amœba in glucose-agar cultures of a yeast-like fungus, *Cryptococcus pararoseus* Cast. (*Jour. Trop. Med. and Hyg.*, June 2, July 1, Aug. 1 and 15, 1930). The amœbæ appeared as large, delicate, roundish or oval bodies, which from time to time slowly emit blunt pseudopodia of clear ectoplasm, usually singly. A single round nucleus is present in the protoplasm, which often contains yeast cells. The diameter without pseudopodia varied from 13·5μ to 22·5μ. Movements of translation were observed only in preparations made with Ringer's solution. Cysts occur, 9μ to 12μ in diameter, with a somewhat coarse granular protoplasm and well defined double-contoured membrane. The organism develops only in association with fungi or bacteria: for example, typhoid bacilli, alive or dead. When inoculated into cultures of various bacteria, alive or dead, zones of clearing or lysis were observed. The systematic position of this amœba is discussed by M. Douglas, who concludes that it is an undescribed species belonging to the genus *Hartmannella*, for which he proposes the name *Hartmannella castellanii* (*Jour. Trop. Med. and Hyg.*, Sept. 1).

Reversal of Cilia on the Gill of Mytilus.—D. Atkins (*Jour. Mar. Biol. Assoc.*, **16**, 1930) found that nearly one-third of the mussels obtained from the Fal Estuary during October and November 1927 presented abnormalities in their gills "doubtless correlated with some factor in the environment". Mussels from other localities were occasionally found with abnormal gills, perhaps in the majority of cases due to the presence of a large female pea-crab (*Pinnotheres pisum*), but the percentage of pea-crabs in the mussels from the Fal was so low (4·8 per cent) that their presence could not account for the large number of abnormal cases observed. The most interesting abnormality is the occurrence of supernumerary food grooves on the surface of the gill, accompanied in most cases by a permanent reversal of the beat of the frontal cilia on that part of the lamella between the main and secondary grooves. Particles drawn on to that part of the gill over which the cilia beat in a reversed direction are carried dorsally into the secondary groove and along it until they reach a filament with normal ciliation, along which they are passed into the main groove. While the author considers that the evidence points to a reversal of the effective beat of the cilia, she has not overlooked the possibility that the epithelium bearing these cilia may be partly formed anew after the production of the secondary groove, and the cilia may from their first formation have acted in the reverse direction.

Absorption of Fats and Lipoids in the Plaice.—Mr. B. Dawes (*Jour. Mar. Biol. Ass.*, vol. 17, No. 1, pp. 75-102; 1930) gives an account of his investigations on fat and lipoid absorption in plaice. He found fat to occur in all three types of cell composing the gastric epithelium of the plaice, at the end of a fasting period extending over six or seven days, but to be completely absent from the mucosa of all post-pyloric regions of the alimentary canal at such times. He found a marked increase in the fat content of the superficial epithelium of the stomach after thirty hours and fifty hours of gastric digestion, the stomach thus being shown to be an effective organ of fat absorption. Considerable quantities of fat are present in the duodenal and intestinal epithelia after fat-containing meals have been digested. The rectum also is capable of slight fat absorption. The author suggests that there is a transference of the function of fat absorption from the stomach to the post-pyloric intestine when the frequency with which meals are taken is increased. Globules of true fat are not typically observed in the areolar tissue layer of the alimentary canal, though lipoid granules may occur in abundance. It is concluded that resynthesis of the cleavage products of fat does not occur in this layer.

***Atlantobellerophon*, a New Rhætic Gastropod.**—Under the name *Atlantobellerophon zealandicus*, n. gen. et sp., Dr. C. Trechmann describes a *Bellerophon*-like mollusc from the Upper Trias, or Rhætic, of New Zealand (*Trans. N.Z. Inst.*, vol. 61). That its affinities are with *Bellerophon* and its allied forms, here discussed by the author, is evident. That it was presumably a Heteropod mollusc and allied to the modern *Atlanta*, as the author is inclined to infer, is a suggestion which malacologists are scarcely likely to accept without much stronger evidence, seeing how widely apart *Atlanta* and *Bellerophon* have always been ranked in the molluscan phylum.

Raman Effect.—A valuable analysis of the literature of the Raman effect published up to the end of June of this year is given by S. Bhagavantam in the September number of the *Indian Journal of Physics*. Some three hundred and fifty references are dealt with—a large increase on the 150 listed by Dr. Ganesan last year in the same journal—and have been grouped under twenty-six heads, the first three of which contain book references and articles of a general character, and the remainder papers on special aspects of the effect. These are followed by an author index and an alphabetical list of the substances which have been studied, and there is a further list of almost a hundred other papers on light scattering which have been published by Indian authors since 1919.

Radioactivity of the Alkali Metals.—Investigation of the radioactivity of potassium and rubidium, which is a matter of considerable difficulty when attempted by the usual methods, has been much facilitated by the introduction of the new sensitive particle counter of Geiger and Müller, and the radioactive constants for these elements found in this way by W. Mühlhoff (*Annalen der Physik*, vol. 7, p. 205) are probably as accurate as any yet published. Mühlhoff has confirmed the existence of a hard γ-radiation from potassium, and, from comparative measurements with radium-C and thorium-C, finds for the value of its absorption coefficient in lead, $\mu = 0{\cdot}59$ cm.$^{-1}$: the absorption was followed up to a thickness of more than 8 cm. Measurement of γ-radiation from rubidium could not be undertaken for lack of material, but the β-ray activity was found to be 14·2 times that of potassium, and it was confirmed that many of the rubidium β-rays are relatively very slow, their absorption coefficient in aluminium approaching 10^3 cm.$^{-1}$. The half-period for decay of rubidium is given as $4{\cdot}3 \times 10^{11}$ years, and the half-period for potassium $1{\cdot}5 \times 10^{13}$ years, but the latter number must be reduced to $7{\cdot}5 \times 10^{11}$ years if, as is probable, radioactivity is confined to the heavier isotope (41), which is present to the extent of some 5 per cent in ordinary potassium. In any event, the average life of a potassium or rubidium atom is not less than about 100 times that of an atom of uranium.

Band Spectra of Carbon Isotopes.—The July issue of the *Astrophysical Journal* contains an article by A. S. King and R. T. Birge, in which they review the work which has been done up to the present on the isotope bands of carbon. The evidence for the existence of the heavier isotope, of atomic mass 13, is now conclusive, bands due to the molecules $C^{12}C^{13}$, $N^{14}C^{13}$, and $O^{16}C^{13}$ being known to accompany the more intense bands of $C^{12}C^{12}$, $N^{14}C^{12}$, and $O^{16}C^{12}$, and from a study of the isotopic bands of C_2 at 4737 A. ($C^{12}C^{12}$) and 4744·5 A. ($C^{12}C^{13}$) it has now been shown that the mass ratio of the isotopes is 12 to 13, with an accuracy of one part in ten thousand. The most surprising result of this investigation is, however, that the relative intensity of two related isotope bands depends upon the conditions of excitation, making it impossible to estimate their relative abundance with certainty. There is some evidence that the controlling factor may be the effective temperature of the source; when the degree of excitation is low, as in a furnace or in the *N* type stars, the spectra associated with the heavier isotope are prominent. With more intense excitation, such as that of the arc, bands due to the heavier isotope are less strong, the only evidence for the existence of C^{13} from this particular source being a group of lines in the cyanogen band at 3883 A. It is not easy to see how such differences can arise, and after a discussion of the most probable influences (true differences in relative abundance, excitation difference, and dependence on the optical path), the authors practically leave the question open with the remark that the abundance of the isotope of mass 13 and the dependence of its spectrum upon excitation conditions will require much additional evidence. [See in this connexion NATURE, Oct. 25, p. 649.]

The Schütz Law of Enzyme Action.—According to the Schütz law, if x is the quantity decomposed, E the quantity of enzyme, and t the time, then $x/\sqrt{Et}=K$, a constant. In the *Journal of the Faculty of Agriculture*, Hokkaido Imperial University, Sapporo, Japan, vol. 28, part 3, K. Nakajima describes experiments by many previous investigators, and in a critical discussion arrives at the conclusion that the so-called law has no validity in the kinetics of enzymes except in the form $x/\sqrt{E}=K$ for dilute pepsin solutions. He also criticises the Arrhenius law and the Northrop theory, which are held to confirm the Schütz law. A bibliography is provided.

Solubilities of Salts in Ethyl Alcohol.—In the October number of the *Journal of the American Chemical Society*, some experiments on the effect of one salt on the solubility of another without a common on, ethyl alcohol being the solvent, are described by Seward and Schumb. An increase in solubility (as in other solvents) was found. In agreement with results of previous experimenters, it was found that the solubility curves show considerable deviations from the theoretical curve given by Debye and Hückel's equation, but they are considered to be in qualitative agreement with the extensions of that equation which take account of ionic size.

Reactivity of Coke.—The reactivity of a coke, which measures its capacity for reacting with steam and carbon dioxide, has usually been expressed as the percentage of each gas decomposed under defined conditions. This method of expression does not allow of a quantitative comparison of different cokes, or of the application of values determined under one set of conditions of temperature, gas velocity, etc., to another set of conditions. These shortcomings are avoided by a method described at a meeting of the Society of Chemical Industry, at Leeds on Oct. 28, by Dr. A. Key and Prof. J. W. Cobb, who express reactivity as the reciprocal of the weight of coke required to decompose a definite percentage of gas under specified conditions. It is not necessary to find this weight experimentally, since it is related to the percentage of gas decomposed by a standard weight of coke. This relation has been found and expressed on a reactivity curve which covers all known kinds of coke. It was also shown that the reaction between carbon and carbon dioxide is unimolecular with respect to the gas, while that with steam deviates from this because of complications. The uses of cokes are very largely dependent on their reactivity, and a method of comparison which can be applied generally should prove of great value in the study of carbonised fuels.

Synthesis of Creatine and Alacreatine.—A method worked out by Wheeler and Jamieson in 1908 for the preparation of alkylated guanidines is applied by H. King in the October number of the *Journal of the Chemical Society* to the synthesis of creatine. Sarcosine hydrochloride is treated with alkali and methyl isothiocarbamide hydriodide, with production of a 40 per cent yield of crude creatine. From alanine, the base alacreatine was similarly obtained. The substances were analysed as the crystalline picrates.

Sulphonation of Hydrocarbons.—Although it is generally supposed that saturated hydrocarbons are more or less inert to powerful sulphonating reagents, there have been references in recent technical literature which indicate that this is not the case, and in a paper in the October number of the *Journal of the Chemical Society*, G. N. Burkhardt shows that when an excess of *n*-hexane, cyclohexane, or methyl cyclohexane is stirred vigorously with fuming sulphuric acid (35-65 per cent SO_3) at 0°-10° for four to five hours, practically all the sulphuric anhydride is used up. About 1 mol. of sulphur dioxide is formed per mol. of hydrocarbon, and oxidation of some of the hydrogen of the hydrocarbon is an important part of the reaction, perhaps after sulphonation has occurred. The product contained sulphato-sulphonic acids, such as are formed by the action of fuming sulphuric acid on unsaturated compounds; the barium salts, however, were not crystallisable, and special methods were used for the identification of the products of reaction.

Bionomics of Marine Algæ.—In *Bulletin* 67 of the Bernice P. Bishop Museum, "Hawaiian Marine Algæ", Miss Marie C. Neal investigates the seaweeds of the Hawaiian reefs by studying certain small areas throughout the year. The iron stakes which marked out the areas proved very satisfactory for algal growth, also concrete slabs and blocks. Most of the algæ are at their lowest state in December and January, the largest kinds old and dying out. Young plants appear usually in February, when temperatures are slightly higher. Many of the seaweeds have regular life cycles, maturing once, twice, or three times in a year. The succession of plants on an originally clean surface was approximately uniform, diatoms appearing first, then *Ectocarpus*, sometimes *Colpomenia sinuosa* third, or *Padina*, minute green, blue-green, or red algae occurring at the same time. The succession was rather different on a scraped concrete block which was nearer shore and exposed to the air at very low tides, and was thus subjected to some drying and to strong light, the surrounding shallow water being often warmer than the deeper area. The best base for algæ is apparently an immovable one, raised above the sea floor so that sand and stones do not collect on it. Many of the larger seaweeds grew fastest before maturity. The work is illustrated by many text figures.

Colour Vision.*

By Prof. H. E. ROAF.

THE physiological problem in colour vision is to determine the varieties of receptors which are present in the retina. An experimental investigation of some aspects of this problem is summarised below.

The best starting point is the result of some investigations on hypochromats (colour-blind individuals).[1] The object was to find out if there was any particular region of the spectrum in which they differed from the 'normal'. They were asked to copy geometrical designs in colour, and the copies were compared with the originals in the light of a recombined spectrum from which any specified region could be eliminated. It was found that agreement could be obtained only if the long wave-length end of the spectrum was eliminated. The cases varied in the extent to which the spectrum must be cut down, but it is not certain whether this was due to differences in the degree of the defect or to mere chance: that is, they might make different mistakes in making another copy. At the same time, there is not necessarily any diminution in sensitivity to light (rise in threshold) even to those parts that they fail to discriminate.[2] This is one of the main objections to the Young-Helmholtz hypothesis.

The graph relating wave-length to change in wave-length necessary to produce a visible difference in colour shows two minima (maxima of discriminating power), one about 5800 A. and the other about 4900 A.[3] In hypochromats the former is absent, whilst the latter is as well marked as in 'normals'. This is further evidence that there is a failure to discriminate between the long wave-length and neighbouring parts of the spectrum. It can be said that the hypochromat fails to discriminate what affects the normal as a red element; thus a yellow by loss of red value is matched with green.

To explain the phenomena revealed by the preceding series of experiments, we have to imagine some system whereby the differences between 'red' and 'green' are diminished or abolished without an alteration in the threshold to light from the long wave-length end of the spectrum. On the other hand, the difference between 'green' and 'blue' (neutral region of hypochromats) is as great as with normal individuals.

A type of experiment which ought to show to what extent separate receptors are stimulated by different regions of the spectrum is to shine two lights on the same area of the retina and to measure to what extent they interfere with each other. Quite different results were found for central and peripheral vision.[4]

For central vision, long wave-lengths raise the threshold for all regions of the spectrum, whilst shorter wave-lengths have comparatively little effect on longer ones. Fig. 1 shows an experiment of this sort with three different backgrounds. The ordinates show the multiple of the absolute threshold which is necessary in order to produce a noticeable difference against the background. It is clear that a background of 6214 A. interferes with the visibility of all parts of the spectrum, whilst backgrounds of 5404 A. and 4708 A. have comparatively little effect on the 'red' end of the spectrum. An additional point is that the curves are horizontal down to about 6000 A., which suggests that this part of the spectrum varies only in brightness, and not in colour, with alteration in the wave-length.

With peripheral vision, short wave-lengths raise the threshold for the whole spectrum.

These experiments suggest that there is some common underlying factor in all sensations of light: a fact which is recognised by Hering's assumption that there is a black-white substance and by the spreading out and overlapping of the sensation curves in the Young-Helmholtz hypothesis.

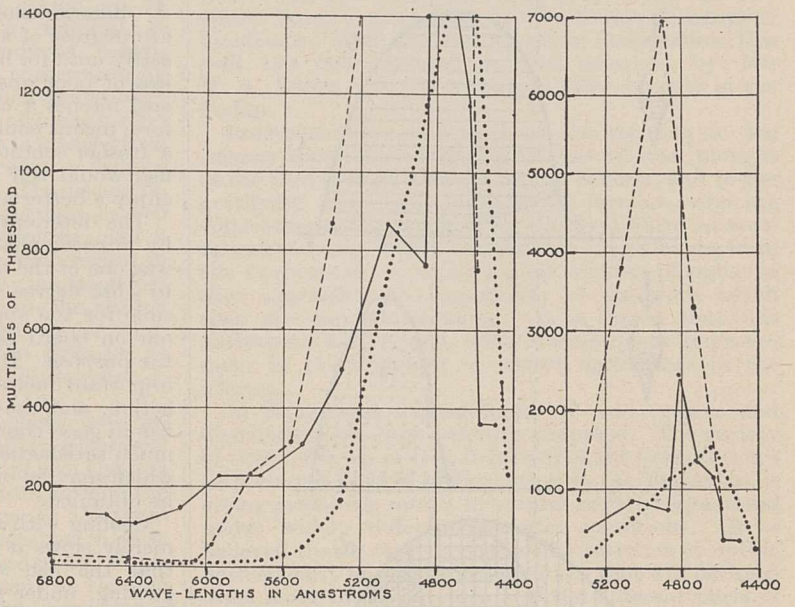

FIG. 1.—Ordinates, multiples of absolute threshold; abscissæ, wave-lengths in A. In order to show the higher values a part of the range is reproduced in one-fifth of the scale. Continuous line, background of 6214 A.; interrupted line, background of 5404 A.; dotted line, background of 4708 A.

It is possible to explain the facts of colour vision on the assumption that there are three sets of receptors (see Fig. 2):

(*a*) One which is stimulated by the whole of the visible spectrum and this may correspond with the sensation curve of the dark adapted eye;

(*b*) One which is stimulated by long and medium wave-lengths from the extreme 'red' end to about 4900 A.;

(*c*) One which is stimulated by long wave-lengths from the extreme 'red' end to about 5800 A.

As shown by the diagrams in Fig. 2, the long wave-length end of the spectrum stimulates all three sets of receptors and the short wave-length end stimulates only one set. That the short wave-length end of the spectrum stimulates a special mechanism is shewn by measurements of visual acuity.[5] Wave-lengths less than 4900 A. have a low ratio of intensity to brightness and to visual acuity. Additional evidence that the 'blue' mechanism is stimulated by the whole spectrum is that blue is seen when a pure long wave-length stimulus is looked at slightly eccentrically.[6]

* Substance of a contribution to a joint discussion—"In what Sense can we speak of Primary Colours?"—of Section I (Physiology) and Section J (Psychology) of the British Association at Bristol on Sept. 8.

The three sets of receptors might be explained on the basis of three photochemical substances or that there is one photochemical substance with coloured filters in front of the receptors. The second suggestion receives support from comparative anatomy, as amphibians, reptiles, birds, and marsupials all have

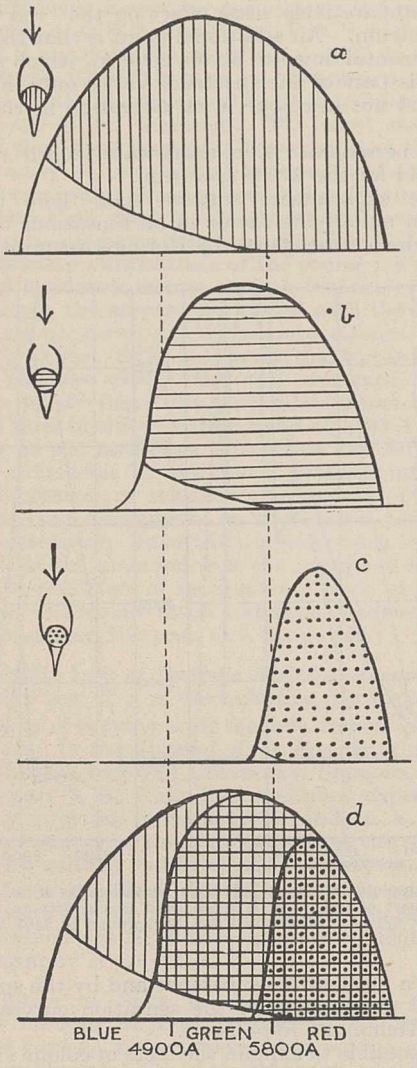

FIG. 2.—(*a*) Sensation curve for receptors sensitive to the whole of the visible spectrum.
(*b*) Sensation curve for receptors which fall off rapidly in sensitivity about 4900 A.
(*c*) Sensation curve for receptors which fall off rapidly in sensitivity about 5800 A.
(*d*) Superposition of the three sensation curves. The clear area indicates the photochromatic interval. The shift of maximum brightness with increase in intensity may be due to the effect of stimulating more than one set of receptors at the long wavelength end of the spectrum. For the hypochromat the dots would be deleted, leaving the other two sets of receptors active as in the 'green' area.
Insets: cones from hen's retina with corresponding coloured globules. The arrows show the direction of light.

coloured globules in front of the cones. As shown by the insets on the diagrams, those for the hen (red, yellow, and almost colourless) agree with the sensation curves deduced from experiments on human vision.[7] If such coloured globules should be discovered in the fovea of the human retina, the facts of colour vision would be explained. Perhaps, instead of cones with almost colourless globules, the rods may be the structures stimulated by the whole of the visible spectrum in the peripheral part of the eye. That cases of *retinitis pigmentosa* are blue blind is in favour of the blue sensation being the result of stimulation of rods.

This view is as sound from the photochemical point of view as the Young-Helmholtz hypothesis. It does not require quite so much unsupported speculation and it agrees better with the facts.

[1] Roaf, *Quart. Jour. Exp. Physiol.*, **14**, p. 151; 1924.
[2] Bradbrooke and Roaf, *ibid.*, **15**, p. 447; 1925.
[3] Roaf, *ibid.*, **16**, p. 379; 1927.
[4] Roaf, *ibid.*, **18**, p. 243; 1928.
[5] Roaf, *Proc. Roy. Soc.*, B, **106**, p. 276; 1930.
[6] Roaf, *Jour. Physiol.*, **69**, proc. p. 1; 1929.
[7] Roaf, *Proc. Roy. Soc.*, B, **105**, p. 371; 1929.

Preservation of Fish at Sea.*

FISH, even when kept in ice, soon show signs of deterioration which gives rise to 'staleness'. There are degrees of staleness, and a stale fish is not necessarily unfit for human consumption, but it is nevertheless of poor quality in the eyes of the market buyer and fetches a correspondingly lower price. If, therefore, means could be found to bring fish to market in a fresher condition after voyages of several days, the fish would sell at a better price, and the consumer enjoy a better article.

The deterioration of the fish may be caused either by intrinsic changes or by the effects of bacteria; it was one of the first aims, then, of the research to find to what degree either of these two causes was responsible for the staleness of fish. Research was carried out on board two steam trawlers specially fitted for the purpose. It has been shown that by far the more important factor in the staling of the fish is bacterial action, and that aseptic methods go far to keep the fish in good condition while at sea. This finding gives much satisfaction, as it shows at the start that results which may be of economic value to the fishermen can be obtained.

Cooling with ice does not stop bacterial action; it merely slows it down. It is therefore of importance that the fish should be thoroughly washed, after gutting, under aseptic conditions so far as possible. This, although it by no means sterilises the fish, reduces the initial contamination to a minimum and tends to keep the fish from rapid deterioration when stowed under suitable conditions. Full details and suggestions are given in the report for the equipment of trawlers with the necessary plant, and it is estimated that a capital expenditure of about £500 would be entailed and the running costs increased by about £400 a year. It remains to be seen whether the fishing trade will consider this outlay a financial proposition.

Since the introduction of the aseptic method would only extend the period during which a fish will keep fresh from 6-7 days to 10-12 days, it follows that it will only be of real value to short-distance vessels. While it would help towards keeping a larger proportion of the catches of long-distance vessels fresh, there would still be a large amount of fish caught early during the voyage that would inevitably become stale, or even bad. For the vessels making long voyages the possibilities of brine-freezing are being explored. The possible commercial advantages of this method are, however, not so sure, because, although the good flavour of the fish is preserved, the fish itself loses much in appearance; it can therefore only be taken by the salt-curers and smoke-curers.

* Department of Scientific and Industrial Research: Food Investigation. Special Report No. 37: The Handling and Stowage of White Fish at Sea. By Adrian Lumley, J. J. Piqué and Dr. George A. Reay. (London: H.M. Stationery Office.)

Problems of Cotton Growing.

A RECENT publication of the Empire Cotton Growing Corporation is a detailed report of the Conference on Cotton Growing Problems which was held in August last at the Shirley Institute, Didsbury, the station of the British Cotton Industry Research Association. The conference was attended by officers of the Corporation and of the Institute, by representatives of the cotton growing countries of the Empire, Egypt, and the Research Stations of Trinidad and Amani, as well as by other workers directly engaged on problems bearing on cotton. The sixteen papers presented, with the discussions thereon, covered much ground and included in their survey problems of manufacture in the factory as well as problems of production in the field.

The main problem, around which all others orientate, is the nature of the characters which go to produce quality in cotton, the raw material of the industry. This subject was introduced, appropriately at the commencement of the conference, by Mr. Peirce. Here is raised a problem which carries back at once to field conditions, the cause of immaturity, that 'curse of Lancashire'—neps. The evidence given by Mr. Bailey from the Sudan indicates a definite relation between nepiness and drought. The discussion ranged over the effect of gins in producing neps, as well as their behaviour in the processes of spinning; and it showed how much there is still to learn with regard to the origin of neps. The subject of quality in cotton was carried a step further by two papers from the Shirley Institute: on uniformity of cotton, by Mr. Underwood, and on the methods of correlating the strength of yarn with hair properties, by Messrs. Foster and J. Gregory.

On the agricultural side many problems were reviewed. The organisation of a seed supply which will retain purity in the crop when grown, as it is in Uganda and Nigeria, by a host of small cultivators, formed the subject of a paper by Mr. Lewin, of Nigeria; the practicability of limiting the number of varieties, in view of the variations of soil and climate found in any single territory, was raised on a reference from the Uganda Government and provided an interesting discussion—not unconnected with the subject of 'new place effect', introduced by Mr. Hutchinson, of the E.C.G.C. Research Station, Trinidad; while the discussion of the efficiency of cotton picking machines, raised by the Tanganyika Government and of interest to so many cotton areas owing to the acuteness of the labour problem, indicates that at the present time there is little hope of any practical solution.

The application of more fundamental research to cotton growing problems was also discussed. Two papers, one by Dr. Maskell, formerly of the E.C.G.C. Research Station, Trinidad, and the other by Dr. Gregory, of the Imperial College of Science and Technology, and Messrs. Crowther and Lambert, of the Sudan, dealt with the application of Dr. Fisher's recent methods of plot technique and analysis of field experiments. The former dealt more particularly with the possibility of securing a co-ordinated series of experiments in the different cotton growing territories, a subject to which reference was made in an editorial article in NATURE of April 12 last; the latter recorded some interesting results obtained in the Sudan by the application of these methods. The discussion on both papers illustrated the practical limitations by which such lines of investigation are rigidly bound.

The work at Rothamsted on the investigations, under controlled conditions, bearing on that widely distributed and elusive disease 'black-arm' (*Bacterium malvacearum*) was described by Dr. Stoughton, and the discussion revealed a critical attitude by many to the value of results obtained under such abnormal conditions of growth of the host plant. Finally, Prof. Weiss introduced a discussion of the subject of grafting and chimæra formation in its application to cotton.

On Oct. 21 a meeting of the Administrative Council of the Empire Cotton Growing Corporation was held, and in presenting the quarterly report of the Executive Committee, the director referred to the fact that the Sudan Government is about to reorganise its work on agricultural research, and with the view of effecting closer co-ordination between the different research workers, a Research Policy Committee is to be set up, of which the financial secretary will be chairman. In addition, an officer will be appointed to control the whole of the agricultural research work and to be the official channel of communication between the Research Farm in the Gezira and the Sudan Plantations Syndicate. With the consent of the Corporation, this post has been offered to, and accepted by, Mr. M. A. Bailey, the Corporation's plant breeder in the Sudan.

Reference was also made at the meeting to the success which has attended the use of steel ploughs at the Corporation's Seed Farm in Nigeria, and to the gratifying fact that neighbouring farmers, who are cultivating the land adjoining the Seed Farm on a co-operative basis, intend to purchase steel ploughs from the Corporation to replace their wooden ploughs, as they appreciate the superiority of the work which they are capable of doing. It is hoped that this movement will extend, with a consequent improvement in the standard of native agriculture in the district.

In Nyasaland a programme of seed control and distribution has been carefully prepared. The variety of cotton known as *U*.4, first bred at the Corporation's Experiment Station at Barberton in the Transvaal, is giving promising results in various parts of Nyasaland under widely different climatic conditions. It is believed that it may be possible by selection to obtain both an early and a late strain of *U*.4 that will between them meet the requirements of the different parts of the Protectorate in which cotton is cultivated.

University and Educational Intelligence.

BIRMINGHAM.—Leave of absence has been granted to Profs. Brash (Dean of the Faculty of Medicine), Haswell Wilson, and Daly, to visit the United States as guests of the Rockefeller Foundation to inspect the buildings and equipment of medical schools in that country in view of the building and development of the new medical school of the University of Birmingham.

There is a considerable increase in the entry of medical students to the University this session, but the number of entries to the University as a whole shows only a slight increase.

CAMBRIDGE.—The Appointments Committee of the Faculty of Agriculture and Forestry has appointed Dr. H. G. Sanders, of St. John's College, to be University lecturer in agriculture.

The Regent House has approved the recommendations contained in the report of the Council of the Senate on Mr. Montague Burton's benefaction for the endowment of a professorship of industrial relations, with a stipend of £1200 a year. If after the payment of this stipend and the appropriate pension contribution there is still a surplus in the fund in any year, it

is provided that it shall go into a separate fund from which may be paid the expenses of the professor in visiting Geneva, in order to keep in touch with the International Labour Office, or in investigating at first hand industrial relations in America. The new chair is to be called the Montague Burton Professorship of Industrial Relations and will be primarily assigned to the Faculty of Economics and Politics.

OXFORD.—At a meeting of Congregation held on Nov. 11, a decree was passed establishing regulations for the Joint Coal Mining Diploma of the Universities of Oxford and Birmingham. The decree provides that candidates for the diploma who are graduates of the University of Oxford must have obtained a class in the final honour school of engineering science, and must have attained a satisfactory standard in geology as a special subject. They must also present certificates of at least four months' practical experience in mining, and must attend the diploma course in mining at the University of Birmingham, extending over one session.

On Nov. 13, Prof. Pannekoek, of the University of Amsterdam, delivered, on behalf of Prof. Milne, a lecture on "Researches in the Intensities of Absorption Lines in Solar and Stellar Spectra". By means of certain formulæ and substitutions, which he employed with great fluency and readiness, he showed how the investigation of these intensities is capable of throwing light on the chemical constitution of solar and stellar atmospheres. Certain discrepancies between the calculated and observed results require further research. They may possibly indicate (as suggested by Prof. Milne) that some physical data need reconsideration in the light of astrophysics.

NOTICE is given by the Institution of Chemical Engineers, that application forms, particulars of the 1931 associate-membership examination of the Institution, and a memorandum on "The Training of a Chemical Engineer" are obtainable from the Hon. Registrar, Institution of Chemical Engineers, Abbey House, Westminster, S.W.1. The latest date for the return of application forms is Dec. 22.

Historic Natural Events.

Nov. 24, 1639. Transit of Venus.—The rare occurrence of a transit of the planet Venus across the sun's disc was first predicted and then observed on this date (old reckoning) by Jeremiah Horrocks and also by his friend Wm. Crabtree to whom he had communicated his prediction. "I then beheld a most agreeable spectacle, the object of my sanguine wishes, a spot of unusual magnitude and of a perfectly circular shape, which had already fully entered upon the sun's disc on the left, so that the limbs of the Sun and Venus precisely coincided, forming an angle of contact. Not doubting that this was really the shadow of the planet, I immediately applied myself sedulously to observe it." Only four other such transits have been seen, those of 1761, 1769, 1874, and 1882. The next is due in 2004.

Nov. 23-24, 1926. Rock Fall at Roquebillière.—Following heavy rains, a crevasse opened on the steep flank of the Maritime Alps above Roquebillière on Nov. 22. Suddenly on the night of Nov. 23-24 a great mass of rock broke away and fell on the village, destroying a dozen houses and killing 25 persons. The catastrophe was due to the saturation of the ground above a sloping bed of clay, down which the whole mass slipped.

Nov. 26-27, 1703. Defoe's Great Storm.—On the night of Nov. 26-27 the southern half of England was visited by a storm unequalled for at least 300 years and possibly for far longer. Daniel Defoe, the author of "Robinson Crusoe", compiled a detailed and graphic account of the disaster, with the help of correspondents in all parts of the country. The greatest intensity of the storm was experienced to the south of a line from Pembroke to Yarmouth, and here the damage was so great that masses of lead from the roofs were rolled up and carried considerable distances. Houses were blown down, unroofed, or otherwise damaged, and the cost of building materials rose to three or four times the normal level. Eddystone lighthouse was destroyed, with Winstanley, its designer; and according to Defoe's account there was great loss of shipping. The loss was greatest on the south and south-east coasts of England and even in the Port of London many ships were driven aground. On the shores of the Severn the damage was accentuated by an abnormally high tide. At Bristol the water rose eight feet above the previous highest level. In south-west England the winds began from south-west and veered to north-west; in south-east England they began from south-south-west and veered to west. There were several interesting peculiarities; the storm was generally accompanied by lightning, though the wind drowned the noise of the thunder. A 'spout' or tornado was observed at 4 P.M. on Nov. 26 near Oxford, and possibly elsewhere; and among the buildings of London the wind produced remarkable eddies, the damage to the roofs taking place on the eastern or leeward sides of the houses. In Kent the trees and grass were covered by a deposit of salt 25 miles from the sea. On Nov. 28 there was a very high tide in the Thames, which added to the confusion by flooding riverside London. The storm ravaged Holland on Nov. 27, struck Hanover and Copenhagen on the night of Nov. 27-28, while severe gales which may have been due to the same storm were afterwards reported from the Baltic, Sweden, Finland, and northern Russia. These led Defoe to conjecture that the storm, originating in North America, may have travelled entirely round the globe, losing force in the Arctic and dying out near its birthplace.

Nov. 26-27, 1898. "Portland Storm".—A violent storm traversed the coast of New England, accompanied by a heavy fall of snow. One hundred and forty-two ships were wrecked, with a loss of 455 lives, including the steamship *Portland*, which left Boston in spite of a storm-warning from the Weather Bureau, and foundered off Cape Cod, this disaster costing 175 lives.

Nov. 26-29, 1921. Glazed Frost.—During a period of strong northerly and north-easterly winds, snow and freezing rain fell steadily for more than three days in Massachusetts, forming thick coatings of ice on all trees and telegraph wires. Wires one quarter of an inch in diameter carried ice two inches in thickness, and weighed 1½ lb. per foot, and whole rows of telegraph and trolley-car poles were snapped off at the base, while almost every tree lost at least one good-sized branch. Communications and electric supply were interrupted for days, several people were injured and a number of horses killed.

Nov. 27, 1909. Hurricane.—A violent hurricane struck the Cocos Islands (Keeling Group) soon after 7.30 P.M.; the wind and high seas did considerable damage. At 8.15 P.M. cable communication was interrupted owing to the vibration of the instruments. The centre of the storm passed over about 10 P.M., the barometer reading being 947 mb. (27·96 in.).

Societies and Academies.

LONDON.

Society of Public Analysts, Nov. 5.—**G. M. Moir**: The determination of the milk proteins. By mixing definite quantities of milk with a suitable acetic acid and sodium acetate buffer, maximum casein values are obtained between *p*H 4·5 and 4·7. Casein thus precipitated is identical with the substance precipitated by acetic acid alone at *p*H 4·2. For the combined determination of albumin and globulin the filtrate obtained from the iso-electric precipitation of the casein is treated with trichloroacetic acid to give a concentration of about 4 per cent, and the nitrogen in the resulting precipitate determined by Kjeldahl's method. Casein and globulin are determined by precipitation with neutral saturated magnesium sulphate or sodium sulphate, and the individual proteins calculated by difference.—**S. G. Clarke**: The lead reduction method for the volumetric determination of tin, and the interference of copper and antimony. Tin is determined by Powell's method of reduction from the stannic condition by means of lead, and direct titration with iodine, in an atmosphere of carbon dioxide. Copper causes the results for tin to be too low in direct proportion to the amount of copper present. Antimony also interferes, a considerable amount of tin being removed from the solution by the precipitation of the antimony; this reacts with the iodine during the titration.—**W. J. Agnew**: A new method for determining traces of chromium in steel. Chromium is oxidised with potassium permanganate, excess permanganate being reduced by hydrochloric acid. The iron is then precipitated with sodium carbonate, and the dichromate determined by Evans's colorimetric method based on the purple coloration which it gives with diphenylcarbazide.

Linnean Society, Nov. 6.—**J. G. de Man**: On a new species of the genus *Hoplophorus* (*Oplophorus*) H. M.-Edw. A new species of deep-sea prawn belonging to the genus *Hoplophorus*. The specimens were taken from the stomach of a groper, *Polyprion prognathus*, captured in 2 fm. of water off the east coast of the South Island of New Zealand, at a place where deep water comes to within a short distance of the shore.—**Isabella Gordon**: Brachyura from the coasts of China. In the endeavour to find satisfactory systematic characters for the discrimination of species and genera, particularly in the families Xanthidæ and Portunidæ, attention was given to the form of the abdominal appendages in the male sex. These appendages appear to afford a ready and reliable means of distinguishing males of the species discussed here and also in other species.—**H. H. Allan**: Some remarks on wild hybrids in the New Zealand flora. Wild hybrids are very prevalent in the New Zealand flora, and these hybrids occur, for the most part, as highly polymorphic swarms, often between extremely diverse species, and showing a high degree of fertility. Where a species occurs alone it shows no 'variability', apart from environmentally induced modifications, and reproduces itself truly. The many so-called 'variable' species of the flora are really artificial groups compounded of true-breeding forms along with various hybrids. These artificial groups are now being studied by means of artificial hybridisation.

PARIS.

Academy of Sciences, Oct. 20.—The president announced the death of Adolf Engler, *correspondant* for the Section of Botany.—**Ernest Esclangon**: New observations of the trans-Neptunian planet and a new determination of its orbit.—**Georges Perrier**: The fourth general assembly of the International Geodesic and Geophysical Union; Stockholm, August 1930.—**Serge Bernstein**: An interpolation formula.—**P. Vincensini**: Surfaces of constant total curvature.—**Paul Delens**: Representations of complex elements and conformal transformations on the sphere.—**S. Finikoff**: Transformations of couples of stratifiable congruences.—**Paul Mentré**: The complexes produced by a non-special linear congruence.—**Alfred Rosenblatt**: The unicity of solutions of partial differential equations of the first order.—**Henri Poncin**: A particular case of flow.—**Ch. Ledoux**: Method and apparatus for studying the deformations of aerial helices.—**Mme. Camille Flammarion**: Photographs of the trans-Neptunian planet Pluto. Photographs were taken on Aug. 30, Sept. 3 and 25. On the last date the negative was satisfactory, permitting the determination of the planet's position with reference to neighbouring stars: the planet was estimated to be of mag. 15.—**J. J. Trillat**: The structure of celluloid. Study of the structure with an X-ray spectrograph of celluloid films of constant thickness containing variable proportions of camphor. The relations found between the intermolecular distances of the external ring and the proportions of camphor are given graphically.—**Jean Thibaud**: Remarks on the fine structure of the α-radiation.—**C. Pawlowski**: Researches on the artificial disintegration of some elements. The presence of disintegration particles has been proved for carbon, magnesium, aluminium, silicon, and sulphur, but for the heavier elements, iron, zinc, silver, and lead, only the reflected α-particles have been observed. The numerical results agree with those obtained by another method by Bothe and Fränz.—**Louis Meunier** and **Jacques Corbière**: The absorption of fatty materials from an aqueous emulsion by wool fibres.—**Hackspill** and **Winterer**.—The decomposition of the bromates of the alkaline earths by heat. The rate of oxygen evolution with rise of temperature has been studied by a continuous photographic method. Barium bromate gives a point of inflection at 300° C. corresponding with the possible formation of barium perbromate, but attempts to isolate this salt have been unsuccessful.—**G. Lejeune**: The equilibrium of cerous and perceric salts.—**Georges Brus** and **J. Vebra**: Crystallised complex compounds starting from bornyl and isobornyl acetates.—**J. H. Hoffet**: The age of the limestone formations of central Indo-China.—**J. Fromaget**: The age of the porphyrites and rhyolites in Haut-Laos and the bordering regions.—**Georges Dubois** and **J. Pierre Hatt**: Peat bogs and post-glacial forest modifications of the middle Vosges. An application of the method of pollen analysis.—**Jean Lugeon**: The examination of the upper ionised layers at sunrise between Paris and the Sahara by short waves. The results obtained by the atmospheric and short wave methods are in close agreement, and suggest that on the date of the experiments (Nov. 2) there were four reflecting layers at altitudes of 280, 185, 85, and 50 km. During the night the short waves are reflected by the upper ionised layers, but during the day are reflected by the lower layers.—**R. Argaud** and **M. Pesqué**: The persistence of the phacocytic activity of the thymus in the course of its involution.—**Fontaine**: Researches on the internal medium of the sea lamprey (*Petromyzon marinus*). Its variations as a function of those of the external medium.—**Ph. Jayet-Lavergne**: A physico-chemical theory of sexuality.

BRUSSELS.

Royal Academy of Belgium, April 5.—**E. De Wildeman**: The morphology of *Zygnema ericetorum*.—**Th. De Donder**: The physical interpretation of the

constant h of Planck by gravific.—**Th. De Donder**: The invariantive theory of the calculus of variations (6).—**D. V. Jonesco**: A problem relative to a recurrence formula or to a finite difference equation.—**Lucien Godeaux**: Researches on the cyclic involutions belonging to an algebraical surface.—**Raymond Defay**: The thermodynamical study of surface tension, affinity, and adsorption velocity (5).—**Jacques Van Mieghem**: Study of retarded potentials.—**G. Gueben**: The distribution of the radiation round radium tubes. The study of the distribution of radiation round radium tubes is of importance in radium therapy and has already been the subject of several publications, mainly from the mathematical point of view. The experimental method used by the author is based on the action of the radiation on a photographic plate, followed by measurements with a microphotometer. The proportionality between blackening and radiation found by Hoed and Stoel is confirmed. The relative advantages of the radiographic and ionometric methods for practical use are discussed.—**H. Keiffer**: The mechanism of lactation in mammals.

May 6.—**G. Cesàro**: Some functions of the sides or angles of the triangle capable of being expressed as a rational function of the perimeter and of the radii of the inscribed and circumscribed circles.—**Armand Renier**: A scientific centenary: André Dumont and the geological constitution of the province of Liége.—**Lucien Godeaux**: (1) Remarks on desmic surfaces of the fourth order.—(2) The complex locus of the straight lines belonging to the quadrics of a network.—(3) Plane curves of the sixth order possessing six points of inflection.—**M. Maury**: The geodesic service. Report on the work of 1929. The programme of work included the establishment of the triangulation network of the Grand Duchy of Luxemburg, and linking up the French, Belgian, and Luxemburg systems.—**Alb. J. J. van de Velde**: The sterilisation of flours and enzymes in the state of powder. Earlier researches with flour proved that of the various reagents tested, only carbon disulphide treatment gave a sterile powder, leaving the biochemical properties unchanged. Experiments on the sterilisation of enzymes (amylase, pepsinase) are described: even after a double treatment at the ordinary temperature with carbon disulphide, the hydrolysing properties of both these enzymes remained unchanged.—**A. De Waele**: Contribution to the study of cholesterol in the earthworm. The presence of cholesterol was proved, and found to be chemically and physically identical with that obtained from the higher animals. The proportion found was 0·092 per cent and no other sterol was present.—**Raymond Defay**: The thermodynamic study of surface tension. Affinity and adsorption velocity (6).—**R. H. J. Germay**: The Lagrange formula.—**Mlle. Georgette Schouls**: Study of dynamic azeotropism.—**Radu Badesco**: A functional equation (3).—**Fernand Bolus**: Surfaces of the fourth order possessing three double singular points.—**Raphael Deladrière**: The parametric or homogeneous form in the calculus of variations.—**E. Leloup**: Concerning *Monotheca obliqua*.

June 7.—**Th. De Donder**: The invariantive theory of the calculus of variations (8).—**Th. De Donder**: The physical interpretation of Planck's constant h by the gravific. Applications (2).—**P. Bruylants, L. Ernould, and M. Dekoker**: The α-methylbutenoic amides.—**Raymond Defay**: The thermodynamical study of surface tension. Affinity and adsorption velocity (7).—**Jacques Van Mieghem**: The study of retarded potentials (4).—**L. Godeaux**: The correspondence between two surfaces and birational transformation of space.—**M. Winants**: Some linear partial differential equations possessing three distinct families of real characteristics.—**R. H. J. Germay**: The rôle of an exponential in the development in series of solutions of generalised Lagrange equations. Application to the Gauss equation.—**M. Alliaume**: Simplifications of the Gauss method for the determination of orbits in the case of a very distant planet.—**A. Castille**: The ultra-violet absorption spectra of the α-methylbutenoic amides.—**Miron Nicolesco**: A theorem of M. Pompéiu.—**J. Thoreau**: The crystallographic characters of the α-methylbutenoic amides.—**M. Nuyens**: The quantification of the gravific and electromagnetic fields.

LENINGRAD.

Academy of Sciences, *Comptes rendus*, No. 11, 1930.—**P. Davidovich**: Spectroscopic problems in the study of new stars.—**A. Cvetkov**: The part played by statistical fluctuations in a living organism from the point of view of the ionic theory of excitation. Theoretical considerations on the problem.—**P. Wittenburg**: Discovery of an Upper Triassic fauna at Wrangel Land. New data for a palæogeographical map of the Upper Triassic period are supplied by the discovery of *Pseudomonotis ochotica* Keys. and *P. ochotica* var. *densistriata* Tell. at Wrangel Land.—**A. Mordvilko**: Notes on Aphids (1-3). Description of *Brasilaphis bondari*, gen. and sp. n., from Brazil, belonging to the peculiar subfamily *Setaphidinæ*, consisting of only four genera distributed in the tropics and subtropics. Attention is directed to *Neophyllaphis* Takah., living in Japan on *Podocarpus*, and a description is given of *Tetraneura takahashii*, sp. n., from roots of *Miscanthus* in Formosa.—**S. Smirnov**: Two new forms of Copepoda from the Amur region. Descriptions of *Attheyella borutzkyi*, sp. n., and *Cyclops languidoides* Lillj. var. *gracilicaudatus* n. var.—**V. Barovskij**: Description of a new genus of the tribe *Lycina*, family *Lycidæ* (Coleoptera). *Eudictyoptera brevicornis*, gen. and sp. n., is described from the South Ussuri region.

Comptes rendus, No. 12, 1930.—**P. Lazarev and L. Teile**: Action of certain substances, introduced into an organism by different methods, on the centres of peripheral vision. When morphine was injected into the blood the mean increase in the sensibility of the eye was greater than when morphine was taken through the mouth.—**P. Lazarev and P. Belikov**: Action of quinine on the centres of vision and of hearing. Since the time necessary to produce effect on the eye and the ear by the same substance (quinine) is different, it may be concluded that the physico-chemical mechanism of the visionary and the auditory centres are different.—**S. Kostychev and S. Klupt**: The activity of ferments in the maceration juice of yeast after filtration and dialysis. The reduction of the fermentative power of the yeast juice is a specific character of the zymase, while the carboxylase, mutase, invertase, and maltase of the juice are not affected by the filtration; the true diastases are not, then, absorbed in the filter.—**I. Kozhantchikov**: Habits of the sable (*Martes zibellina* L.) in the Sayan mountains and its geographical distribution. An analysis of the distribution of the sable on the basis of its ecological requirements.—**B. Dzerdzejevskij**: Some results of the aerological observations on Lake Baikal. Balloon observations on the velocity and direction of wind at different altitudes.—**V. Vlodavec**: Geological investigations carried out in 1925 in the region of the River Umba, Kola Peninsula. The investigations revealed a wide distribution in the area of rocks belonging to the habbro-pyroxenite formation.—**A. Saukov**: The cinnabar deposits of Nertchinsk. A description of the deposits from the point of view of their possible exploitation.

Official Publications Received.

BRITISH.

Canada. Department of Mines: Mines Branch. The Gypsum Industry of Canada. By L. Heber Cole. (No. 714.) Pp. viii+164+20 plates. (Ottawa: F. A. Acland.) 30 cents.

Transactions of the Mining and Geological Institute of India. Vol. 24, Part 3, July. Pp. 223-339+xiii+plates 15-18. 2.8 rupees: to non-Members, 4 rupees. Vol. 25, Part 1, August. Pp. 79. 2.8 rupees; to non-Members, 4 rupees. Member List, 1930. Pp. 26. (Calcutta.)

Proceedings of the University of Durham Philosophical Society, 1929-1930. Vol. 8, Part 3, July. Pp. iii+161-279+vii. (Durham.) 5s.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 9: The Foundations of Yarn-Strength and Yarn-Extension. Part 4: The Influence of Yarn-Twist on the Diameters of Cotton Yarns and on the Proportions of Fibre-Slippage and Fibre-Fracture in Yarn-Breakage. By A. N. Gulati and Dr. A. J. Turner. Pp. ii+22. (Bombay.) 8 annas.

Department of Scientific and Industrial Research. Report of the Forest Products Research Board, with the Report of the Director of Forest Products Research, for the Period ended 31st December 1929. Pp. v+54+11 plates. (London: H.M. Stationery Office.) 4s. net.

The Organization of the Electrical Industry in Great Britain. By P. Good. Pp. 44. (London: Institution of Electrical Engineers.)

The North Staffordshire Field Club. Transactions and Annual Report, 1929-30. Edited by H. V. Thompson. Vol. 64. Pp. 211+A24. (Stafford.) 7s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1318 (E. 35): Detonation and Lubricating Oil. By R. O. King and Dr. H. Moss. (I.C.E. 747.) Pp. 23+3 plates. 1s. 3d. net. No. 1326 (E. 37): Wind Tunnel Experiments on Steam Condensing Radiators. By Dr. R. G. Harris, L. E. Caygill and R. A. Fairthorne. (T. 2591: I.C.E. 497.) Pp. 28+10 plates. 1s. 6d. net. No. 1330 (Ae. 462): Maximum Force on the Fin and Rudder of a Bristol Fighter. By F. B. Bradfield and R. A. Fairthorne. (T. 2964.) Pp. 4+4 plates. 4d. net. No. 1331 (Ae. 463): Hinge Moments of Balanced and Unbalanced Ailerons on R.A.F. 14 Wing, to Large Angles of Incidence. By F. B. Bradfield and R. A. Fairthorne. (T. 2968.) Pp. 9+5 plates. 9d. net. (London: H.M. Stationery Office.)

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1929. Fifteenth Report. Pp. vii+64. (London: H.M. Stationery Office.) 3s. 6d. net.

Annual Report for the Year ended March 31st, 1930, of the Executive Council of the National Institute for the Blind. Pp. 66. (London.)

Proceedings of the Royal Irish Academy. Vol. 39, Section B, No. 17: The Marine Mollusca of the Shores and Shallow Waters of County Dublin. By Nathaniel Colgan. Edited by A. R. Nichols. Pp. 391-424. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1s.

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Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on October 21st, 1930. Pp. 8. (London.)

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Ordnance Survey. Report on the Experimental Revision of the 1/2500 Ordnance Survey Plans with the aid of Photographs taken from the Air. (No. 2, 1928–30.) Pp. 8. (London: H.M. Stationery Office.) 2d. net.

FOREIGN.

The Fishery Experiment Station, Government-General of Tyôsen, Husan, Tyôsen, Japan. Annual Report of Hydrographical Observations. No. 2-3: For the Years 1927–28. Pp. 42+22 plates. No. 4: For the Year 1929. Pp. 44+6 plates. Oceanographical Charts for the Year 1928: Appendix to Annual Report of Hydrographical Observations, No. 3. 24 charts. Oceanographical Charts for the Year 1929: Appendix to Annual Report of Hydrographical Observations, No. 4. 43 charts. (Husan.)

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United States Department of Agriculture. Circular No. 109: Parasitism of the Mediterranean Fruit Fly in Hawaii, 1922–1924. By H. F. Willard and T. L. Bissell. (Corrected edition.) Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the United States National Museum. Vol. 78, Art. 1: New Two-winged Flies of the Family Calliphoridae from China. By J. M. Aldrich. (No. 2844.) Pp. 5. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 266: On the Stark Effect of Aluminium and Carbon. By Yoshio Ishida and Masaichi Fukushima. Pp. 123-143+plates 22-24. 40 sen. Nos. 267-270: Thickness of the Oxide Film which produces Temper Colour on Iron, by Masawo Kuroda; Resistance of Impact on Water Surface, Part 2: Cone (continued), by Shumpei Watanabe: Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 6: Die Kohlenwasserstoffbildende Wirkung des Eisenkatalysators, von Shinjiro Kodama; Studien in der Fluorenreihe, von Keizo Nakamura. Pp. 145-188+plates 25-30. 90 sen. (Tôkyô: Iwanami Shoten.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 9, Septembre. Pp. 545-592. Année 2, No. 10, Octobre. Pp. 593-652. (Prague: Regia Societas Scientiarum Bohemica.)

Acta Zoologica Fennica, 9. Edidit Societas pro Fauna et Flora Fennica. Beiträge zu einer einheitlichen Auffassung gewisser Chromosomenfragen: mit besonderer Berücksichtigung der Chromosenverhältnisse in der Spermatogenese von Alydus calcaratus L. (Hemiptera). Von Enzio Reuter. Pp. viii+487+8 Tafeln. (Helsingforsiae.)

Vísindafélag Íslendinga (Societas Scientiarum Islandica). 5: Some additional Notes on Thermal Activity in Iceland. By Thorkell Thorkelsson. Pp. 31+3 plates. (Reykjavík: Ríkisprentsmidjan Gutenberg.)

Comité national français de Géodésie et Géophysique. Assemblée générale du 7 avril 1930: Compte rendu publié par G. Perrier. Pp. 63. (Paris.)

Rapport annuel sur l'état de l'Observatoire de Paris pour l'année 1929. Par Ernest Esclangon. Pp. 40. (Paris.)

Journal de la Société des Américanistes. Nouvelle Série, Tome 22, Fasc. 1. Pp. 247. (Paris.) 60 francs.

Proceedings of the United States National Museum. Vol. 77, Art. 5: The Excavation and Repair of Betatakin. By Neil Merton Judd. (No. 2828.) Pp. 77+46 plates. Vol. 77, Art. 6: A Monograph of the Foraminiferal Family Polymorphinidae, Recent and Fossil. By Joseph A. Cushman and Yoshiaki Ozawa. (No. 2829.) Pp. 195+40 plates. (Washington, D.C.: Government Printing Office.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1929. By William Henry Fox. Pp. 77+5 plates. (Brooklyn, N.Y.)

Cornell University Agricultural Experiment Station. Bulletin 505: Some Factors affecting the Cost of Operation of Retail Feed Stores in New York State. By Whiton Powell. Pp. 126. Bulletin 506: An Economic Study of Tractors on New York Farms. By C. W. Gilbert. Pp. 80. Memoir 129: Genetical and Cytological Studies of Mendelian Asynapsis in *Zea mays*. By G. W. Beadle. Pp. 23+6 plates. Memoir 130: A Study of Meadow-Crop Diseases in New York. By James G. Horsfall. Pp. 139. Memoir 131: Some Cold-Storage and Freezing Studies on the Fruit of the Vinifera Grape. By D. B. Carrick. Pp. 37. (Ithaca, N.Y.)

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 12, October: Records of Meetings, 1928–1929, 1929–1930; Biographical Notices; Officers and Committees for 1929–1930, 1930–1931; List of the Fellows, Associates and Foreign Honorary Members; Statutes and Standing Votes; Rumford Premium; Index. Pp. 463-613. (Boston, Mass.)

CATALOGUES.

The Thring High Pressure Indicator. Pp. 4. (London: C. F. Casella and Co., Ltd.)

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Surveying Instruments; Drawing Instruments and Materials; Photographic Apparatus and Materials; Plan Reproduction. Pp. iv+251. (London: A. West and Partners.)

Books on the Subjects of Conchology, Entomology, Geology, Ornithology and General Zoology. (Catalogue No. 179.) Pp. 32. (London: Dulau and Co., Ltd.)

Orchidaceae. Supplementum: Iconographiae Botanicae coloratae. (No. 78.) Pp. 38. (Berlin: W. Junk.)

Diary of Societies.

FRIDAY, NOVEMBER 21.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science), at 2.30.—Dr. H. F. Barnes: The Specific Resistance of Willows to Insect Attack.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.—Major W. H. Goddard: The Application of Diesel Engines to Road Transport.

ROYAL SOCIETY OF MEDICINE (Balneology and Climatology Section), at 5.—Dr. F. G. Thomson: The Rôle of Hydrology in Preventive Medicine.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—Dr. E. T. Paris: The Determination of the Acoustical Characteristics of Singly-resonant Hot-wire Microphones.—Dr. K. R. Rao: The Spectrum of Doubly-ionised Arsenic.—Dr. H. C. Bowker: The Effect of Temperature on Spark Potential.—Dr. L. F. Bates: The Curie Points.—Demonstration of an Instrument for Compounding Curves, designed by Dr. Haughton.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Specimens illustrating the Enlargement of the Prostate, with an Account of the Present State of Knowledge concerning the Etiology of the Condition.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—Dr. J. H. Reid: Nicotine.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—A. Eagle and R. M. Ferguson: The Coefficients of Heat Transfer from Tube to Water.
SOCIETY OF DYERS AND COLOURISTS (at Literary and Philosophical Society, Manchester), at 7.—Dr. J. L. Hankey: The Treatment of Aniline Black subsequent to Ageing.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group) (Informal Meeting), at 7.—W. H. Clark: A Talk on Lantern Slides.
JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—R. P. H. Graham: Ancient Clocks and Horological Curiosities.
INSTITUTION OF STRUCTURAL ENGINEERS (at Merchant Venturers' Technical College, Bristol), at 7.30.—G. F. C. Caswell: The Erection of Steelwork.
INSTITUTE OF CHEMISTRY, at 8.—B. F. Howard: Some Notes on the Cinchona Industry (Streatfeild Memorial Lecture).
ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. T. W. Eden, Dr. J. S. Fairbairn, and others: Discussion on the Interim Report of the Departmental Committee on Maternal Mortality and Morbidity.
INSTITUTE OF BREWING (at Institution of Electrical Engineers), at 8.15.—Dr. E. S. Beaven: The Culture of Barley for Brewing (Horace Brown Memorial Lecture).
ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Clinical Meeting.
INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Leeds).—Annual General Meeting.
SOCIETY OF DYERS AND COLOURISTS (London Section).—Prof. F. M. Rowe: Properties of Insoluble Azo Colours on the Fibre.

SATURDAY, NOVEMBER 22.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene: What Schubert did for Song.
BRITISH PSYCHOLOGICAL SOCIETY (at Royal Anthropological Institute), at 3.30.—Extraordinary General Meeting.

MONDAY, NOVEMBER 24.

INSTITUTE OF ACTUARIES, at 5.—Sir Alfred Watson: The Analysis of Sickness Experience.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.45.—C. H. Russell: Machine Tools.
INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—J. Paley Yorke and others: Discussion on The Syllabuses of Day and Evening Courses in Electrical Engineering—Do they meet Commercial Requirements?
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.—G. Bianchi: Some Data concerning Railway Electrification in Italy.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. H. Reynolds: Slides and Films in the Exhibition of the Society.
INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.—J. Bradley and S. A. Wood: Some Experiments on the Factors affecting the Motion of a Four-wheeled Vehicle when some of its Wheels are locked.—J. Bradley and R. F. Allen: Factors affecting the Behaviour of Rubber Tyred Wheels on Road Surfaces.
ROYAL SOCIETY OF ARTS, at 8.—Prof. C. R. Darling: Modern Domestic Scientific Appliances (Cantor Lectures) (1).
ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—J. L. Payne: A Case of Re-plantation and the Result after Nine Years.—Dr. A. F. Hurst: The Teeth and the Stomach.
MEDICAL SOCIETY OF LONDON.—Clinical Evening.

TUESDAY, NOVEMBER 25.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Section), at 4.30.—G. E. Woods Humphrey: The Development of Air Communication in Africa.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Sir W. H. Bragg: Two Old Friends of the Royal Institution (2): Warren de la Rue.
EUGENICS SOCIETY (at Linnean Society), at 5.30.—W. T. J. Gun: The Heredity and Environment of our Empire Builders.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—G. Bianchi: Some Data concerning Railway Electrification in Italy.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—O. Bloch: How it Works in Photography (3): The Emulsion Maker's Point of View.
SHEFFIELD METALLURGICAL ASSOCIATION (at 198 West Street, Sheffield), at 7.30.—G. C. Waite: Preparation of Standard Steels.
DESIGN AND INDUSTRIES ASSOCIATION (at Institution of Electrical Engineers), at 8.—R. D. Best and R. McGrath: Discussion on Modern Electric Lighting and Lighting Fixtures.

WEDNESDAY, NOVEMBER 26.

BRITISH ASTRONOMICAL ASSOCIATION (at Sion College), at 5.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Annual General Meeting) (at Caxton Hall), at 5.30.—Rhys Jenkins: Early Fire Extinguishing Engines.
INSTITUTION OF ENGINEERS-IN-CHARGE (jointly with Association of Supervising Electrical Engineers) (at Magnet House, Kingsway), at 7.15.—H. J. Eley: Ventilation by Air Movement.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—O. E. Fletcher: Further Aspects of Boiler Design.
ROYAL SOCIETY OF ARTS, at 8.—Prof. W. A. Bone: The Chemical Constitution of Coal.

THURSDAY, NOVEMBER 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. L. C. Martin: Colour Vision (2).
INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—Dr. O. F. Hudson: Solders.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group), at 7.—Projection of Films.
INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Great Northern Hotel, Leeds), at 7.15.—Annual General Meeting.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—L. J. Kettle and W. Tatlow: Progress in the Electrical Industry.
MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.1), at 8.30.—Dr. F. C. Martley: The Importance of Blood-grouping Tests in Paternity Cases.

FRIDAY, NOVEMBER 28.

GENETICAL SOCIETY (at Linnean Society), at 3.—A. E. Gairdner and Dr. C. D. Darlington: The Theory of Ring-formation exemplified by *Campanula persicifolia*.—J. Philp: An Explanation of the Inheritance of Double Flowers in *Matthiola incana R.Br.* based on Cytological Evidence.—At 3.45.—Prof. A. H. R. Buller: Sexual Phenomena in the Higher Fungi.—C. Diver: Studies in the Genetics of the Common Garden Snail, *Helix aspersa*.—A. A. Moffet: Cytology of Pomoideæ.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—W. S. Hinde: The Ocean-going Tramp Steamer from the Owner's Point of View.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—Lt.-Col. H. E. O'Brien: Electric Traction (Students' Lecture).
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—E. Batten and others: Discussion on Export Trade Emancipation.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—G. H. Willett: Photography applied to Science.
INSTITUTION OF CHEMICAL ENGINEERS.—S. Mayne: The Sources of Published Technical Data and how they should be used.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (jointly with Society of Dyers and Colourists) (at Glasgow).—F. W. Lake: Dyeing and Dry Cleaning.

SATURDAY, NOVEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Plunket Greene: Verse in Song.

PUBLIC LECTURES.

FRIDAY, NOVEMBER 21.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at Surveyors' Institution), at 5.30.—Col. C. H. Bressey: Some of our Road Problems.
TOWN HALL, GATESHEAD, at 7.30.—Dr. M. Ray: The Treatment of Rheumatism (Chadwick Lecture).

SATURDAY, NOVEMBER 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Norris: A Survey of Costume from Prehistoric Times to the Elizabethan Era.
UNIVERSITY OF CAMBRIDGE (at Newnham College), at 5.—Prof. A. V. Hill: Biology in Education (Henry Sidgwick Memorial Lecture).

MONDAY, NOVEMBER 24.

UNIVERSITY OF LEEDS, at 5.15.—Prof. R. Robinson: The Colouring Matters of Red and Blue Flowers, Fruits and Blossoms.

TUESDAY, NOVEMBER 25.

KING'S COLLEGE, LONDON, at 11 A.M.—S. P. Turin: Russian Farming and Agriculture.—At 5.30.—Miss Hilda D. Oakeley: The Approach to Reality: Through History and Practice.

WEDNESDAY, NOVEMBER 26.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—L. Ward: The Prevention of Accidents in Factories and Workshops.
KING'S COLLEGE, LONDON, at 5.30.—H. T. Tizard: Scientific Industry.
UNIVERSITY COLLEGE, LONDON, at 5.30.—A. M. Wijk: Stockholm and its Environs. (Succeeding Lectures on Dec. 3 and 10.)
BELFAST MUSEUM AND ART GALLERY, at 8.—J. Taylor: Venetian Art.
UNIVERSITY OF READING, at 8.15.—J. H. Coste: The Object and Methods of Sewage Treatment (Chadwick Lecture).

THURSDAY, NOVEMBER 27.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. H. Chapple: Contraceptive Responsibilities of the Medical Practitioner.
LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (Public Health Division), at 5.—Dr. J. S. Owens: Atmospheric Pollution.

FRIDAY, NOVEMBER 28.

ROYAL SOCIETY OF ARTS, at 5.30.—Sir Robert Philip: The Outlook on Tuberculosis: Changing Orientation (Malcolm Morris Memorial Lecture).

SATURDAY, NOVEMBER 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Some Mediæval Beasts, Real and Otherwise.

CONGRESS.

FRIDAY, NOVEMBER 21.

PUBLIC HEALTH CONGRESS (at Royal Agricultural Hall).
At 10.30 A.M.—Discussion on Sterilisation of the Unfit.
At 11 A.M.—Meeting of Institute of Public Cleansing.
H. Cook: The Future of Public Cleansing Work.
At 3.—Prof. C. S. Myers: Industrial Psychology and Public Health.
Meeting of Association of Superintendents of Parks and Botanic Gardens.
W. W. Pettigrew: Public Parks in Relation to Public Health.
Meeting of British Red Cross Society Hospital Library.