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The Position of Fundamental Research.

THE current report of the Medical Research Council directs attention to the present dearth of men able and willing to devote themselves to clinical research in experimental medicine. In spite of the success which has attended the appointment in 1916 of Sir Thomas Lewis to organise work in clinical medicine—an experimental appointment which it may be noted in passing has been responsible for an output of valuable work on the scientific study of the heart and blood vascular system, its disorders and their treatment, which has constituted the main stream of international progress in these subjects—it has been very difficult to find suitable men for appointment to the necessary assistantships. This shortage of recruits of high attainments for scientific research work retards seriously the general progress of medical research. Immediate opportunities for research in the hospitals are being wasted, while the present system yields no proper supply of men qualified to undertake research elsewhere in the modern conditions required for scientific progress.

A similar situation has been reported from France, and in post-War Europe generally there has been a very marked shortage of candidates for careers of pure and experimental science, as compared with careers in applied science. Progress in applied science depends upon fundamental scientific experimental investigation, and the concern of the Association of British Chemical Manufacturers in regard to the chair of organic chemistry at University College, London, is primarily due to realisation of this fact. The awkward situation has revealed the unfortunate fact that not even a handsome salary has been able to attract a really first-class organic chemist of the younger generation.

Replacement of a chair of organic chemistry by one of physical chemistry may have grave consequences for the chemical industry of Great Britain and tend towards that same neglect of organic chemistry which fifty years ago was primarily responsible for our dependence on foreign countries for synthetic dyestuffs, drugs, etc. Much more serious for mankind generally will be the consequences of neglecting the present international situation, and if no inquiry is made into the contributory causes of the shortage of recruits for professions of scientific research or attempt directed towards their removal.

The International Committee on Intellectual Co-operation, however, has been devoting some attention to this problem, and it was early realised that

the underlying causes are similar in most countries. Prominent among these is the very different position offered to those who adopt a career of scientific research, whether in medicine, chemistry, or other branches of science, as compared with those offered in the field of applied science. While the intellectual demands made upon the research worker may be, if anything, more severe than those made upon his colleagues in professional or industrial practice—he must have his problems in mind during most of his waking hours and be thoroughly versed in the scientific literature of all countries—his prospects are much inferior. Brilliant success in research, even if measured by high international standards of value, will bring him no more than a moderate salary. On the other hand, in medical practice, for example, merely moderate ability combined with good luck may make him a rich man, and even in Great Britain the opportunities for the chemist or physicist who adopts an industrial career or takes up consulting work to attain positions of high responsibility and remuneration are far greater than those of one who adopts a career of scientific research. Even in industry there are many tendencies which act to remove the ablest investigators from the sphere of research, the normal avenue of advance or promotion being to administrative positions and away from laboratory work.

Until there are a reasonable number of positions in the various branches of scientific research the occupation of which at middle age provides reasonable remuneration and adequate power of educating a family, the successful recruitment of young men of ability for experimental research cannot be maintained. It must be realised, too, that young men of the type required will not be attracted if the promotion open to them is to positions which carry such burdens of teaching and administration as to debar them from the research work that it is their ambition to pursue. In the words of the Balfour special research sub-committee reporting to the last Imperial Conference: "Special inducements offered at any early stage to tempt young men into a profession cannot make up for inherent deficiencies in the prospects which that profession can provide in salary, promotion, status, and opportunities."

To stress this point does not deny that the main driving force of research work of any high standard is scientific enthusiasm. The real stimulus will always be primarily intellectual, but that stimulus cannot operate effectively if the investigator is too much occupied either with the struggle to secure and maintain a reasonable standard of living or with the discharge of administrative or tutorial duties. Major F. A. Freeth alludes to this danger in his May Lecture to the Institute of Metals on "The Influence of Technique on Research", and he would be the first to admit that in the team work which industrial research demands under modern conditions, enthusiasm is as important a factor as a high standard of technique.

It is to this latter factor that Major Freeth devotes most attention in the lecture to which reference has just been made. One of the weakest spots in research in Great Britain to-day, he asserts, is the totally disproportionate strength on the side of technique as against the numbers and efforts of people who are engaged in research, and the experimental facilities of the average university or research institution, industrial or not, are not nearly so effective as they could easily be. This is true of other countries, notably of Austria, Czechoslovakia, Poland, Hungary, Russia, where remarkably fine experimental work has been carried out during the post-War years under most discouraging conditions by a number of men of science whose work is only just receiving recognition. The fundamental cause is the same everywhere—a shortage of men and a shortage of money, varying in acuteness from country to country. There are, of course, a few brilliant exceptions; for example, Holland, where the foresight of Prof. Kamerlingh Onnes led to the development, through the Instrument Makers' School at Leyden, of the technique and technicians required for his attack on the physics of low temperatures. Again, in Great Britain, the wisdom and initiative of Imperial Chemical Industries, Ltd., have supplied the apparatus and equipment that have made possible the remarkably successful work in physical chemistry and in high pressure reactions at the Imperial College of Science and Technology and elsewhere.

The future of fundamental research is, as Major Freeth suggests, dependent largely upon our ability to raise either from the community or from powerful individuals the money required for the development of adequate technique and resources. It is dependent also on our ability to stimulate the maximum intellectual interest and enthusiasm of our experimental investigators. It is dependent, too, upon our ability to reward the brilliant prosecution of laboratory work with recognition both in pay and in status which can compare with that which rewards similar abilty in administrative and other spheres of intellectual life. The effort of the Medical Research Council to deal with this situation, not only by helping recruits of ability

during their preliminary period of training and probationary work, but also by increasing the number of stable positions in which the career of clinical research can be pursued with proper facilities and reasonable remuneration, for example, by increasing the number of clinical workers upon their staff as suitable candidates are available, is one that deserves support. It means an immense contribution to the alleviation of human suffering, and renders possible the utilisation for the benefit of posterity of a wealth of experience which at present is being wasted.

Medical research is, however, only one section of the field in which the shortage of recruits is so serious a problem. While national efforts must play a great part in solving the problem, the efforts of such an international organisation as the Committee on Intellectual Co-operation of the League of Nations may not only stimulate national effort but also may make important direct contributions. Wisely directed, such a Committee can do much to bring the different national groups of scientific workers, or even the different classes of research workers, into closer touch with one another, to facilitate the exchange of technique, and by encouraging travel, remove some of the worst consequences of modern scientific specialisation. It can assist materially in raising the status of the investigator in experimental science and in securing a more widespread appreciation of the importance of his work and its contribution to human progress—both fundamental factors in fostering that scientific enthusiasm and intellectual stimulus upon which fundamental research of the highest class so closely depends.

The Doctrine of Atomic Valency.

August Kekulé. Von Richard Anschütz. Band 1: *Leben und Wirken.* Mit Titelbild, 119 Abbildungen im Text und auf 20 Tafeln und einem Faksimile. Pp. xxiii + 708. Band 2: *Abhandlungen, Berichte, Kritiken, Artikel, Reden.* Mit 5 Abbildungen im Text und 3 Tafeln. Pp. xvi + 960. (Berlin: Verlag Chemie, G.m.b.H., 1929.) Preis: M. 120; M. 90 to Fellows of the German Chemical Society, if ordered directly from the publisher. Weight about 7 lb. 10 oz.

"IT was set down many years past and was the sense of my conceptions at that time, not an immutable law unto my advancing judgment at all times; and therefore there might be many things therein plausible unto my passed apprehension which are not agreeable unto my present self. There are many things delivered rhetorically, many expressions therein merely topical and as they best illustrate my intention; and therefore also there are many things to be taken in a soft and flexible sense and not to be called unto the rigid test of reason. Lastly, all that is contained therein is in submission unto maturer discernments."—Sir Thomas Browne—Preface to "Religio Medici".

Such doctrine may well be applied to our "Religio Chemici", particularly in dealing with a work such as that under notice. In terms which can only be spoken of as pathetic, Prof. Anschütz presents these two massive volumes to us as the completion of a task piously undertaken thirty-three years ago, at the time of Kekulé's death, at the request of Emil Fischer, on behalf of the German Chemical Society. It is impossible to overrate the value of the service our German colleague renders to his cloth in this his centenary gift. Few know how great are the difficulties of writing real biography, the heart-searchings attending the desire to compose a truthful picture, with balanced judgment. From my own experience, I can form a fair estimate at what great cost of effort this likeness has been limned.

Were there not so much barium in it, the first volume might be said to be worth its weight in gold. The price charged, however, is beyond that penniless, pensionless English professors can afford to pay. Why German scientific books are now so very expensive is a mystery—and a misfortune. Libraries even are ceasing to purchase them.

No self-respecting chemical librarian should be without the books. No chemist's biography yet written is of greater interest and importance: it is, however, necessarily very difficult reading; few of the younger generation will be able to grasp the story in its entirety; so many and such diverse and dominant characters cross the stage and so much is told of disputes, which, if not due to misunderstanding, were at least due to a failure of those concerned to understand one another and be in sympathy or, indeed, show any real sense of humour. We are in face of a play of commanding and rather irascible intellects, very difficult to interpret without considerable experience of life and personal knowledge of the men concerned, as well as of the times in which they moved—the more so, as the plot is laid not in one country but in three, England, France and Germany, leading characters being drawn from all three. Having known most of the chief actors, I probably am in a better position than most to carry a thread through the labyrinth to its core: to give some weight to the many personal equations involved in the story.

Kekulé was a born collector: Prof. Anschütz

has been fortunate in having a large amount of documentary evidence at his disposal in the correspondence he preserved; also the help of many who knew the man. Not a few hitherto doubtful points in chemical history are cleared up in the course of the recital. The task of writing such a memoir must have been a heavy one, though clearly a labour of love. We cannot be too grateful for the work, having long awaited its appearance; our patience is amply rewarded in most respects, not in all.

The account is written throughout upon the serious side: we scarcely learn enough of the man apart from his work, in his leisure and social moments. He was born in 1829 and died in 1896. His origin, his upbringing, his character, his unceasing activity as a laboratory and literary worker are clearly displayed; the problems he dealt with are all stated: yet no sufficiently vivid picture is drawn of the man himself—otherwise than incidentally—enabling those who did not know him quite to understand his magic personality. We do not hear enough of his entourage—of the wild pranks of some—of which I have heard Dewar relate. The book is one which a general historian could scarcely read—even a Lytton Strachey could make little of it: yet the story will be found full of fascination to the expert. Fortunately, a number of photographs, taken at different periods of Kekulé's life, are reproduced, which are of great psychological value. One charm of the work is the large number of photographic reproductions it contains: to them it owes its weight. Nearly everyone referred to is pictured.

The leading theme is the part played by Kekulé in establishing the basic doctrine of chemical structure—that of atomic valency (1857). The subject is treated with a rather heavy hand: Anschütz, in fact, claims (as indeed did the subject of the memoir himself, originally, I have no doubt in perfect sincerity—young people who 'hear voices' are prone to think that they come to them alone) that Kekulé was essentially the first to recognise and formulate its rules: not merely that he developed the doctrine specially in relation to carbon, the view that is generally held. Frankland is simply denied all credit. Williamson and Odling are favourably mentioned and Gerhardt is seen standing *in loco parentis* in the dim background. Kekulé, with Williamson and Odling, were, we know, lineal descendants of the Laurent-Gerhardt school. Frankland and Kolbe were of another stock, dating back to the Stockholm stable, the main seat of chemical philosophy in the early post-Lavoisier period. Some day, probably, when the Arrhenic ion is no longer our ikon, we shall return more to the worship of Berzelius—if meanwhile we do not lose our power to interpret the language of his period, as we have that of the phlogistic period, of which we have warning already in Kekulé's difficulty in understanding Kolbe. Prof. Anschütz has much to say of Kolbe's *Grobheit* towards Kekulé, which he bitterly resents, without attempting to explain it. Kolbe was greatly affected by the 1870 war, which made him a most violent nationalist and '*Franzosen-fresser*'. I suppose I am one of the very few alive who knew him: I can never think of him in terms other than those of admiration and affection. In writing (1927) a review of the period for the *Chemiker-Zeitung* on the occasion of its jubilee, I took occasion to speak out on his behalf and recall the greatness of his service. I have since heard from German colleagues, that they were surprised by my advocacy. Kolbe is chiefly known to-day by his attacks on Kekulé and van 't Hoff: the fundamental importance of his work is overlooked. Some day when—as Sir Thomas Browne might urge us to do—we omit the 'improperations and terms of scurrility' which he launched at Kekulé, he may come to be regarded as the parent of the modern system of resolved structural formulæ: we here have to thank him for having made Frankland, whose senior he was, what he became. When I left him early in 1870, he was already peculiar: he afterwards, in his last years, so fixed his mind upon certain grievances as to be little short of a monomaniac.

No four men could have been more different than were Frankland, Kolbe, Hofmann and Kekulé. Hofmann was the complete courtier and diplomatist, a man of the most engaging and sympathetic manners, gifted with a marvellous enthusiasm for his subject. Kekulé was a born aristocrat in manner. An intellectual of a high order, many-sided in his interests, he was too critical and cynical to be a leader of men in the way that Hofmann was, though even superior to him as an orator; he attracted through his clear-cut talent, his gift of precise speech and his great command of knowledge. He had an astounding memory. Frankland was a man of eminently simple, retiring nature, with a strong practical outlook, a demon worker but in no way eloquent. Kolbe was equally simple, never a man of the world, a good lecturer and a far better writer but not an orator: the best chemist of them all. Hofmann and Kekulé were cosmopolitans; Frankland was ever the plain, high souled Lancashireman; Kolbe—just the dear old German, academic peda-

gogue of the highest class: there is no other way of describing him.

Nothing is more certain than that most of us only take in new ideas through experience—the want must be felt before it can be satisfied. Once assimilated, an idea is expelled or modified with great difficulty. It is this that makes scientific thought, the scientific habit of mind, so difficult of attainment. Kekulé at once fell a victim to Gerhardt's magic influence, when he met him in Paris. His belief in Gerhardt's system became strengthened, in London, through association with Williamson and Odling. He does not seem to have been intimate with Frankland. He appears to have been so satisfied of the superiority of Gerhardt's system, that he took little, if any, notice of Kolbe's work: I do not believe that he ever mastered the inner meaning of Kolbe's formulæ. Kolbe had little use for the Gerhardt formulæ, knowing that he had penetrated deeper than they carried him. I feel sure he resented the way in which he and Frankland were waved aside by Kekulé: and probably, this was the subconscious, if not conscious, primary cause of the bitterness he displayed towards him, in later life. In addition, he was a linguistic purist and idealist and was greatly annoyed by Kekulé's at times flamboyant masterful style. As I have said elsewhere, Kolbe's doctrine was ever the Pauline "Alles prüfen"—Prove all things! He took exception, therefore, to what he thought to be Kekulé's dogmatic, if not arrogant, declarations. Intellectually, Kekulé probably was Kolbe's superior but not as a constructive worker. Frankland and Kolbe's synthesis of acetic acid (1846) is one of the most clear-cut achievements in the early history of the development of the doctrine of chemical structure: Kekulé seems never to have grasped its significance and the extent to which it put their work in advance of his.

In his Kekulé memorial lecture (1897), the late Prof. Japp, who was intimately associated with both Frankland and Kekulé, boldly took the valency infant in hand and divided it between the contending parties, assigning the body to Frankland and the head, at most, to Kekulé. His ultimate conclusion was that indicated by Kekulé himself, on the occasion of the great benzene festival in Berlin, Mar. 11, 1890, at which I was present as representative of our Chemical Society. As Kekulé then said, speaking of the contending parties, eventually, "both sides—he at the head of the one, Frankland of the other—saw that they had been striving towards the same goal, although by different routes. They exchanged experiences, each side profited by the experience of the other and with united forces they sailed onward."

This is a charitable and broad point of view to which, unfortunately, our German colleague has not lent himself. He takes no notice of Japp's argument, although fully aware of his lecture. He lays no weight upon Kekulé's considered confession. The chief cause of misunderstanding, we now see, was the uncertainty of atomic weights. The cloud was not dispelled until 1860, when Cannizzaro came forward at Carlsruhe and electrified chemists by proclaiming Avogadro's theorem as a precise physical means of establishing the constants of atomic mass. The congress was Kekulé's work: he had seen the need of a decision.

It is only when obituary notices are to be written, that the difficulty of securing any real picture of a man and his achievements becomes the stark, staring certainty it usually is. Then the lights are over-painted and the shadows are usually left out. The *nil nisi* adage has done infinite injury. Later on, when the general historian sets to work, he finds himself without safe material to go upon—so history becomes a polite and perjured fiction. The recent marvellous exhibition of Italian pictures at Burlington House has brought this difficulty to the fore—little is known of most of the painters to give the full and desired clue to their painting. We shall never arrive at a real appreciation of the psychology of the scientific worker until we devise some system of periodically reviewing men's progress; better, perhaps, a scheme whereby the keeping of a real diary, including critical comments by friends, relations and others, be made compulsory. In such a way only will truthful history be written in future. Kekulé set an example in keeping his letters. Some of us who are grown up to old age must bitterly repent that we have not followed Mr. Pepys.

To arrive at a general understanding upon special issues must often be impossible—our minds cannot all grasp all that is involved, even if we grasp the issue at all. It is not that "bowsprit gets mixed with rudder sometimes" but that fiddle cannot play the part of flute. Our discussions are often absurd, for this reason: two minds are not always, indeed seldom, open to the same reason.

I would urge, with Sir Thomas Browne, that "it is the method of charity to suffer without reaction"—that it were time to bury the Kekulé-Kolbe hatchet and give all the workers their due meed of recognition, without reference to any incidental reflections. German chemistry has a great heritage in the two men. Kolbe was especially great as a practical executant guided by acute

theoretical conceptions; to him we owe salicylic acid as a manufactured product. Kekulé we can claim as a great intellectual master of his subject—donor of the carbon tetrahedron as well as of the immortal benzene hexagon, both veritable and imperishable foundation stones of the theoretical structure of organic science.

His biographer is quite outspoken as to some of the social events in Kekulé's career. Marrying in June 1862, when thirty-three years old, he lost his wife, within a year, in child-birth. He thereafter devoted himself to the upbringing of his son, only marrying again in 1876. The choice seems to have been a very unfortunate one, his wife being not only of weak physical stock but, in temperament and outlook, incompatible with a man of his intellectual disposition and habits. Three children were born of the marriage but all these died in middle age of tubercular disease. The comparative scientific infertility of his later years is easily understood when these distressing facts are known.

Prof. Anschütz has established a Kekulé museum in the Polytechnic at Darmstadt. He tells us, that among its treasures is a complete set of notes of Liebig's lectures taken down by Kekulé; also a similar set by Dr. Holzmann of Kekulé's Ghent course. These must be priceless historical documents. Is it asking too much that they should be reprinted as an Ostwald "Klassiker"?

In fine, we cannot thank our German colleague too heartily for his full and reasoned statement of the case Kekulé *v.* Frankland, Odling and Kolbe being cited as co-respondents in support of one or the other side. In the interests of historic truth, we have now to submit this to a full Court of Appeal. It must be dealt with as a Chancery case of world-wide import and the meaning of every word and sentence considered, as well as the conditions of the times to which the issues raised relate. The brief is a heavy one and the permission of the Court may well be asked for a postponement of the trial until all the necessary interrogatories have been administered and the evidence marshalled afresh. We can in no way admit that a case is established: we feel sure that eventually honours will be declared divided. The statement is none the less interesting, as a passage in the history of our science. Prof. Anschütz, all will agree, has laid chemists under a debt beyond repayment, by providing them with an adequate memoir of a great warrior, who will always stand before us carrying as shield the incomparable Hexagon: to which we may well add the magic tetrahedron as a quartering.

HENRY E. ARMSTRONG.

World Power and the Power of Man.

The Time-Journey of Dr. Barton: an Engineering and Sociological Forecast based on Present Possibilities. Edited by John Hodgson. Pp. viii + 89 + 16 plates. (Egginton, Beds.: John Hodgson, 1929). 3*s.* 10*d.*

IT has become a platitude to say that modern science has provided man with unlimited power over Nature; but if Nature includes man, the platitude is false. Slums, unemployment, starvation, and wars bear ample witness to this. We may be able to devise the most cunning calculating machines, we may conquer the sea, the air, and the road at incredible speeds, we may flash messages around the globe, probe the atom, and span the outermost confines of space, we may multiply our productivity a thousand-fold, but we have not yet conquered the simple problem of distributing the produce of the earth among its inhabitants. Has the world population multiplied so enormously that, even with the immensely increased productivity that science has provided, we inhabitants of the globe cannot supply our needs, or are we merely still unscientific fools who have not yet considered the first step towards a rational view of world supply and distribution? The fact is, of course, that we are still so steeped in historical and racial prejudices that we have not yet a glimmering of the historical and racial prejudices we have to overthrow before we can examine this question with scientific detachment.

Even with our comparatively new-found control over material things we are little more than rampaging savages, tearing minerals from the bowels of the earth and levelling forests in wasteful profligacy, to convert them into machinery and power, without a thought of the morrow. We have scarcely given a serious thought towards the control and utilisation of world power.

Mr. J. L. Hodgson, the well-known engineer, in "The Time-Journey of Dr. Barton", makes a brave attempt to face these and similar issues. The author is clearly not one to be swayed by local prejudices, or to be turned from a grand idea by a mere question of national or international complications. If it is necessary, in the interests of world power production, to dam up the Straits of Gibraltar with 500,000 million tons of rubble, clay, masonry, concrete, and rock blasted from the Jebala mountains in Morocco fifty miles away, then dammed up it must be. The work of construction may take more than a hundred years, and another six hundred years may be required

to lower the sea-level sufficiently by evaporation, but what of that? The great power stations at Gibraltar and Port Said would produce 250 million horse power each, evaporation from the whole basin would provide 600 million horse power, or about three times the world's present estimated available water horse power, while some 60,000 square miles of fertile land would be reclaimed.

In order to provide a survey of these problems in sufficient perspective, the author borrows Mr. H. G. Wells's device of a "Time Machine", and projecting Dr. Barton 2000 years forward, flies him over the surface of the earth as it is transformed and organised according to the ideas of Mr. Hodgson. By this means he is enabled to pass in critical review the wastefulness of the present day, and to contrast it with the world as it might be under a rational system of organisation. It is an old device, an old dream, but the author with his individual point of view has many penetrating things to say. His criticisms are not all new, of course; they have been the concern of socially conscious people for years, but he has succeeded in producing a thought-provoking book, and a number of constructive—if grandiose—schemes. The idea of straightening the great rivers for power production, altering their courses to transform arid deserts into luxuriant and fertile lands, of boring miles into the earth for heat power, and of damming up the Mediterranean Sea, are enchanting dreams for an engineer. Meanwhile, we cannot make up our minds on the question of a mere Channel Tunnel.

The author is not content, however, with a mere exposition of the power of power. He has much to say of our human wastage, useless child-bearing and infant mortality, debility from preventable diseases, indulgence in soporific drugs, wars, competition and obstruction in civil life, faulty planning of necessary world routine work, our stupid and obscure money system, restrictions due to language differences; all the criticisms, in fact, that inspire isolated small groups to enthusiastic but impotent reform. To most of these he has something new and refreshing to add.

Mr. Hodgson's attempt to read a lesson in world potentiality, while it is intensely illuminating, does not face the real issue. There have not been lacking religious, social, and now scientific enthusiasts to point to a visionary future as a possible present, but inherent in its attainment is always the difficulty of reaching to it. As well ask a paralysed thirsty man to reach out for water. If we were merely inhabitants of the earth, we might corporately and intelligently avail ourselves, in the most scientific manner, of the world's enormous possibilities; but we are not such idealised beings. We are creatures of prejudice, we prefer Oxford to Cambridge, England to Scotland, Britain to France, whites to blacks. We have acquired special rights here, and inherited prestige there, which we must not lose; in groups we are morally and racially superior to this one and that, and we have Imperial, national, civic, or parochial 'principles' at stake. To the student who, like Mr. Hodgson, frames his problem on a world-scale, there is no measure for these trivialities. His picture is grandiose and alluring. But to him who has to handle the problem on a national or local scale, the picture is sordid and cramped. We become paralysed spectators. We are hungry, but with all the will in the world we cannot eat of the alluring fruits dangled before us. H. LEVY.

North American Dragon-flies.

A Handbook of the Dragonflies of North America. By Prof. James G. Needham and Hortense Butler Heywood, assisted by Specialists in certain Groups. Pp. viii + 378. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1929.) 31*s.* 6*d.* net.

NEARLY seventy years have elapsed since the last comprehensive publication on North American dragon-flies appeared and the number of known species has about doubled itself in the meantime. The present volume will be welcomed as one which fills a much-needed requirement, since it is not merely a guide to the species found over that continent, but is also a general introduction to the order as a whole. Unlike its predecessor, it is not a severely technical work, and it is primarily designed for collectors of these insects and for students of their natural history.

Part 1 of the book is introductory and describes the essential facts of the structure and biology of dragon-flies, together with methods of dealing with the rearing of the nymphs, and the collecting of the adult insects. The greater part of the text is comprised in Part 2, which is devoted to an account of every species of these insects found in North America. Free uses are made of synoptic keys to the families, genera, and species, the nymphal stages being treated similarly wherever possible. Each species is further described in detail, its distribution is indicated and notes on its habits, times of appearance, or other special features, are added in a large number of cases. Some

of the keys, however, appear to be exceptionally short and brief, and it seems open to doubt whether they are really sufficient for the purpose intended in every case. Also, the illustrations, although numerous, are of very mixed character—the venational figures leave little to be desired, but those which portray the genital appendages are somewhat crude and deficient in detail—in some cases it would appear difficult in practice to separate one species from another from the illustrations.

Taken as a whole, the book is an excellent one for the needs it is intended to supply, and it is no small achievement to have dealt with a fauna comprising 75 genera and 360 species and describe every one of the latter. Over so wide an area as the North American continent there must be many more species yet to be discovered : the geographical ranges of the known species are, as yet, but imperfectly mapped ; often only one sex has so far been described, but for many species the nymphs still remain unknown. To these desiderata may be added the need for life-history studies, since they have only been followed completely and accurately in very few dragon-flies. It is, therefore, within the capacity of every user of this book to contribute something new to the subject, however small or apparently insignificant the facts may be. With the present guide at their command, those who observe and collect American dragon-flies will acquire renewed stimulus, and their gratitude is due to the authors of this book, and to the specialists who assisted in its production. A. D. I.

Our Bookshelf.

Grosse Naturforscher : eine Geschichte der Naturforschung in Lebensbeschreibung. Von Philipp Lenard. Pp. 324 + 16 Tafeln. (München : J. F. Lehmanns Verlag, 1929.) 12 gold marks.

IN his account of the personal history and life-work of great men of science, the author has attempted the ambitious task of selecting the most outstanding achievements in scientific thought from the days of Pythagoras to modern times. Naturally enough, he has excluded from his survey all living persons, and for this reason he has arbitrarily chosen the end of the War as his time limit. The reader is bound to marvel at the thoroughness and patience with which the original records have been searched in the earnest desire to avoid the temptation of following too closely the many standard historical works on the subject. In fact, the author claims that credit has sometimes been erroneously given for new lines of thought to those who have merely developed and expanded what was no longer new but had with the lapse of time been overlooked. For example, the discovery of the rare gases of the atmosphere, to which merely a passing reference is made, is regarded as the natural development of an early experiment by Cavendish, and the actual discoverer of radium is not named.

The book opens with Pythagoras, founder of a great school of morals, to whom is attributed the credit of pointing out the importance of quantitative measurement. The daily rotation of the earth, for the recognition of which Galileo had to fight two thousand years later, was also taught. Euclid, Archimedes, and Hipparchus, the astronomer, whose accurate observations were chiefly made known through the writings of Ptolemy, complete the list of pioneers of the pre-Christian era. Then follows a dead period of more than fifteen centuries, in which none of equal eminence is to be found. The new era opens with Leonardo da Vinci, the famous painter, who left behind a valuable mass of notes, which reveal his extraordinary genius in no uncertain manner. Then follows a brilliant succession of astronomers, mathematicians, physicists, and chemists, among whom we find the names of many eminent Englishmen—Boyle, Newton, Black, Watt, Priestley, Cavendish, Dalton, Davy, Faraday, Kelvin, Maxwell, Crookes, and others. Biological science is represented by Darwin, to whom several pages are devoted, and by Mendel.

A Course in Physics : for Medical and Dental Students. By Richard Ablett. (Oxford Medical Publications.) Pp. xviii + 249. (London : Oxford University Press, 1930.) 8*s.* 6*d.* net.

THERE was reviewed in these columns last year a book by Prof. Russ on physics for medical students. In that book the author stated his aim to be to concentrate on parts of physics of most direct application in medicine. This meant cutting down the sections on sound and magnetism to a minimum. Mr. Ablett in his book, with apparently the same object in view, has omitted these two subjects altogether. As he says, he feels that sufficient ground is already covered in these subjects at school and any further work in the subjects would not be commensurate with the value of the applications met with later, at least in comparison with those in other branches of physics.

These two aims at departure from the stereotyped form in which physics is presented to the medical student of to-day indicate a genuine desire on the part of at least two teachers to do more for the medical student with physics than has been attempted in the past. To the reviewer it seems that Mr. Ablett has succeeded extraordinarily well in the task he has set himself. In practically every section of the book some space is given to the direct application in medicine of the physical principles enunciated. This makes excellent reading, and the student cannot fail to see the significance of the subject in the bigger one of medicine that he is tackling.

If, however, these attempts are to be anything more than attempts, some recognition should be given to them, and the only way in which authority can do this is to agree upon a recasting of the syllabus for the pre-medical examinations. For the furtherance of his plan Mr. Ablett is placed at an

advantage in that he is teaching his physics to students whom his department will be examining later on; but it is a very different matter to get these different aspects of physics a definite place in the curriculum of medical schools all over the country. The first thing, of course, is to get a responsible body of people to express an opinion as to whether it is desirable, and if it is, then immediate steps should be taken to give effect to responsible opinion.

Traité de biocolloïdologie. Par W. Kopaczewski. Tome 1: *Pratique des colloïdes.* Deuxième édition entièrement remaniée et mise à jour. Fascicule 1: *Propriétés mécaniques des colloïdes.* Pp. xviii + 166 + iv. (Paris: Gauthier-Villars et Cie, 1930.) 40 francs.

DURING the past eight years the author has produced eight volumes dealing with various branches of colloid science, with catalysis, hydrogen ions, and mineral waters. The present treatise appeared first in 1922, but is now being expanded to a series of five volumes, dealing with colloid technique, bio-colloids, conditions of equilibrium of bio-colloids, the colloidal state and biology, and the colloidal state and medicine, respectively. The first section of the first volume, which has now been issued as a separate part, under the general heading of mechanical properties of colloids, covers the preparation and properties of pure water, the preparation of hydrosols and hydrogels, determination of density of liquids, determination of micellar dimensions, diffusion, ultra-filtration, dialysis, and the swelling of gels.

In the preface to the new edition, the author himself describes the success that has attended his work, explains why his book has been so successful, points out that no similar book exists in scientific literature, and issues a warning as to the treatment that will be meted out to those who quote his work without acknowledging the source from which they have borrowed their material. Since the first volume, when complete, will include about 600 pages and is to be followed by four others, it is clear that the literature of 'biocolloidology', like the gels described in the last chapter of the present issue, is likely to undergo considerable swelling in the near future.

A Simplified Presentation of Einstein's Unified Field Equations. By Prof. Tullio Levi-Cività. Authorized translation by Dr. John Dougall. Pp. 22. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1929.) 2*s.* net.

AT the beginning of 1929, Einstein published his unified field theory of gravitation and electromagnetism, based on the concept of parallelism at a distance with respect to four orthogonal vectors of reference. Levi-Cività discards this concept and uses Ricci's coefficients of rotation. This is termed a simplified presentation of Einstein's theory, but it really differs from it in one important respect. It is perhaps more elegant than Einstein's work, and obtains Maxwell's electromagnetic equations and the gravitational equations of the older relativity theory exactly, whereas Einstein now obtains these only as first order approximations. The fact that Einstein's new equations, in their exact form, contain both gravitational and electrical terms in a way that defies separation, however inconvenient it may be mathematically, is yet the most attractive feature from the physical point of view, as it may possibly lead to the discovery of new experimental facts on the interaction of gravitation and electricity. Up to the present, in spite of improvements in the mathematical presentation of Einstein's work, little progress has been made on the physical side, and the problem of incorporating the quantum theory with relativity remains still unsolved.

H. T. H. P.

Differential Geometry of Three Dimensions. By Prof. C. E. Weatherburn. Vol. 2. Pp. xii + 239. (Cambridge: At the University Press, 1930.) 12*s.* 6*d.* net.

THE distinctive feature of Prof. Weatherburn's treatment is the great use that is made of vector analysis. At first sight a page full of terms such as *div*, *rot*, *grad*, and *dyadic* looks rather alarming, and the Clarendon type used for vectors stands out from the ordinary type used for scalars, producing a somewhat unattractive mixture, as if the printing had been done by an unskilled hand. However, a careful study will show the advantage of vector methods. They are very concise, and yet they emphasise the geometric considerations which are often obscured by the use of co-ordinates.

The book contains thirteen chapters, the majority based on Prof. Weatherburn's own researches. Chapters i. and v. deal with differential invariants; ii., iii., and viii. with families of curves on a surface; iv. and vi. with families of surfaces; vii. with dyadics; ix. with Levi-Cività's parallel displacements; x. with projection and allied topics; xi. and xii. with deformation and flexion; xiii. with congruences of curves. There are twelve sets of examples, eleven diagrams (we could wish for more), and an index. H. T. H. P.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1929. Edited by Dr. M. Epstein. Pp. xiv + 326 + 164. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 30*s.* net.

THIS valuable work again contrives to cover a survey of the world's history within the compass of a few hundred pages. Its hundred and seventy-first issue speaks for its usefulness. Little change is made in the customary arrangements. Part I., which constitutes more than half the volume, is devoted to English, Imperial, and foreign history; for this year the sections on India and the Dominions are grouped together. Mandated territories are included in the foreign section but the colonies seem to be omitted. Part II. begins with a chronicle of outstanding events followed by reviews of literature, science, art, finance, and law, and a number of biographies. The scientific section has ten pages of an admirable summary of work in the biological and physical sciences. Appendices give the text of certain treaties of the year.

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 Age of *Australopithecus*.

THE little fossil ape skull that was found at Taungs five years ago is, in the opinion of many, the most important fossil ever discovered. It is manifestly the remains of an anthropoid ape somewhat allied to the chimpanzee, and of about the same size. But it differs from both it and the gorilla in a large number of characters, and in almost all these characters it resembles man. It thus seems highly probable that it is very near to the ape from which man sprang, and possibly a representative of the very genus. One difficulty has been our ignorance of the age of the cave deposit. The bone breccia found in most caves has proved to be of Pleistocene age, and if the Taungs cave is also of this period, then *Australopithecus* would be too recent to be a possible human ancestor, as man is known to have existed in the Pliocene.

Dr. du Toit and I have independently suggested that the deposit is quite as likely to be Pliocene as Pleistocene, but we had very little evidence of the age. A couple of months ago Prof. Dart kindly allowed me to have for examination a few pieces of bone breccia that had been found in association with the ape; and an examination of this material has resulted in such important new light that a preliminary announcement seems called for.

It has been known for some years that remains of an extinct baboon occur in considerable numbers in the deposit, and this has been named by Haughton *Papio Africanus*. It is a primitive baboon not very closely allied to any living forms.

There are also large numbers of skulls and bones of a Dassie. This on examination also proves to be an extinct form, which I am calling *Procavia* (*Prohyrax*) *antiqua*. It is fairly similar in size to the common Cape hyrax, but the teeth are much more brachyodont.

A more startling discovery has been a giant rodent mole rather larger than *Bathyergus*, but more nearly allied to *Georhychus*. It has large flat permanent growing molars. I am naming it after Prof. Dart, *Gypsorhychus darti*.

Then we have remains of a small spring-hare which is quite a distinct species from the living one. This is being called *Pedetes gracilis*.

There are portions of the skulls of at least three antelopes. One too imperfect for identification is about the size of a reed buck. The other two which can be determined are both extinct forms. The larger of these two bucks is roughly about the size of an oribi. It has a very large antorbital depression, and the orbit is placed farther back than in any living buck of the subfamily Neotraginæ to which it clearly belongs. I am calling it *Palæotragiscus longiceps*.

The smaller of the two identifiable bucks is allied to the blue buck, but much smaller, and the smallest member of the genus. It is being called *Cephalophus parvus*.

There are fragmentary remains of a number of other small mammals, and of birds, tortoises, and lizards; beside numerous carapaces and limbs of a fresh-water crab (*Potamon* sp.).

All the mammals sufficiently preserved to be identifiable prove to belong to extinct species; and the baboon and hyrax are primitive types.

A deposit in south-west Africa, which is believed by Stromer to be of Miocene age, has yielded remains of a Hyracoid, a spring-hare, and a Bathyergid. But none of these south-west African forms is closely allied to the Taungs animals.

As no forms exactly similar to those of this breccia are known from elsewhere, we cannot, of course, determine the age with certainty. As, however, all the mammals are extinct forms, the evidence is strongly in favour of the deposit being Pliocene, and I think quite likely it will prove to be Lower Pliocene.

R. BROOM.

3 Trollope Street,
Grahamstown, South Africa,
April 9.

Comparison of the Ultracentrifuge Method for Molecular Weight Determination with the Classical Methods.*

UP to the present there has been scant possibility for a direct comparison between the ordinary methods for the determination of molecular weights of substances in solution and the recently developed ultracentrifuge method. In fact, Adair's refined osmotic pressure measurements on hæmoglobin,[1] giving a value (66,000) that compares favourably with the ultracentrifuge value of 68,000,[2] provided the only independent data. It was therefore thought desirable to attempt a comparison on a substance of sufficiently low molecular weight to give fairly trustworthy results with the ordinary methods of boiling-point elevation or freezing-point lowering.

The ultracentrifuge method of determining molecular weights depends in principle upon the analysis of the light absorption of the radial concentration gradient in the solution subjected to a strong centrifugal force. In order to obtain satisfactory results for molecules of the order of 1000 in weight, we therefore chose two substances possessing a high light absorption and a high density: sodium eosinate and sodium erythrosinate. With a centrifugal force of 9000 times gravity the sedimentation equilibria in 0·5 per cent salt-free solutions corresponded to molecular weights of 403 and 977 respectively; the boiling-point method gave 530 and 601 for the first compound and 622 and 636 for the second.

These centrifuge values are only apparent owing to the electrical effect arising from the partial separation of the large dye ions from the small sodium ions; similarly, the boiling-point values give only an apparent molecular weight on account of the large ionisation of the sodium dye salts. When enough sodium chloride was added to eliminate the electrical potential arising from the partial separation of ions in the centrifuge, both dyes were found to consist in solution of double molecules with two dissociated sodium ions. The other two sodium ions are perhaps rendered osmotically inactive by the close proximity of the complex dye group—that is, the Hammersten effect. The sodium eosinate consists wholly of double molecules—the value found was 1343, as compared with 1384 for the molecular weight of $(Na_2 \text{ eosinate})_2$—but the sodium erythrosinate has, in addition to double molecules, a small amount of more highly associated material and perhaps some fragments of molecules in solution as well. It is not likely that the concentration of sodium chloride used was sufficient to produce any 'salting out' effect, but this point must be studied in more detail.

The successful application of the ultracentrifuge method to the study of these dyes enables us to attack the special problems—degree of uniformity, purity,

* Contribution No. 33 from the Experimental Station of E. I. du Pont de Nemours and Company.

degree of ionisation, and the like—of the substances of molecular weight of the order of 1000 from two converging angles: first, the ordinary methods for relatively simple molecules, and second, the centrifuge method for more complex molecules.

In the ordinary methods, the solution must be absolutely free of foreign ions of low molecular weight and the ionisation must be considered in calculating the true molecular weight of the substance in solution. On the other hand, it is evident from the results obtained that the centrifuge gives the molecular or ionic weight directly even though foreign ions or impurities are present, that is, if enough electrolyte is added to repress the electrical potential set up by the partial separation of the ions in the centrifuge.

A detailed account of this work will be published elsewhere.

J. B. NICHOLS.

Du Pont Experimental Station,
Wilmington, Delaware,
U.S.A., Mar. 29.

[1] Adair: *Proc. Cambridge Phil. Soc.*, Biological Sciences, **1**, 75; 1924. Sorensen's osmotic pressure value of 34,000 for the molecular weight of egg albumin agrees well with the ultracentrifuge value. However, his interpretation of his data has lately been questioned by Adair and also by Marrack and Hewitt, who consider 43,000 to be the correct value.
[2] Svedberg and Fåhraeus: *J. Am. Chem. Soc.*, **48**, 430; 1926; Svedberg and Nichols: *J. Am. Chem. Soc.*, **49**, 2920; 1927.

Stability in Soap Films.

THE great increase in recent years of knowledge of the specific properties of surface films has naturally made it easier to understand more of the recorded behaviour and stability of Dewar's long-lived soap bubbles and films; but among the questions that may still be considered uncertain that of the possible stratification is not the least interesting. Recently it has been suggested that stratification in soap films is an abnormal condition, partly because under a certain defined condition a sheet of permanently solid leaflets can be produced.

Now it is certain first that the usual limpid grading of the several colour bands down to the universally sharp boundary of the 'black' film is a deception masking the real mechanism. When a bubble develops under perfectly quiet conditions of temperature, humidity, etc., the colours do not remain graded for long, but separate between numerous boundaries, usually visible to the unaided eye, and often quite as distinct as that defining the 'black' area. Several of the Dewar colour photographs show this in part. The fully developed appearance is very like stratus clouds at sunset. Further, in early stages of development especially, the graded coloured film is invaded by numerous stars, often drawn out by movement into a comet-like shape, and always well contrasted in colour from their surroundings; that their boundary tends to the circular shape is evidence of their definite separation from the surrounding film (Fig. 1). Even in a film much too thick to show colour, similar behaviour can be detected at glancing incidence.

This latter appearance can be induced in greater or less measure over the whole of a quiet bubble by very small departures in the direction of either alkalinity or acidity from the optimum value for the stable bubble. This reaction is akin to the well-known tumultuous or 'critical' development (but not extending to the black stage) and can be readily seen, for example, by momentarily removing the stopper from an ammonia reagent bottle near to a quietly graded bubble on a ring in the open air. It is reasonable also to suppose that this is a similar occurrence to the experiment of Lyons and Rideal in forming at will a bimolecular from a monomolecular acid film by small increase in alkalinity, and that it is in the same class as the observations recorded in the Dewar papers of the spontaneous change of second-order into first-order black in dilute 'Plateau' solutions, the deeper black appearing on the uniform greyer black as a slowly growing circle ringed with tiny silvery droplets from the aggregation of the disappearing layer. It may be added that this has occurred in a quiet black film formed from ordinary concentrated Plateau solution which is approximately 2½ per cent sodium oleate in 25 per cent glycerin.

Here, then, the Perrin and Wells stratifications become revealed as almost certainly pervading the whole film, which appears therefore to persist not merely because of the intrinsic cohesiveness of the several bi- or poly-molecular strata, but also by means of a powerful but labile attraction between their successive surfaces throughout the film, these surfaces being so well ordered in some definite arrangement as to be mutually active. The picture agrees with an extension of the McBain diagram, with a more extended and more complete orientation beneath the surface layers; and it seems reasonable to suppose that cohesive layers, in whatever position they may be formed, would be as orderly as possible, in the absence of disturbance, and finally extend to complete lamination in films of reasonable thinness. McBain's diagram shows partial bimolecular layers often reduced almost to monomolecular thickness by a sort of alternate lateral surface cohesion or mutual activity of the successive long chain molecules; and indeed such a mesh gives the impression of greater strength and stability than the more commonly depicted monomolecular sheet, unsymmetrical of course on its two faces, and supposedly only so maintained by the anchoring action of the carboxyl radicles presented over one face only.

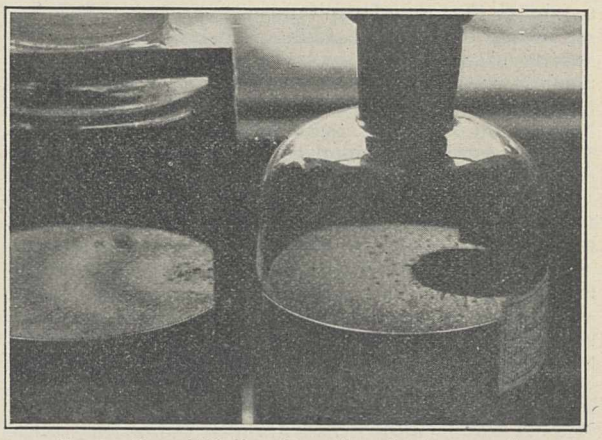


FIG. 1.—Normal thinning of soap films, showing separation of various coloured spots.

The extended stratified appearance is no doubt presented in large quiet bubbles rather than in flat films on rings of moderate dimensions, because the disturbances from the Gibbs' ring support are more remote in the former case. The intensity of formation of the thicker coloured leaflets is not so great as that producing the black or thinner stages. So much is evident from the description in the Dewar papers of various forms of black development—from the slow separation and coalescing of tiny black spots throughout a coloured film, to the cataclysmal aggregation of black masses from a thick scarcely coloured liquid sheet up through a whirling delta to the rapidly extending black area. 'Spots' and 'black masses' are, however, the very antithesis of what must, on the dimensions of the film itself, appear relatively as deep hollows and abysmal canyons; the black stream, as

it forces its way through, piles up the thick film on each side in a manner almost as miraculous as the passage of the Israelites across the Red Sea! A very large lowering of surface energy in the production of the black state would explain this.

Doubtless, then, the intensity of separation becomes less as the separating layer is greater in thickness. Separate coloured discs upon the black area skate about not only without being absorbed, but without even spreading, and show much of the behaviour of impacting bodies; and they can be increased to a thick colourless stream flowing across the black film without altering its character, another evidence of differences of surface energy. So also a bubble, partly black, is expanded and contracted only by variation in thickness of the coloured portion, the black area remaining constant despite very large changes of diameter; but coloured areas, although to a less extent, do display mutual repulsion and maintained separation.

Such matters of actual observation lead to views on stability that may be epitomised as follows: Stability in a soap bubble is possible only where the disruptive action of surface tension is overpowered by structural cohesiveness, surface action, however, being vital to ordinary thinning; any local fault or developed weakness in the structure results in instantaneous collapse. The protection provided by an enclosure freed from floating solid matter or spray or deleterious volatile material is necessary; but the bubble is likely to be stable only when its composition is maintained sufficiently uniform throughout the thinning process to allow of the production of layers of equal or approximately equal surface activity and therefore cohesion. Otherwise too sudden local changes of surface energy will cause rapid sweeping up or local aggregation of these layers; and a closed vessel has the obvious further use of facilitating the desirable uniformity.

For the purpose of encouraging simple experimentation it may be added that, so far as the quality of the materials is concerned, it is doubtless true that highly purified oleic acid is advantageous for special observations; but perfect success and stability are readily secured with good oleic acid purified by the old Allen method (warm treatment with successive small proportions of lead oxide, etc.). This ensures a sufficient absence of saturated acids, which produce unworkable variations in viscosity, or even, as Lawrence has recently shown, solidifiable stratifications with consequent 'faults' in film structure.

W. J. GREEN.

Royal Institution,
London, W.1, April 17.

Measurement of Relative Specific Heats of Gases at High Temperatures.

IN two recent papers [1] a new method has been described for measuring the specific heats of gases. The essential part of the particular form of apparatus described is a calorimeter containing an iron tube, which is heated by an electric current, so as to raise the temperature of its centre some 10° C. above that of its ends. Two thermojunctions placed symmetrically each side of the centre of the tube, and therefore at points initially at the same temperature, are connected in opposition to a galvanometer. It was shown that when a gas flows through the tube, the resulting deflection of the galvanometer is an accurate measure of the heat capacity of the gas. Although this method has already been used with success up to temperatures of 500° C. by placing a calorimeter of this type in a suitable oven, serious technical difficulties are likely to be encountered at considerably higher temperatures. In this letter a modification of the method will be described which is very well suited for the measurement of relative specific heats at high temperatures.

A long platinum tube, which in the preliminary experiments to be described had a length of 25 cm. and an external diameter of 1·5 mm., has its ends maintained at room temperature and is heated by passing through it an electric current. Except near the ends the tube will have a uniform temperature of, say, 1300° C. The distance from the ends at which this uniform temperature is appreciably attained depends on the thermal conductivity of the tube and on the heat loss. For the tube used at 1300° C., this length is about 6 cm., leaving the central 13 cm. of the tube at a uniform temperature. The tube is now cooled (or heated) slightly at its centre, so as to produce a temperature drop (or rise) of, say, 20° C. This can be done in many ways, perhaps the simplest being to increase the radiation loss from the centre of the tube by attaching there a small piece of platinum.

It has been shown (loc. cit.) that the heat transfer H between a tube and the gas flowing in it, is given, to a first approximation, by $H=Q\frac{d\theta}{dz}$, where $\frac{d\theta}{dz}$ is the temperature gradient along the tube and where Q is the heat capacity of the gas passing in unit time. Thus

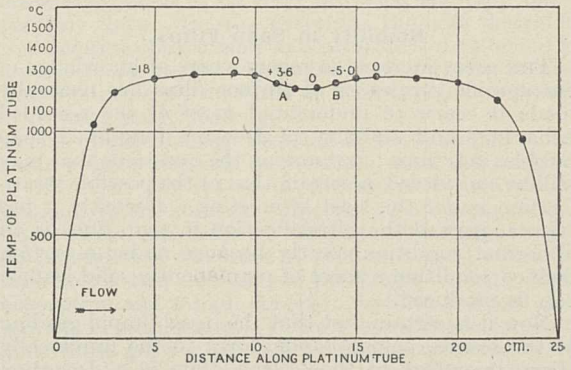


FIG. 1.

when a gas flows through the platinum tube the temperature distribution will be altered, the parts where the gas is rising in temperature being cooled and vice versa. But the temperature of the two uniform temperature parts of the tube will not alter since there $\frac{d\theta}{dz}=0$. Hence the *central* part of the tube, with its temperature dip of 20° C., will have its 'ends' maintained at the constant temperature of 1300° C. It will therefore serve to measure the relative heat capacity of gases between 1280° C. and 1300° C.

The essential feature of this method is the existence of the two uniform temperature parts of the tube separating the shallow central dip from the steep gradients near the ends. These parts serve to make the temperature distribution near the centre quite independent of what happens near the ends, even when a gas is flowing in the tube. This method therefore enables one to measure the relative specific heats of gases over, say, a 20° C. range at 1300° C., with an apparatus in which the only part heated at all is a narrow platinum tube.

A convenient method of measuring the temperature changes due to the flow is to project images of two short lengths of the tube, situated symmetrically at A and B on each side of the central dip, on to two thermopiles. These are connected in opposition to a galvanometer and the deflection of this, due to a gas flowing in the tube, will be proportional to the flow

rate multiplied by the mean specific heat between 1280° and 1300° C. The curve in Fig. 1 shows the temperature distribution, measured with an optical pyrometer, obtained in some preliminary experiments. The numbers against the curve are the measured temperature changes, in degrees centigrade, due to a flow of air from left to right. In spite of the large cooling (40° C.) near the end, the temperatures of the uniform parts are unchanged. This gives experimental demonstration of the practicability of the method. The actual dip shown of 60° C. and the flow rate of 70 c.c. per minute are both too large for actual determination of specific heats.

By using platinum-iridium tubes the method should be feasible up to 2100° C., and with certain gases in tungsten or molybdenum tubes up to even higher temperatures.

P. M. S. BLACKETT.
E. K. RIDEAL.

Cambridge.

[1] Blackett, Henry, and Rideal, *Proc. Roy. Soc.*, vol. 126, p. 319; 1930; and Blackett and Henry, *Proc. Roy. Soc.*, vol. 126, p. 333; 1930.

Mortality amongst Plants and its Bearing on Natural Selection.

IT is a familiar fact that the majority of plants produce a vastly larger number of offspring than can possibly survive, but unfortunately exact quantitative observations respecting their mortality is meagre in the extreme.

In the course of collecting data for ecological purposes, certain facts have come to light regarding the death of young plants which, if typical, would appear to be of fundamental importance in any estimate of the incidence and intensity of natural selection. By briefly indicating here the nature of these preliminary observations, it is hoped that other investigators may be induced to record their experience and to collect data of a similar character so that it may be possible to judge as to how general is the phenomenon in question.

A typical example is furnished by *Silene conica* L. This plant, which is one of the steppe species in the flora of Great Britain, behaves as a 'winter-annual'. The seedlings germinate in September, and on a marked quadrat there were present, soon after germination, no less than 175 seedlings per square decimetre. By Nov. 23, whilst still in the cotyledonary stage, the number of seedlings had become reduced to 110, whilst by Jan. 31 only nine survived. There is thus not only a very high mortality amounting to nearly 95 per cent, but also the important fact is that this mortality was entirely confined to the seedling stages. All the mortality occurred prior to the formation of the second pair of foliage leaves, and all the nine survivors will clearly attain the flowering condition. A large plant of *Verbascum Thapsus* L. produced several hundred thousand seedlings, of which, however, all but 108 died during the first six months. All the survivors which attained the rosette stage flowered and produced seeds. Similarly, the winter-annual *Ranunculus parviflorus* L. in Cornwall produces large numbers of viable seeds, and sometimes the seedlings are seen in great abundance, but in an experience of this species extending over several years close observation both in culture and in the feral state, it is evident that practically the whole mortality occurs prior to the rosette phase and that almost all the individuals which attain this condition produce flowers and fruits.

Observations on the spring-germinating *Helleborus viridis* L. showed a mortality of more than 50 per cent in the first month, and observations on *Cochlearia danica*, *Dianthus prolifer*, and other species would appear to warrant the conclusion that, in these plants at least, the mortality and therefore the operation of natural selection is almost entirely confined to the juvenile stages of development. Observations on seedlings of *Fagus sylvatica* after the 'mast' year of 1922 indicate that this is true also of arboreal species. In the case of two species of *Silene*, namely, *Silene conica* and *Silene anglica*, the mortality, in the plants under observation, took place at so early a stage that, if growing intermingled, the seedlings could only have been distinguished if at all with the greatest difficulty. Of the plants which survive to the stage when the distinctive external specific and generic characters appear, almost all produce flowers and fruit and probably yield offspring.

Field observations suggest that the incidence of mortality described may well be of general occurrence. Certainly in the instances cited it would appear that the adult characters, apart from those concerned with efficient pollination and seed dispersal, can play no direct part in determining survival, but that in so far as survival is dependent upon the structure and physiology of the species, it is the characters of the juvenile, not the adult, which are important. When mortality does occur in the more adult phases of development, it is generally the result of catastrophic causes which destroy the fit and unfit with equal impartiality.

If the adult characters upon which we rely for taxonomic distinctions, apart from the exceptions mentioned, owe anything to natural selection, it must be not because of their external manifestations but because they are the inevitable consequence of those characters, probably internal, which determine survival in the juvenile stages. Any selection which might occur in the adult phase will clearly be connected with the direct production of viable seeds by individuals and not by a selection amongst progeny.

The actual selection amongst the progeny of individuals, the classical *modus operandi* of natural selection, would then appear to occur almost entirely in just those phases of development which show the greatest similarity between species, those phases which show the least divergence of morphological type. If, then, natural selection be an important factor, the uniformity of the juvenile morphology and the great diversity of that of the adult present natural selection in the guise of a factor tending towards homogeneity rather than towards the divergence of type which it has usually been supposed to bring about.

E. J. SALISBURY.

Botanical Department,
University College, London,
May 7.

Methyl Glyoxal as an Intermediary in Fermentation.

WHILST the earlier work on fermentation, especially Prof. Neuberg's investigation of the *second form of fermentation*, rendered the participation of methyl glyoxal as an intermediary stage probable, proof that methyl glyoxal is formed by systems capable of fermenting or glycolysing sugar has been obtained by the recent work of Toeniessen and Fischer (*Zeits. physiol. Chem.*, **161**, 254), Ariyama (*Jour. Biol. Chem.*, **77**, 395), and especially by Neuberg and Kobel and various collaborators (*Biochem. Zeits.*, **203**, 463, and later papers). The latter workers conclude that methyl glyoxal is only dismuted or fermented in presence of cozymase, whilst its formation takes place also in absence of cozymase if hexose phosphate is used as the substance of origin.

Its identification as a substance produced *in vivo*

raises again the question as to why methyl glyoxal is not fermented when added to yeast or yeast preparations. With glycolytic systems, no such difficulty arises, as the glyoxalase of Dakin and Dudley (Neuberg's keto aldehyde mutase) provides an enzyme system capable of acting on added glyoxals. Prof. Neuberg has suggested as a hypothesis that methyl glyoxal, in order to be fermented, has to be present in one of the many tautomeric forms theoretically possible for this substance, perhaps some enol or ring form.

The first transformation that methyl glyoxal undergoes in fermentation, its oxidation to pyruvic acid, appears to be a dismutation, in which acetaldehyde is simultaneously reduced to alcohol. It is not possible on the present evidence to decide whether an aldehyde mutase of the type discovered by Parnas and by Battelli and Stern is responsible for this transformation; a close analogy is, however, suggested by recent work of the Euler school (particularly Euler and Myrbäck (*Zeits. physiol. Chem.*, **165**, 28) which shows that the necessity for cozymase is characteristic for aldehyde dismutations. Since dismutation is typical for substances possessing a free – CHO group, and independent of the structure of the rest of the molecule, one would expect methyl glyoxal to be fermented in its – CO – CHO form and not in some enolic modification. It is interesting that according to Ariyama (*Jour. Biol. Chem.*, **77**, 359) the lactic acid formed from methyl glyoxal by liver extract accounts quantitatively for the methyl glyoxal disappearing; that is, all methyl glyoxal is destroyed by internal dismutation, none undergoing the ordinary aldehyde mutation to $CH_3.CO.COOH$ and $CH_3.CO.CH_2OH$.

Work by me (*Biochem. Jour.*, in the press) has shown that phenyl glyoxal, though reacting in a peculiar way with di-amino acids, does not show the reaction with mono-amino acids typical for the – CHO group. It is known that phenyl glyoxal forms a stable hydrate, and this peculiarity might explain its refusal to behave as an aldehyde, which is also shown by the sluggish way in which it reduces Fehling's solution. According to unpublished work by Mr. Pirie, chloralhydrate also does not react with mono-amino acids. Enolisation might also explain this peculiarity of phenyl glyoxal, but the readiness with which it forms osazones, glyoxalins, and so on, shows that if enolisation does take place in solution, it must be easily reversible. Methyl glyoxal resembles phenyl glyoxal in its chemical reactions and in its behaviour towards glyoxalase. It also forms a stable hydrate (as shown, for example, by its great heat of solution) and it seems probable that methyl glyoxal is not fermented, because, in solution, it does not possess a free – CHO group, One would then assume that methyl glyoxal formed *in vivo* exists at first in the – CO.CHO form, and is normally oxidised before it has time to take up water. Any methyl glyoxal escaping and passing into the inactive form would presumably be removed by glyoxalase.

The question remains as to why the internal dismutation under the action of glyoxalase is not similarly inhibited. It must be kept in mind that the above argument only applies to reactions which require a free – CHO group. Since in the action of glyoxalase both carbonyl groups of the glyoxal are concerned, it seems possible that the point of attack of the enzyme is at the keto group. The examples of chloralhydrate and mesoxalic acid show that stable hydration of a carbonyl group is dependent upon the neighbourhood of strongly negative groupings; in glyoxals the keto group is responsible for the untypical behaviour of the adjoining – CHO. Hence reduction of the – CO – to – CH.OH – group, or even the reaction of the – CO – group with the combining group of the enzyme, might enable the terminal carbonyl to react as a normal aldehyde group.

J. O. GIRŠAVIČIUS.

School of Biochemistry,
Cambridge, April 24.

Quantitative Analysis by X-Rays.

No doubt it is at present true that X-ray analysis is more sensitive in detecting a trace of an element of high atomic number dispersed in an element of lower atomic number than it is in the reverse case. For that and other reasons given by Prof. Hevesy (NATURE, May 24, p. 776), the sensitiveness is variable. As the result of experience gained with non-metallic substances, the sensitiveness was stated in 1925 to be roughly 0·1 per cent, and we assumed that would be true for metals. On making careful tests, in which we had the assistance of chemists experienced in the requisite analysis, the method was found to be more sensitive than that for all impurities in zinc of higher atomic number than chromium. Evidence is given (see Eddy, Turner, and Laby, *Proc. Roy. Soc.*, **124**, p. 163; 1929) that the elements 24 Cr, 25 Mn, 26 Fe, 27 Co, 29 Cu, of atomic number less than 30, as well as nine elements of atomic number greater than 30, can be detected in 30 Zn, although none, it is believed, was present to more than about 0·0005 per cent, and one, 33 As, gave its $K\alpha_2$ (and probably its $K\alpha_1$) lines well enough to be measurable to 1 X.U., when present by chemical analysis to less than 0·00001 per cent. Thus evidence is given in the paper quoted that the K X-ray spectrum of an element present to less than 0·0001 per cent in a metal can be photographed. Prof. Hevesy disagrees with this statement. It should be admitted that up to some months ago we had not obtained that sensitiveness when using non-metals, but there appears to be no theoretical reason why the technical difficulties met with should not be overcome. Has Prof. Hevesy evidence that the sensitiveness mentioned cannot be obtained with a metal?

Within the limits of space allowable it is not possible to discuss here what Prof. Hevesy writes with reference to quantitative analysis more than to emphasise that Dr. Eddy and I did not use a reference method in most of the experiments described in *Proc. Roy. Soc.*, **127**, p. 20; 1930; that is, in calculating the composition of an alloy, no use is made of an alloy of known composition. Chemical analysis (or synthesis) was only used to verify the results so calculated. The assumption made and verified is "that the ratio of the number of atoms of two elements in an alloy of metals of nearly equal atomic number is equal to the ratio of the intensities of the corresponding lines (say the $K\alpha_1$ lines) in the spectra of the elements provided the lines are excited under equivalent conditions". We believe that this principle, and the method which has been worked out to apply it, will prove of value in atomic analysis by X-ray spectroscopy, and make it less empirical than it has been, although it is obvious there is considerable scope for improvement in that respect. This advance should be attainable by a further study of the physical phenomena involved.

X-ray analysis is being applied much more than might be inferred from the literature of this subject. In our experience it is more readily applied to the atomic analysis of metallic than non-metallic substances, which means it is more immediately susceptible of application in metallurgy than in mineralogy, although Profs. Hevesy and Coster and others have of course obtained most valuable results in the latter field.

T. H. LABY.

London.

Early Chinese Rice.

AN unusually detailed account of the discovery and utilisation of a 'sport' occurs on page 470 of the 1859 edition of an English translation of "The Chinese Empire," by Monsieur Huc. The account may be of interest to agriculturists and geneticists. The book is not often met with, and indeed I have had no opportunity of consulting the French original.

"'I was walking,' says the Emperor Khang-hi, 'on the first day of the sixth moon, in some fields where rice was sown, which was not expected to yield its harvest until the ninth. I happened to notice a rice plant that had already come into ear; it rose above all the rest, and was already ripe. I had it gathered and brought to me; the grain was very fine and full, and I was induced to keep it for an experiment, and see whether it would on the following year retain this precocity, and in fact it did. All the plants that proceeded from it came into ear before the ordinary time, and yielded their harvest in the sixth moon. Every year has multiplied the produce of the preceding, and now for thirty years it has been the rice served on my table. The grain is long, and of a rather reddish colour, but of a sweet perfume, and very pleasant flavour. It has been named *ya-mi*, or 'Imperial rice', because it was in my gardens that it was first cultivated. It is the only kind that can ripen north of the Great Wall, where the cold begins very early, and ends very late, but in the provinces of the south, where the climate is milder, and the soil more fertile, it is easy to obtain two harvests a-year from it. . . .'"

M. Huc adds that this rice was introduced into Manchuria, and that it succeeds admirably in dry countries, having no need of perpetual irrigation. He thought it would certainly prosper in France, but although he sent several samples to that country he never heard that any experiment was tried with it.

Two French books allude somewhat vaguely to this rice. "Le Rapport sur les Céréales: Exposition Universelle" (Paris, 1878), mentions the above story and offers the alternative name *riz précoce*. "Les Plantes de grande culture" (Paris, 1893) says that there appears to be a variety of rice in China which completes its growth in less than three months.

The variety is probably identical with the *yu-mi* (*Oryza communis pyrocarpa* Al.) which is the only variety specifically attributed to China by M. A. Carleton ("The Small Grains"; New York, 1916).

The emperor Khang-hi reigned from 1662 until 1723.

HUGH NICOL.

Rothamsted Experimental Station,
Harpenden, Herts, May 3.

Raman Spectra of Crystalline Nitrates.

IN a communication to NATURE of Mar. 22, p. 463, P. Krishnamurti describes some results of his experiments with powdered crystals. In a paper sent two weeks ago to the *Annalen der Physik* I have given the results of my measurements on much the same subject. By suspending the crystal powder in a liquid of suitable refractive index, and using suitable light filters, I obtained the Raman spectrum of such intensity that a spectrograph with large dispersion and very narrow slit could be employed.

Like Krishnamurti, I found a displacement of the inactive NO_3' frequency depending on the kation, and also a new remarkable difference between the anhydrous crystals and the hydrates. The frequency differences of the inactive Raman frequency of the NO_3' ion are as follows: (1) monovalent salts: lithium (anh.), 1086; lithium (hydr. $\frac{1}{2}$ H_2O), 1073; lithium (hydr. 3 H_2O), 1055·5; sodium (anh.), 1067·5; potassium (anh.), 1048·4; silver (anh.), 1045·0. (2) bivalent salts: calcium (anh.), 1064·3; calcium (hydr. $4H_2O$), 1044·6; strontium (anh.), 1054·4; copper (hydr. $6H_2O$), 1052·9.; copper (hydr. $9H_2O$), 1044·4; barium (anh.), 1046·5; lead (anh.), 1045·0.

Some of the wave numbers are in accordance with the data given by Krishnamurti.

Furthermore, in solutions of the nitrates, I found a variation of the NO_3' frequency with the concentration; for example, for a solution of 10 mol $NaNO_3$ in a litre of water $\Delta\nu = 1049{\cdot}8$, and for a 3 mol solution $\Delta\nu = 1047{\cdot}2$. For a 14 mol solution of $LiNO_3$ the Raman difference was $\Delta\nu = 1050{\cdot}3$; for a 0·5 mol solution $\Delta\nu = 1046{\cdot}0$.

WALTHER GERLACH.

Physical Institute,
University of Munich, Mar. 31.

Effect of Direct Current on the Frequency of Sonometer Wire.

THE maintenance of oscillations of a sonometer wire by the passage of an alternating current through it has been studied in detail by Krishnaiyer and others (*Phil. Mag.*, 1922, etc.). If, however, direct current of the value of about an ampere be passed through the wire, it is found that the frequency of the oscillations, for a fixed position of the two sonometer bridges, is slightly lower than what it is when no current is passing. This effect is best observed by tuning the sonometer with an electrically excited fork placed on the sonometer board. When the wire is tuned to this frequency it begins to vibrate with a large amplitude. These vibrations are observed with a low power microscope. If the direct current be now passed through the wire, the amplitude of the vibrations is immediately reduced, and can be restored again to its original strength by shortening a little the length of the wire between the bridges.

We have verified that this lowering in frequency is not due to the heating effect of the current and is also not a magnetic effect. This effect can also be observed with an ordinary tuning fork and wires of any material.

The quantitative measurements and other interesting results will be published elsewhere.

D. V. GOGATE.
Y. G. NAIK.

Physics Laboratory, Baroda College,
Baroda, India, April 10.

Band Spectra of Copper Oxide.

EDER and Valenta in 1911 had observed some of the bands of copper oxide in the flame spectra of all copper salts. Hertenstein observed them in the flame of the arc in air in 1912. R. S. Mulliken (*Phys. Rev.*, **26**, 4; 1925) also noticed them while working on the spectrum of CuI as excited by active nitrogen. They would appear better by a small leakage of air into the halide vapour, or the presence of a little oxygen in the nitrogen used. I have obtained these bands by arcing between copper electrodes in an atmosphere of oxygen. They are degraded towards the red and occur in pairs, of which the shorter wave-length component is relatively weak. Their rotational structure reveals that the system is due probably to a $^2\Sigma \rightarrow {}^2\Sigma$ transition. The frequencies of vibration for infinitesimal amplitude are found to be approximately 620 cm.$^{-1}$ and 345 cm.$^{-1}$ for the final and initial states respectively. A detailed investigation will be published elsewhere.

P. C. MAHANTI.

Applied Physics Laboratory,
University College of Science,
University of Calcutta, April 4.

New Light on Vision.*

By Prof. G. ELLIOT SMITH, F.R.S.

MAN alone among living creatures really sees the world in the sense that we usually associate with the verb 'to see'. The apes and monkeys are provided with eyes which are closely similar in structure to those of man and on the functional side are perhaps equally efficient dioptric instruments. Man's comprehension of what he sees, however, and his understanding of the world of things and actions revealed by his powers of visual discrimination, clearly transcend those of the apes, to which we have no reason to attribute the human quality of understanding what is revealed by sight, of appreciation of beauty, and the subtler forms of actions such as facial expression, or of possessing the initiative and skill that result from the wider vision.

Investigation of the comparative anatomy of the brain reveals the fact that within the natural order of mammals (Primates), to which man belongs, the cerebral connexions of the optic tracts have been so profoundly revolutionised that what is virtually a new instrument of vision has been evolved. The progressive cultivation of this 'new vision' (see NATURE, April 28, 1928, p. 680), eventually led to the emergence of those profound changes in the whole organism which transformed an ape into a human being and conferred upon him the distinctive attributes of mind and skill which are the outstanding tokens of his humanity.

The factors involved in the making of the mind fall into several distinct phases. The acquisition of definite representation for touch, vision and hearing in a newly evolved area (neopallium) of the cerebral hemisphere was responsible for the emergence of mammals. It conferred upon vision not only the possibility of closer integration with other kinds of sensory experience, but also a greater influence in the conscious control of behaviour. The birth of a new cortex created a new type of animal profoundly different in every part of its organism and especially in its potentialities. In particular the evolution of the neopallium involved the transference to the cerebral hemisphere of the control of voluntary movements and that led to far-reaching changes in the parts of the brain and spinal cord concerned with muscular activities. The new cortex established direct connexion with the spinal cord, new links with the cerebellum which provoked the evolution of a new element in that organ, and corresponding transformations of the cerebral and cerebellar connexions with all other parts of the central nervous system involved in the control and regulation of movement. This remaking of the brain involved the usurpation by the new cortex of many of the functions of the midbrain.

The next phase is displayed in the Primates, in which the increasing dominance of vision accentuated the process of transference to the neopallium of the control of movement. The increasing concentration of visual functions in the cerebral cortex conferred upon vision a fuller participation not merely in the affairs of conscious life but also in the regulation of motor behaviour, and integrated visual, tactile, and motor experience with the kinæsthetic products of the animal's own movements, the consciousness of the postures and actions of its own body. The cortex came to play a part

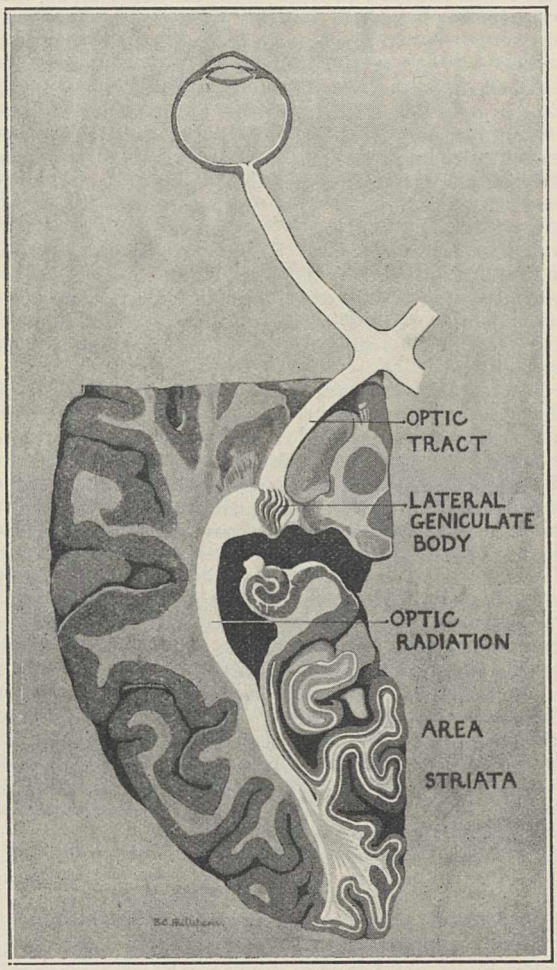


FIG. 1.

in the control of posture, and this conscious activity eventually conferred upon man not only the erect attitude, but also that intimate integration of skill of hand and eye with the no less important factors we call balance, poise, and rhythm, which with perfection of timing are the essential elements in dexterity.

The nervous system was first called into being to facilitate the performance of rapid and precise movements. In the direction of these activities an important part has always been played by the eyes. Long before they were capable of true vision, such

* Friday evening discourse delivered at the Royal Institution on Mar. 14.

as the appreciation of images, they were instruments for recording movement in the outside world, and for guiding the animal's own movements. Throughout the whole of its subsequent history the refinement of muscular skill has been intimately associated with the progressive modification of the nervous system. In its highest manifestation the making of the mind was in large measure due to manual dexterity, the exploration of space with hand and eye and the integration of the knowledge of the world acquired by vision with the intimate personal experience of the movements of our joints.

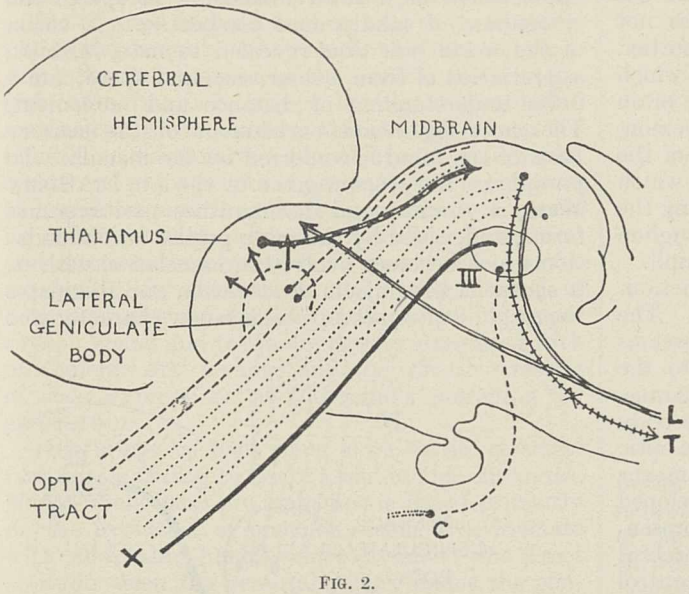


FIG. 2.

The comparative anatomy of the brain reveals the fact that the progressive development of vision is strictly conditioned by the ability of the hands to be used as skilled instruments. It seems that manual dexterity is an implicit condition for the attainment of biological usefulness for the refinement of visual discrimination. Vision could not have extended the range of its powers and influence in the Primates if their hands had not escaped the specialisation which in other mammals restricted their power of adaptation.

The integration of vision and muscular skill is a complex process. The heightened powers of vision provide direction for the acquisition of skill—and the cultivation of skill involves not the hands only, but also the whole body, which is essential for the maintenance of the appropriate posture as well as for the performance of movements that contribute to the successful action of the part, such as the hand, upon which the visual attention is fixed. This participation of the whole organism in any act of skill contributes (in some way that we do not understand) to the development of the intricate co-ordinations involved in the conjugate movements of the eyes, which in mammals are the essential preparation for the attainment of the fullest cultivation of binocular vision, the development of a macula and fovea, and the ability to see stereoscopically and so add a third dimension to spatial discrimination. In addition, the proprioceptive impulses from the eye muscles, as well as from the muscles and joints involved in any movement, add their quota to the integration and link the process of spatial appreciation with the personality of the individual. This coherence between vision and skill is the essential mechanism for the making of mind and for giving it its distinctive individuality as an intimate part of the personality. The practice of manipulation to satisfy visual curiosity, which is aroused in its most intense form when the macula is developed, necessarily led to the cultivation of tactile discrimination and stereognosis. Visual perception and conception are products of the integration of these factors with vision and as the result the progressive evolution of intelligence.

Bearing in mind these considerations, the facts of the comparative anatomy of the brain take on a new significance; and in turn features which hitherto have been overlooked can be detected in the brain when the fuller understanding of its working suggests the search for them.

In the human brain (Fig. 1) the fibres of the optic tract end for the most part (probably not less than 95 per cent) in the lateral geniculate body, where they transfer the impulses coming from the eyes to a new tract of fibres, the optic radiation, which carry them to the visual receptive area now commonly known as the 'area striata' (*Proc. Roy. Soc.*, p. 62; 1904). This almost exclusively cortical connexion of the pathway leading from the eyes is a token of the fact that in man vision is brought into the full light of consciousness. It had lost

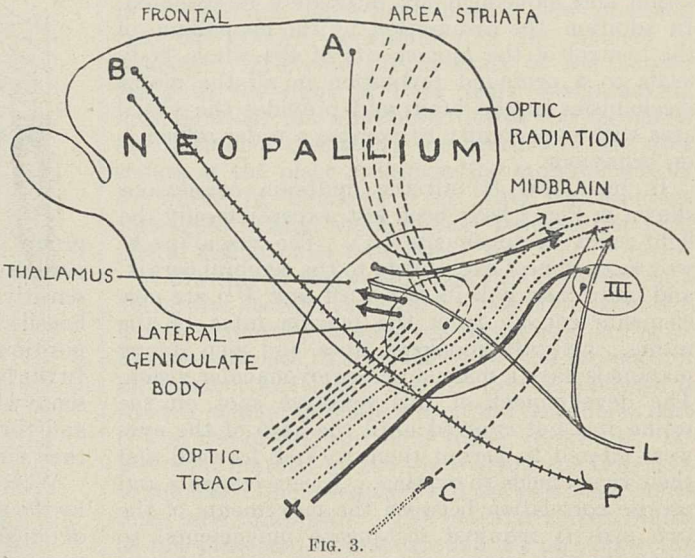


FIG. 3.

most of those automatic and unconscious photostatic influences that are so obtrusive in most other living creatures. Vision is the foundation of intelligence and the chief source of our knowledge.

This distinction can be graphically displayed by means of three diagrams. In the reptilian ancestor of mammals (Fig. 2) the optic tract, in spite of the wide currency of Monakow's diagram, does not establish any connexion with the cerebral cortex. Most of its fibres end in the midbrain, from which tracts (*T*) proceed to the motor nuclei in the brain and spinal cord. In addition to this connexion, which automatically directs the movements of the animal, there is also a group of fibres (*X*), which forms part of the light-reflex mechanism, using the oculomotor nucleus (*III*) and the ciliary ganglion (*C*) to influence the iris and the size of the pupil.

Most of the fibres of the optic tract are functionally related to these unconscious activities. The number of fibres concerned with the conscious awareness of vision is small. They pass to the lateral geniculate body and from it to the thalamus.

In mammals (Fig. 3) the lateral geniculate body receives a larger proportion of the fibres of the optic tract and transmits some of the impulses (by means of the optic radiation) to the newly developed cortical area, neopallium, which affords a representation of vision (area striata) in the cerebral hemisphere. The transference to cortical control of functions previously performed by the midbrain necessitates the establishment of new connexions between the cerebral cortex and the midbrain, both (*A*) from the receptive visual area and (*B*) from the area which controls voluntary movements. For vision and movement are intimately interrelated. In addition, the assumption by the neopallium of the control of the movements of the whole body leads to a profound revolution in all the motor mechanisms in the brain and provides the visual area with opportunity to exercise a wider influence on behaviour.

In man (Fig. 4) all the midbrain connexions shown in Fig. 2 have been lost, excepting only the light-reflex arrangements (*X*). The visual pathway leads almost exclusively to the cerebral cortex, and more than half its fibres (*M* and M^1) are new elements coming from the macula lutea of the retina. Only the monkeys, apes, and men among mammals have a macula and enjoy macular vision. The development of this sensitive spot on the retina was not evolved until the axes of the eyes were altered to permit them to look forward and their visual fields to overlap. A very complex and precise correlation between the movements of the two eyes is required (conjugate movements) to bring the two images of an object with certainty upon certain determined areas in the two retinæ. These areas become the maculæ, the instruments which confer on vision greater powers of resolution and discrimination. The development of macular vision led to the progressive transformation of the brain and eventually to the making of the human mind. It conferred not only the ability to discriminate between the details of form, texture, and colour, but also led to an enhancement of the knowledge which became accessible to a mind intent upon satisfying the curiosity awakened by such new revelations.

Binocular vision enriched by macular efficiency provided the conditions which made possible the attainment of stereoscopic powers, the conscious appreciation of a third dimension in space, the recognition of solidity and perspective. A vision of the world was thus revealed to man, with an appreciation of form, colour, size, and space, and a fuller understanding of distance and movement. The most significant enrichment of the sensory basis of the mind is conferred by the macula. To paraphrase the account given by the late Dr. Henry Watt, it " refines and distinguishes positions and forms, and, aided by the more precise accommodation which becomes evolved in association with it, it sharpens the objects of attention and dissipates the rest ". " Stereoscopy adds a new character to a

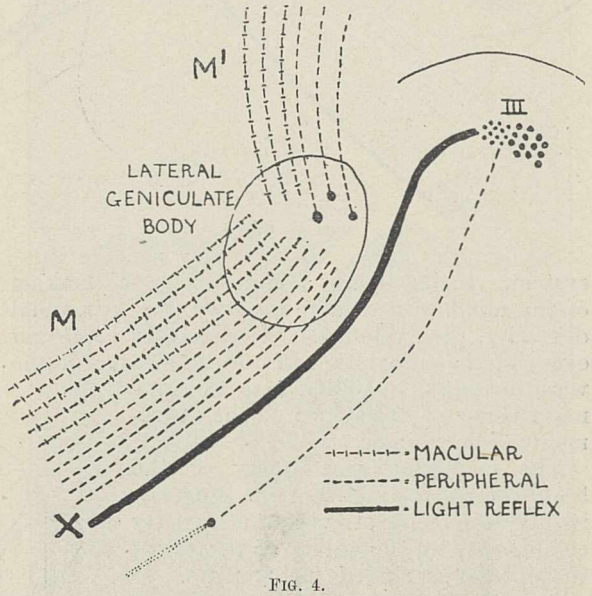


FIG. 4.

group of forms that may persist for indefinite periods of observation ; delicate skin gives greater sensitivity to variations of pressure, and the prehensile hand implies a very great refinement in the positions and forms of the derived articular sense. In the hand this becomes a fine mobile tridimensional sense which, like the stereoscopic eye, can go round and through things, so almost isolating them from their surroundings."

When in response to the visual curiosity excited by the new vision of the forms, textures, and colours of objects, the hand, under the guidance of the eyes, examines these objects, and explores their positions in space, not only is tactile information added to visual knowledge and integrated with it, but also the impulses from the joints, muscles, tendons, and in fact from the whole body, recording the effects upon the organism of the accomplishment of the action, are added to the visual, tactile, and motor sources of knowledge. Hence, as Dr. Watt expresses it, " the articular sense is the conscious correlate of action and of the individual's share in

his experiences". Thus "action enters into the data of sense to integrate with it and so build up psychical mind-stuff".

The consciousness of action makes possible "the integrations of percept and probably of concept that are the beginnings of intellect". It adds the essential personal element in the process of interaction of mind and mechanism, and the interpretation of the means whereby motor skill creates mind. For "the first purpose of the mind is to serve the ends of action. It is not merely a speculative instrument given to man that he may form for himself a disinterested knowledge of the world, create and enjoy works of art, and plan an elysium of happiness and love." It is primarily a means for seeking actively, under the guidance of attention and interest, the objects of its own desire, and for expressing in movement and other forms of behaviour the satisfaction of the impelling appetites. Vision and touch are closely integrated with movements and feelings and the affective results of such expressions of the mind's searching for satisfaction.

This brings us back once more to the essential fact one is trying to make clear in this discourse. Man's intellectual pre-eminence is based primarily on the evolution of macular vision in a Primate with adaptable hands which attained the erect attitude when the cerebral cortex under the conscious influence of vision came to control and regulate posture. The profound and widespread effects of this revolution upon the structure and functions of every part of the brain—cerebral hemisphere, cerebellum, red nucleus, substantia nigra, corpus

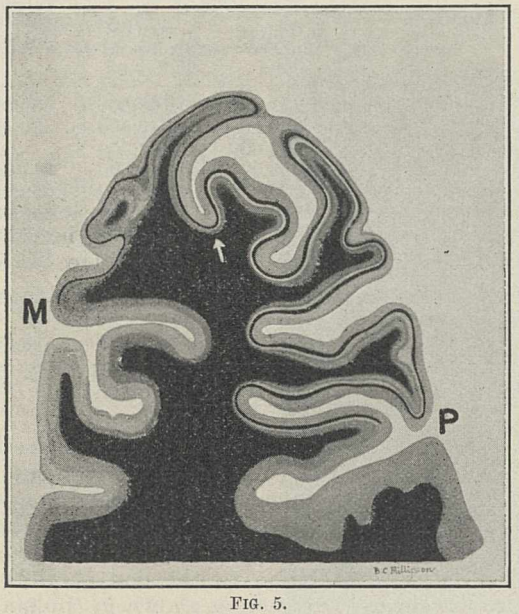


FIG. 5.

striatum, midbrain, and hindbrain—will not be discussed in this discourse. But attention must be directed to some of the obtrusive expressions of this new vision in the anatomy of the optic parts of the human brain.

The development of the macula was responsible for adding to the optic nerves and tracts as many new fibres (Fig. 4) as the whole of the rest of the retina (peripheral) supplies. In the lateral geniculate body a new receptive nucleus of corresponding dimensions is provided to transmit macular im-

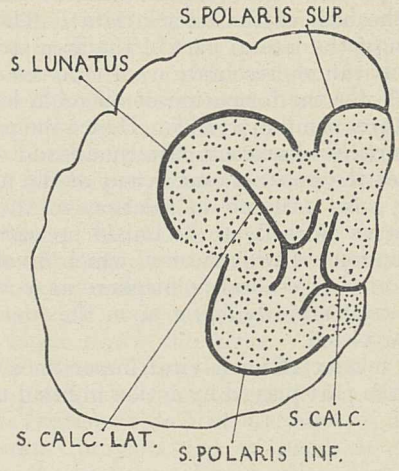


FIG. 6.

pulses to the cerebral cortex. For many years neurologists have been speculating on the nature of the representation of the macula in the cerebral cortex. During the War, Henschen's idea of the 'cortical retina' was revised and corrected by the observations made upon wounded soldiers by Sir William Lister, Dr. Gordon Homes, and many other physicians.

Recently (1928 and 1929) Prof. B. Brouwer and his collaborators, Drs. Van Heuven and Biemond, in Amsterdam, have introduced a new precision into the cortical localisation of the macula in monkeys. Studying preparations of the human brain in the light of their truly epoch-making investigations, one was able to detect with the naked eye a sudden change in the texture of the area striata at the place corresponding morphologically to where in monkeys Prof. Brouwer and his colleagues located the boundary between the peripheral and macular territories.

A drawing of the photograph (the negative) of a horizontal section through the posterior pole of a human cerebral hemisphere is reproduced in Fig. 5. The area striata, distinguished by the presence of an intracortical black line, is seen to undergo a sudden change in character as the peripheral part (*P*) on the medial surface is traced backward. At the point marked by the white arrow the thickness of the black line is reduced and the pale band on its inner side disappears. The macular cortex begins at this place and extends around the pole on to the lateral surface of the hemisphere to end (at *M*) at the lip of a deep furrow (lunate sulcus). As this lateral part of the area striata is much broader than the medial part (*P*) exact measurements reveal the fact that the macular part is at least as extensive as the whole peripheral part.

It is possible also to identify the macular part of the area striata in many human brains by simple observation of the morphological features of the surface of the cerebral hemisphere. Looking at the

posterior aspect of the hemisphere (Fig. 6 represents the pole of the left hemisphere) three semilunar sulci—lunatus, polaris superior, and polaris inferior—may often be seen arranged in a trefoil or shamrock-leaf pattern (grouped around the calcarine sulci in the axis of the area striata). The rapid expansion of the lateral part of the area striata to afford cortical representation of the macula is responsible for the formation of opercula bounded by these three semilunar sulci. Hence the presence of this cortical shamrock-pattern affords definite evidence of the position and extent of the macular area. It is so situated in relation to the other cortical areas as easily to be linked up with them in the functions of wider vision, which involve the activities of the cerebral hemisphere as a whole—the process of mind-building upon the foundation of macular vision.

It is a matter of such vital importance not to overlook the part played by action in mind-making that the argument may be emphasised once more. When under the guidance of vision some delicate manipulation is performed, in addition to the success or failure of the mechanical operation, and the emotions of satisfaction or disgust which the results of the attempt and the attendant circumstances excite, the action itself starts a series of impulses from the joints, muscles, tendons, and from other parts of the body, which integrate the whole process with the intimate texture of the individual's consciousness and personality. The appetites and feelings which prompt the action, no less than the discriminative experience and knowledge which play their part in determining whether it is worth doing and how to do it, become associated with the activities of the whole organism during the progress of the movement. It is no longer a mere matter of muscular contraction under visual control, but a complex process of integration of experience and of creating understanding and intellect.

Canadian Hydro-Electric Power Development during 1929.

By Dr. BRYSSON CUNNINGHAM.

THE recent issue of two reports[1] by the Canadian Government Water Power and Reclamation Service enables a survey to be made of the expansion which has taken place during the twelve months ended Dec. 31 last in the development of hydro-electric power in the Dominion. The review made in NATURE of July 27 last year, on the statistics then available, showed a very striking and rapid rate of progress. This progress has been substantially maintained and important activities are reported from practically every province. The total capacity of new installations brought into operation during 1929 amounts in round figures to 378,000 horse-power, bringing the aggregate for the whole Dominion to 5,727,162 horse-power, as compared with 550,000 h.p. and 5,349,232 h.p. respectively, for the year 1928.

Table 1 shows the available and developed water power of Canada as determined to Jan. 1, 1930. The available power is scheduled in columns 2 and 3 under two heads according to the period of availability. These figures are based on a computation of data relating to rapids, falls, and power sites generally, of which the actual fall or the possible head of concentration is definitely known, or, at least, well established. There are many other rapids and falls of greater or less capacity scattered up and down the country which are not yet included in the register and can only become available for tabulation when the necessary survey work has been undertaken and completed. This is particularly the case in the northern parts of the Dominion, where much exploration remains to be done. Moreover, there are possibilities of power concentration on rivers and streams of gradual gradient which have not been taken into account, except at such selected points as have been the objects of actual study and observation. Altogether, as a record of potential resources, the figures in columns 2 and 3 may be looked upon as minimum values. Indeed, the basis of valuation itself is appreciably below the standard of development obtained in cases of actual installation by so much as 30 per cent. If the necessary correction be applied, it will be found that the present recorded water power resources of the Dominion will permit of turbine installations aggregating about 43,700,000 horse-power.

TABLE 1.—AVAILABLE AND DEVELOPED WATER POWER IN CANADA, JAN. 1, 1930.

Province.	Available 24-hour power at 80 per cent efficiency.		Turbine Installation (h.p.).
	At Ordinary Min. Flow (h.p.).	At Ordinary Six Months Flow (h.p.).	
British Columbia	1,931,000	5,103,500	559,792
Alberta . . .	390,000	1,049,500	70,532
Saskatchewan .	542,000	1,082,000	35
Manitoba . .	3,309,000	5,344,500	311,925
Ontario . . .	5,330,000	6,940,000	1,952,055
Quebec . . .	8,459,000	13,064,000	2,595,430
New Brunswick .	68,600	169,100	112,631
Nova Scotia . .	20,800	128,300	109,124
Prince Edward Island . . .	3,000	5,300	2,439
Yukon and Northwest Terr. .	294,000	731,000	13,199
Canada . . .	20,347,400	33,617,200	5,727,162

The actual installation to the end of 1929 in water wheels and turbines, as shown in column 4, amounted to 5,727,162 horse-power, representing slightly more than 13 per cent of the recorded potential resources.

The progressive development which has taken place since the beginning of the present century is best illustrated by a diagram, and the curve shown in Fig. 1 is remarkable not only for its continuous

upward trend but also for the increasing degree of steepness which characterises its progress. It is

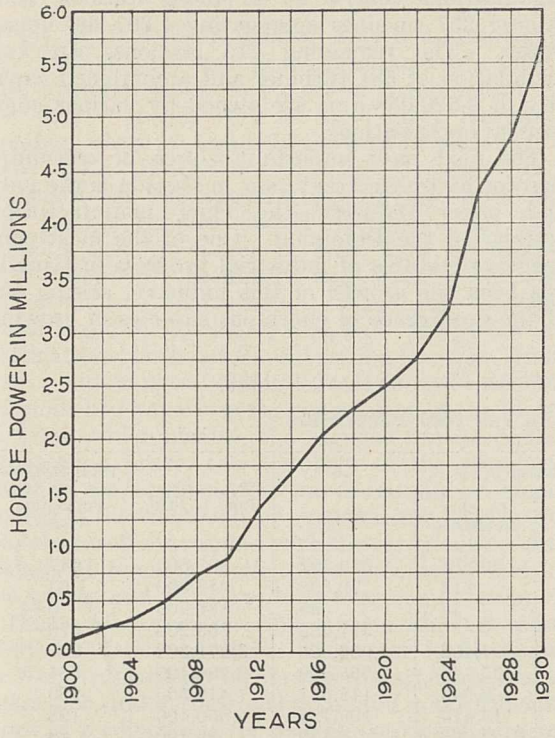


FIG. 1.—Growth of water-power development in Canada, 1900–30.

surprising to realise that thirty years ago hydro-electric installations in the Dominion did not amount to one quarter of a million horse-power.

Obviously it is impossible in the space at disposal to allude in any detail to the various installations which have materialised during the past year. A few observations on one or two stations of outstanding importance is all that may justifiably be attempted in this brief review of the general situation.

The province of Quebec led the way with an addition of more than 208,000 horse-power brought into operation, including chiefly the new plant (72,000 horse-power) of the Montreal Island Power Company on Des Prairies River, near Montreal, and additional units to the existing stations of the Gatineau Power Company and the Shawinigan Water and Power Company. The Gatineau Power Company added fourth units of 24,000 h.p. and 34,000 h.p. respectively to the stations at Farmers Rapids and Chelsea Dam, illustrated in NATURE of July 27, 1929. A third station on the same river at Paugan Falls, a view of which is shown in Fig. 2, has a present equipment of 204,000 horse-power, which is shortly to be increased to 272,000 horse-power. The same Company also completed the construction of a storage dam at Cabonga Lake, an important upper tributary of the Gatineau River, providing a reservoir with a capacity of 45 thousand million cub. ft. This reservoir is the property of, and is now being operated by, the Quebec Streams Commission in conjunction with the Baskatong reservoir above the Mercier dam, with a capacity of 100 thousand million cub. ft., located lower down the river. The Shawinigan Water and Power Company added a 43,000 horse-power unit (eighth in succession) to No. 2 Shawinigan Falls Station (vide NATURE, Sept. 3, 1927).

Important projects are in hand at Chute-à-Caron on the Saguenay River, where four units of 65,000 h.p. each are about to be installed, and at Beauharnois, on the St. Lawrence, immediately above Montreal, where an initial installation of 200,000 or possibly 350,000 h.p. is projected before the end of 1932. This latter outstanding undertaking includes a diversion canal for power and navigation, approximately 15 miles in length. The inauguration of constructional operations by the Governor-General of Canada was referred to in NATURE of Dec. 14, 1929, p. 930, in which some particulars of the project were given.

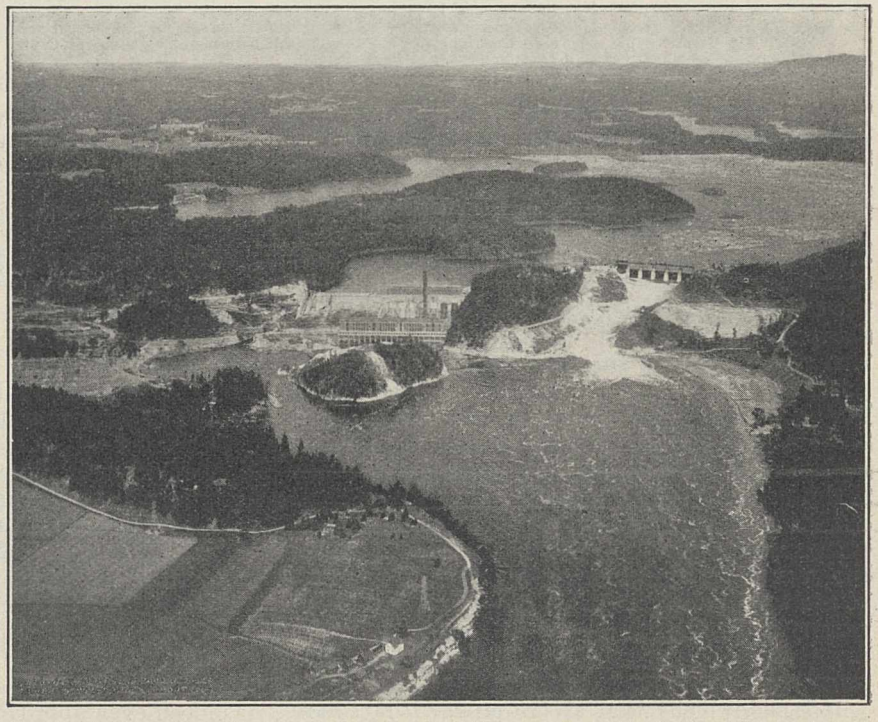


FIG. 2.—Gatineau Power Company's development at Paugau Falls on the Gatineau River, Quebec. Present installation, 204,000 h.p.; ultimate, 272,000 h.p. By courtesy of the Dominion Water Power and Reclamation Service, Ottawa, Canada.

The province of Ontario includes the renowned Niagara Falls, or, at any rate, a portion of them. During 1929, work was advanced on the installation of a tenth unit of 58,000 horse-power at the Queenston Station; it is expected to be completed this year. Another important development was the completion of the 28,200 horse-power installation of the International Nickel Company of Canada at the Big Eddy Dam on the Spanish River.

Table No. 2 enables an idea to be formed of the distribution of the developed power among the leading industries in the various provinces. Supplies to central electric stations constitute by far the major portion of the consumption and there is every indication that the proportion used for all kinds, including traction, lighting, heating, and motive power generally. Municipalities and public organisations control 97 of these stations, containing 237 turbines aggregating 1,297,398 horse-power. The remaining 215 stations, with an installation of 581 turbines and a combined capacity of 3,520,088 h.p., are owned by various commercial organisations.

The next most important source of consumption for hydro-electric power in Canada is the pulp and paper industry—the chief manufacturing activity of the Dominion. One of the most conspicuous features of industrial progress in Canada has been the growth of this industry, arising out of the occurrence of enormous supplies of growing

TABLE 2.—DEVELOPED WATER POWER IN CANADA, JAN. 1, 1930.

DISTRIBUTION BY INDUSTRIES AND PER 1000 POPULATION.

Province.	Turbine Installation in h.p.				Population, June 1, 1929.	Total Installation per 1000 Population (h.p.).
	In Central Electric Stations.	In Pulp and Paper Mills.	In other Industries.	Total.		
British Columbia	417,960	81,000	60,832	559,792	591,000	947
Alberta	70,320	—	212	70,532	846,000	83
Saskatchewan	—	—	35	35	886,700	0·04
Manitoba	311,925	—	—	311,925	663,200	470
Ontario	1,616,773	240,880	94,402	1,952,055	3,271,300	597
Quebec	2,238,525	221,160	135,745	2,595,430	2,690,400	964
New Brunswick	83,910	19,778	8,943	112,631	419,300	269
Nova Scotia	77,697	16,008	15,419	109,124	550,400	198
Prince Edward Island	376	—	2,063	2,439	86,100	28
Yukon and North-West Terr.	—	—	13,199	13,199	12,400	1063
Canada	4,817,486	578,826	330,850	5,727,162	10,016,800	572

Col. 2 includes only hydro-electric stations which develop power for sale.
Col. 3 includes only water-power *actually developed* by pulp and paper companies. In addition to this total, pulp and paper companies purchase from the hydro-power central electric stations totalled in Col. 2 electric energy for power purposes estimated at about 860,000 h.p., making a total of about 1,438,826 h.p. actually used for power purposes in the manufacture of pulp and paper. A considerable amount of off-peak and surplus power is also purchased for use in electric steam boilers.
Col. 4 includes only water-power *actually developed* in connection with industries other than the central electric station and pulp and paper industries. These industries also purchase power from the central electric stations totalled in Column 2.
Col. 5 totals all turbines and water wheels installed in Canada.
Col. 6 shows the population at June 1, 1929, as estimated by the Dominion Bureau of Statistics.
Col. 7 averages the developed water-power per 1000 population.

this purpose will continue to increase. From a percentage of 33½ at the beginning of the century it has grown to more than 84 per cent. A number of factors contribute to this increasing use, notably the extensive economic radius of modern electrical transmission, combined with the fortunate location of water power sites in relation to centres of population and industry without adequate local fuel supplies. The provinces of Ontario and Quebec, as is well known, are entirely destitute of geological deposits of coal. The special adaptation of hydraulic power to central electrical station operations is emphasised by the fact that the last completed central station census, namely, that for the year 1927, shows that more than 95 per cent of the total main plant equipment is in hydraulic generating stations and that this equipment produced almost 99 per cent of the total electrical output.

It is noteworthy that at the present time there are in Canada a total of 312 hydro-electric central stations, possessing an aggregate of 4,817,486 horse-power, distributing supplies for purposes of pulp wood in close proximity to readily developable water power of a magnitude adequate to provide the large supplies of power essential to the conversion of the raw material into the finished product. The value of this fortunate conjunction and the importance of ample supplies of economically produced power may be gauged from the fact that practically 100 horse-power is required per ton of daily output of newsprint.

Column 4 of Table 2 shows the amount of electro-hydraulic power absorbed in miscellaneous industries, including mining, to which it is an invaluable adjunct in consequence of the prohibitive cost of fuel power. Columns 6 and 7 are of interest in instituting a comparison of power development per head of population. The figure for the whole of Canada, 584 per thousand, compares extremely favourably with that of other countries, being considerably in excess of most and rarely exceeded, or indeed even approached.

[1] Report No. 1353: Hydro-Electric Progress in Canada in 1929; Report No. 1361: Water Power Resources of Canada. (Ottawa: Dominion Water Power and Reclamation Service.)

Obituary.

DR. H. J. B. FRY.

DR. H. J. B. FRY died on May 5, at the early age of forty-four years, from an acute infection acquired at a post-mortem examination in the course of his work at the Cancer Hospital, London, where he had held the post of pathologist since 1922. In the investigation of cancer, and especially in the organisation of this work by the British Empire Cancer Campaign, he had found a field for which he was, both by nature and experience, peculiarly well fitted. He was educated at Charterhouse, Magdalen College, Oxford, and St. Thomas's Hospital. His earlier investigations, both before and during the War, dealt with a wide range of biological and clinical subjects: he published papers on the coagulation of the blood in fishes and tunicates, the nervous control of the cephalopod heart, the histology of the pituitary gland in diabetes, and the use of immunised blood donors in the treatment of pyogenic infections. He was thus well acquainted with the complexities and pitfalls of research, both in the laboratory and in the wards, and he had exactly that combination of enthusiasm, experience, and caution which is most needed in cancer research. Moreover, at his home in Welwyn Garden City he was a magistrate and a councillor, and in these positions, and in the difficult work of a committee for placing convicted persons on probation, he had gained a good knowledge of the conduct of business.

As secretary of the Investigation Committee of the British Empire Cancer Campaign, it fell to Dr. Fry's lot to receive those abundant suggestions, of all possible degrees of rationality, which are offered to the Campaign for the investigation and treatment of cancer. He served the *Cancer Review*, which is published by the Campaign and abstracts the literature relating to cancer, from its beginning as sectional editor, and later as chairman of the editorial committee, and the volumes of this journal, of which the fifth is now being issued, contain a mass of good work by him. He took endless trouble over his abstracts, and they are models of thoroughness.

In his own investigations Dr. Fry had attacked two of the most difficult problems, namely, the search for immune reactions which might possibly serve as some basis for the diagnosis, and for the treatment, of cancer. The time given to him was too short to allow of much progress in these immense tasks, and his published writings show a beginning only. His flocculation method for the diagnosis of cancer gave useful results within certain limits, and he was constantly testing possible improvements in the technique. Throughout this research he worked with material from human sources, under clinical conditions, and his work could be under no reproach that it applied only to the artificial conditions of the laboratory.

In his recreations Dr. Fry was a fine athlete, a cricketer, tennis-player, and rider; and a lover of literature with an especial devotion to Hardy's "Dynasts" and Gilbert Murray's translations of Greek drama. He was not a man who spoke of his ambitions, but anyone who knew him well will have no doubt that these lay in the direction of manifold and increasing service to human welfare.

DR. GUSTAF EKMAN.

WE regret to record the death, at the age of seventy-seven years, of Dr. Fredrik Gustaf Ekman. From the *Göteborgs Morgenpost* of Feb. 27, we learn the following details of his life. Ekman was born at Stockholm in 1852, and when he was nine years old, his family moved to Göteborg, where his father and brother obtained posts in the Carnegie sugar-refinery. As a student at the technical high school of Göteborg and Chalmers technical institute, and afterwards at Wiesbaden and Uppsala, Gustaf Ekman specialised in scientific technology with the view of acquiring full knowledge of the technique and the chemico-scientific basis of sugar-refining. On his return to Göteborg in 1880 he obtained the post of technical director in Carnegie's refinery, and for twenty years as technical director and then as one of its managing directors Ekman rendered considerable service to the development of the Swedish sugar manufacture.

In his student days in Uppsala Ekman showed leanings towards natural science, and marine research in particular appealed to him. Some preliminary marine investigations were begun in 1876 in collaboration with Prof. A. W. Cronander, professor of chemistry, and in the following year the State fitted out and financed a Baltic expedition in which Ekman participated. Next year he received from the local authority in Bohuslän a request to investigate the sea off the coast of Bohuslän from the point of view of the herring fishery, and his pioneer discoveries awakened widespread interest in marine biological and fisheries research. Indeed, his name will always be associated with that of his friend Prof. Otto Pettersson in the annals of Swedish hydrographic work. Since 1904 he was associated, first as expert and later as delegate, with the International Council for the Exploration of the Sea.

WE regret to announce the following deaths:

Dr. Joseph L. Markley, professor emeritus of mathematics at the University of Michigan, known for work on Bessel functions and the theory of functions, on April 20, aged seventy years.

Dr. William H. Nichols, past president of the American Chemical Society, known for his work on the metallurgy of copper and in industrial chemistry, on Feb. 1, aged seventy-eight years.

Prof. Katsusaburo Yamagiwa, emeritus professor of pathology and pathological anatomy at the Tokyo Imperial University, member of the Japanese Imperial Academy, who carried out important investigations on cancer, showing in 1915 that it could be produced by prolonged application of coal-tar to the skin, on Mar. 2, aged sixty-six years.

News and Views.

THE presidents of seven American universities have furnished the Scientific Research Committee of the American Association for the Advancement of Science with statements of the salaries paid to executive officers, professors, associate professors, and assistants in 1900 and 1925. The Universities are Yale, Harvard, Ohio State, Michigan, Illinois, Wisconsin, and California. The figures, with other statistical material, provide Prof. W. A. Noyes, of the University of Illinois, with the basis for an interesting argument published in *Science* for April 18. Dr. Noyes says that professors in American colleges and universities are not receiving their fair share of the returns from the rapidly increasing prosperity of the country. In the twenty-five year period, nominal wages in America increased by 200 per cent, corresponding to a real-wage advance of 50-57 per cent. Since the nominal salary increase among professors was only 87-122 per cent, their purchasing power in 1925 was actually below the 1900 level. To be equitable, a salary of 2000 dollars in 1900 should have been 6000 dollars in 1925. Dr. Noyes also compares academic with scientific industrial salaries earned by his own students of the 1918–1928 class. The average salary of those who had taught for four to ten years was 3472 dollars, and the average for industrial workers for the same time 5619 dollars. The highest initial academic salary was 3500 dollars paid to a woman in a women's college, and the highest three initial salaries for industrial work were 4800, 4000, and 3840 dollars respectively. "It seems evident", he says, "that unless these conditions can be remedied our universities must be content to fill their teaching positions with mediocre men". He puts an 'attractive' salary for a professor in present-day America at 20,000 dollars (say £4000) a year.

So much for the 'academic' point of view. That an American business man, Mr. Edward A. Filene, president of a Boston commercial organisation, should discuss the salary problem from a more detached point of view seems to be an adroit move. His address to the Committee does not show him to be better informed or more enlightened than some of our best men of affairs and industrialists. The emphasis falls differently. It is impossible to do more here than outline the salient points of an address interwoven with historical and economic allusions. His points were: (1) That it is idle to accuse the scholar of impracticality because he does not descend to the market place to earn a living by 'useful work': by so doing he would become useless as a scholar, and to refuse to do so is sound practicality. (2) That whether the taxpayers should or should not control education need not be discussed; they cannot. Prohibition of education is only theoretically possible. Science has made it practically impossible. (3) American business has discovered that it cannot be run on opinion, however traditionally correct and authoritative, but only by actual scientific research, which is specialists' work. What is happening is not the commercialisation of scholarship, but a new revolution of economic life by science. The power that comes from science cannot in modern conditions be used selfishly: it will receive many times its present reward. Mr. Filene appears to believe that those educational ideals that really matter will be more secure in the new economic order than they are now, because they are essential to the life of science and the aims of human effort. Another business man, a newspaper magnate, told the Committee that he regarded scientific workers who willingly and unnecessarily laboured on a miserable stipend as "economic imbeciles". It would be unlike the Americans to leave the matter there.

THURSDAY last, May 29, was the three-hundredth anniversary of the birth of King Charles II., an event which should be, for diverse reasons, of interest to men of science. Proclaimed king on May 8, 1660, in Westminster Hall, Charles arrived at Dover, from the Hague, on May 29, his thirtieth birthday. Portraits in national and private collections familiarise the King's lineaments in manhood. A faithful representation of him (its particular source is not known) is seen in the finely executed pen-and-ink drawing in the second charter (1663) of the Royal Society. As to personality, Evelyn enters him as "débonnaire, easy of access, naturally kind-hearted, and of an excellent temper". In his sketch of the rise of scientific study in Scotland (1909), the late Sir William Turner goes further, remarking: "Charles II. lives in the recollection of most people as a lover of pleasure, untrustworthy, indifferent to the welfare of his people and ready to sacrifice the interests of his country to gratify his taste for luxury and ease". In early life Charles received tuition in mathematical studies from Hobbes; he had mechanical skill; and he possessed a turn of mind which led him to discuss the philosophical topics of the period. Pepys, however, noted that the King "mightily laughed at Gresham College for spending time only in weighing of ayre and doing nothing else since they sat". What justly, and in charitable construction, can we say of this monarch, then, from a point of view less relating to conduct and more to corporate effort?

IN brief retrospect we may recall certain national institutions actually attributable to Charles II., through Royal edict, passing over special formative influences. (1) The Royal Society of London took shape amongst a group of men. The King might have adopted and maintained a negative attitude; on the contrary, he was friendly throughout. To his signature in their charter book he appended the word Founder. (2) The Royal Observatory at Greenwich was built in 1675. Flamsteed records the facts concerning its establishment, and the immediate interest shown by Charles II. in its foundation. (3) The Royal Mathematical School of Christ's Hospital centred in a plan of education for service in the navy or in merchant craft. A Royal charter, granted in 1673 by Charles II., affirmed there might be forty boys "there taught and instructed in the Art of Navigation and the whole Science of Arith-

matique untill their age and competent proficiency in those parts of the Mathematiques shall have fitted and qualified them in the judgment of the Master of the Trinity House ". It is true that little was done, however, by the King towards the after maintenance of his foundation. (4) On St. Andrew's Day, 1681, Charles II. granted a patent which, incorporating the physicians, founded the Royal College of Physicians of Edinburgh, a recognition of the claims of the northern city which has redounded to the honour of medicine and learning. Charles II. died in 1685, and was buried in Henry VII.'s Chapel in Westminster Abbey.

IN his Friday evening discourse at the Royal Institution on May 23, on some scientific instrument makers of the eighteenth century, Mr. R. S. Whipple stated that there is little evidence to show that scientific instrument making, as a craft, had obtained a position of any importance in Great Britain before the sixteenth century. The demand for instruments to assist navigation became more insistent as new lands were discovered and the length of the voyages increased. The discovery of the telescope in 1608 and the development of the microscope, largely due to Hooke and Leeuwenhoek in the middle of the seventeenth century, gave a great impetus to the manufacture of scientific instruments. John Marshall, by his skill in developing a method for grinding lenses and by the improved designs of his instruments, became the foremost instrument maker of the latter part of the seventeenth and of the early part of the eighteenth century. Benjamin Martin (1704–1782), who began life as a ploughboy, later became well known as an author of popular scientific books and as an instrument maker. He developed many improvements in the microscope and other instruments. One of his contemporaries, George Adams, became, perhaps, the best-known instrument maker of the eighteenth century. He specialised in the manufacture of globes and surveying instruments, and also in microscopes. He also made a large number of instruments for George III., which are preserved in the Science Museum at South Kensington. They are outstanding examples of finished workmanship. Dolland, Ramsden, and Herschel were other outstanding instrument makers of the eighteenth century.

IN the early days of long-distance telephone communication, many thought that it would be a boon if the speaker and listener could see one another during the conversation. The difficulties at first sight seem insuperable, yet apparently they have, with the important exception of cost, been satisfactorily overcome. At a Press view on April 9 in New York, the feasibility of two-way television was demonstrated. An 'ikonophone' booth was erected in one building and a similar booth was erected in another building some distance away by the Bell Telephone Co. The speaker enters one booth and a 'scanning' beam of mild blue light rapidly and continuously passes over his face. As in ordinary television, this enables the listener to see the speaker. A similar beam traverses the face of the listener, thus making him visible to the speaker. The television booths themselves are lighted with a dim orange light to which the photoelectric cells are insensitive. An ordinary telephone mouthpiece cannot be used, as this would hide part of the speaker's face. The telephone transmitters, therefore, are concealed in the sides of the booth. The received image is formed eighteen times a second and is of the familiar black and pink type seen with neon reception. The increased sensitivity of modern cells and the use of the faint blue scanning beam have reduced the dazzle and glare so much that the conditions are now quite tolerable. Dr. Jewett states, however, that the terminal apparatus is at present very complicated and expensive. A description of the apparatus is given in the *Wireless World* for May 14.

IN the *Times* for May 23 an account is given of a television performance of a play which was seen by an audience of 500 people in a theatre in New York although the actors were more than a mile away in the General Electric Laboratory. The screen was six feet square and it is stated that the actors were clearly visible; also by means of loud speakers their voices were audible in every part of the building. To give variety to the entertainment, one member of the vaudeville company came to the theatre after the first part of the act had been shown and the act proceeded with him playing his part on the stage while his partner was seen by television. The performance was slightly marred by the tendency of the picture to sway slightly, due probably to the synchronisation not being quite perfect. The pictures are said to have been very much superior both in definition and freedom from flickering to cinema pictures when they first began to be shown. Like everything new, it is attracting audiences, and the success of the demonstration has led the management of the theatre to retain television as a regular feature of their programme.

AN account has been received from Mr. A. S. E. Ackermann of the occurrence of three successive waterspouts within half an hour, at a point off the Italian coast four miles west of Portofino Vetta in the forenoon of April 20. The first was the largest, and lasted about ten minutes, while those that followed when the first had drifted away to the west each lasted about four minutes. The description of the actual spout does not suggest anything abnormal—in each case a column of spray first rose from the water, and afterwards the characteristic column of cloud descended to meet the spray, the latter rising at the same time. The cloud column would therefore appear to have developed when the parent atmospheric whirl increased in intensity. The remarkable feature of the phenomenon is the apparent repeated formation at a particular point on the sea at a time when a definite general drift of wind was evidently present, for the atmospheric conditions responsible for a spout might be expected to drift with the wind, and any reappearance of the phenomenon would naturally

be farther to leeward—unless of course there should be a nearly stationary patch of water warmer than the rest of the sea in the neighbourhood, capable of a trigger-like action upon atmospheric conditions already verging upon instability.

PROF. A. C. LANE, writing from the Library of Congress, Washington, in connexion with the discussion on geological climates at the Royal Society on Mar. 27 (NATURE, April 5, p. 546), raises two interesting points. First, he suggests that there may have been during geological ages a slow variation in the density of the atmosphere, which would have a definite climatic effect. On this it may be remarked that the great flying reptiles of the Mesozoic probably could not have lived in an atmosphere much rarer than the present; they have in fact been adduced as an argument for greater density. In the absence of any real evidence, however, it is idle to speculate on the possible climatic effects of such changes. The second point is of greater interest. Suppose a black smoke deposit could be laid over the surface of the Greenland ice sheet, what would be the effect? The experiment would no doubt add something to the earth's heat, for part of the radiation now reflected back to space would be absorbed, and if the blackening could be maintained, there would presumably be a local amelioration of climate, perhaps comparable with that which occurred about the tenth century A.D. But immediately the ameliorating influence in the tenth century, whatever its nature, was withdrawn, the Greenland ice sheet increased again in extent, and one fears that any artificial attempt in the same direction would be equally transient. There is room for speculation whether the existing meteorological system would remain stable under great changes of solar or geographical conditions, but there is little doubt that it is stable under small disturbances, and tends to restore existing conditions as soon as the disturbing factor is withdrawn.

IT is stated in the daily Press that a conference of representatives from all over New Zealand, convened by the Government, met on May 7 in Christchurch to consider the problem of the increase of deer. So greatly have the herds developed in recent years that they have spread into new areas and are becoming a menace to farm and forest lands. Red deer and fallow deer were introduced into New Zealand in the sixties and seventies of last century, and since that time various other species, such as the Indian sambar, the American wapiti and moose and Virginian deer, have been set free and become firmly established. The naturalisation of these handsome animals was hailed with satisfaction by sportsmen and by naturalists, who regarded their presence as an asset to a noble environment. Their dispersal from the limited areas in which they were originally set free to new valleys and districts was recorded with admiration, and their safety was ensured by protection, for the deer belonged either to private acclimatisation societies or to the State, which also took a part in the introductions. Twenty years ago deer were still being introduced.

NOW comes the announcement that the deer have become a pest, and the Minister of Internal Affairs, who presided at the conference referred to, declared that he himself favoured the removal of all protection from deer and chamois. From the short cabled message it would appear that the body of the conference deemed the menace too serious to be met even by such a measure; a unanimous decision was reached that extermination was a matter of urgency, and the Government was asked to supervise the destruction of the animals. Without evidence, we have no means of judging whether this was a reasonable decision on the part of the conference—there are always people who, when their interests are threatened, are ready to call for the extermination of the aggressor. But even if the case against the deer is exaggerated, the venture which began in blessings and after half a century of commendation is ending in cursings, is one of the most emphatic warnings of recent years against the setting free of foreign animals in a new land.

AMONG the recent acquisitions of the British Museum (Natural History) are the following: The Department of Zoology has received the skin and skull of the rare East African bongo (*Boocercus eurycerus isaaci*) from the Aberdare Mountains, Kenya Colony, and also an unusually interesting collection of corals, comprising about 300 specimens with full field notes, presented by Dr. Cyril Crossland, by whom they were collected in the course of his investigations on the coral reefs of Tahiti. Through the kindness of Mrs. V. D. Hughes of Winchester, the Department of Entomology has received a selection of Lepidoptera from the collection of the donor's father, the late Andrew Swanzy. The series includes practically all the type specimens in the Swanzy collection described by the late Dr. A. G. Butler and figured by him in one of his earliest works ("Lepidoptera Exotica", 1869–74). Under the will of the late Prof. F. V. Theobald, who died on Feb. 11 last, his collection of Aphididæ, consisting of 9258 microscope slides carrying preparations of specimens, among which are 402 types, 19 co-types, and 311 paratypes, goes to the Museum. The collection includes the material upon which its late owner based his monograph "The Plant Lice or Aphididæ of Great Britain" (3 vols. 1926–29), and also his reports on African and Indian Aphididæ. This bequest makes the British Museum collection of this family the finest in the world. The most important addition to the Geological Collections is a set of four specimens of an extinct aquatic reptile, *Mixosaurus*, from the Alpine Trias of the Lake Lugano district of Italy. This genus is a somewhat aberrant form of Ichthyosaur in which the characters of several bones are reminiscent rather of land than of water animals. It was about three feet long and in shape rather like a porpoise, and had paddles for swimming and an elongated tail fin. The specimens purchased include a fine skull and lower jaw, the sclerotic ring of one of the rather large eyes, and a good portion of the vertebral column. Paymaster-Commander T. M. Salter, R.N., has presented to the Department of Botany a collection of

1400 prepared and named South African flowering plants.

RESEARCH work in Germany from 1920 to 1927 is outlined in "Deutsche Forschung", a brochure issued as an extract from the fifth Report of the Notgemeinschaft der Deutschen Wissenschaft. Its 116 pages give some idea of the immense range of activities encouraged by thousands of grants-in-aid during years of impoverishment. All academic studies have benefited from theology, philosophy, and philology to biology, agriculture, and medicine. Assistance has taken such forms as subventions for printing expenses of periodicals, grants to research scholars and explorers, publication of works almost completed before the War, provision of expensive physical apparatus and foreign literature. In every department it has been necessary to consider which magazines to support, and in restricting quantity to improve quality; hence two are supported for international law, three for psychology, ten for geology. The most striking venture has been the exploration of the South Atlantic by the research ship *Meteor*. Some two years were spent on about a dozen roughly parallel routes between Africa and South America. Sea and air, winds and currents, plankton and ocean floor were examined by specialists. Other leading lines have been vitamins, ultra-violet and penetrating radiations, cathode rays, vacuum tubes, and spectroscopy. Preparations have been made for total eclipse expeditions and for observations of the opposition of Eros. As a guide to recent research in Germany the book should be valuable to the historians of science and to publishers, editors, and librarians.

WE have received a copy of the Year-book 1928–30 of the Sixth Achema or Great International Exhibition of Chemical Apparatus, which is to be held at Frankfurt-on-the-Main on June 10–22. The book contains much useful information about the development of all kinds of machinery and apparatus which is designed for use in chemical technology. These descriptive sections have been compiled by well-known experts. Dr. Kirschbaum of Karlsruhe gives an interesting account of the method pursued in the technical high schools of adapting the curricula to the needs of the young engineering chemist. It is recognised that the experience gained from a close and intensive study of the main processes in common use in chemical factories is much more valuable than a superficial but more comprehensive course of theoretical studies. Provision is also made for the students to complete their training by carrying out research, the experience thereby gained being of immense ultimate value to industry. Herr Jentgen of Berlin describes some of the mechanical problems encountered in the rayon industry, and other articles deal with the standardisation of plant and apparatus, both large and small. In the industrial section the characteristic properties of special rustless steels, aluminium and its alloys, and bakelite are described. There is also a section upon scientific apparatus, such as Sartorius' balances, electric high-temperature ovens and apparatus for electrometric titrations. This is followed by a chapter upon various types of chemical plant and machinery. An interesting feature of the book is the inclusion of more than fifty portraits of leading German authorities in chemical technology. Copies may be obtained on sending two international postage coupons to Dr. Max Buchner, Hannover.

THE May issue of the *Empire Review* contains an article on vocational psychology by Mr. Eric Farmer. He points out that the subject suffered in its initial stages from too great publicity, so that uncritical people tended to believe that it was a simple matter to devise tests calculated to select those people likely to do well at any given occupation. Research, however, has revealed that vocational psychology is far more complicated than was at first supposed. The term 'vocational fitness' can no longer be limited to the narrower economic factors involved in ability actually to do a certain type of work, or produce during a test period a large output; it must also include relative freedom from accidents and sickness, and satisfaction to the worker from his work. Mr. Farmer discusses the principles involved in the problems, both those belonging to the individual and those to the work. He criticises some of the more usual methods of devising selection tests and shows that in some cases false assumptions are made. He does not, however, imply that vocational guidance and selection are impossible, but points out that the early over-enthusiastic stage is over and that the whole subject has now entered upon a more scientific experimental period. The article is a very valuable critical survey and of importance to all engaged in this very difficult aspect of psychology.

THE Faraday Society will hold a general discussion on "Colloid Science Applied to Biology" at Cambridge on Sept. 29–Oct. 1. A number of workers have been invited to prepare reports on the physico-chemical problems which are encountered in biological work and especially in the study of living matter. These reports will be circulated as far in advance of the meeting as possible so that they may be fully considered by workers in the fields of physical chemistry and biology, and so that considered contributions may be made to the discussion in due course. Sir William Hardy will preside over the first part of the meeting, devoted to "Equilibrium in Protein Systems" and will give an introductory address. Those invited to present reports are Prof. A. V. Hill, Dr. R. A. Gortner (Minnesota), Prof. E. J. Bigwood (Brussels) and Prof. W. Pauli (Vienna). Sir Gowland Hopkins will preside over a discussion on "The Structure of Living Matter" and will give an introductory address. The following have been invited to give reports: Dr. Wilmer (Cambridge), Prof. W. H. Lewis (Baltimore), Prof. R. A. Peters (Oxford), Prof. Fremiet, Prof. Hans Pfeiffer (Bremen), and Dr. J. H. Quastel (Cambridge). The discussion should prove of considerable interest, and the following prominent overseas workers, more particularly in the field of physico-chemistry, have already accepted invitations to take part: Prof. E. F. Burton (Toronto), Prof. J. Duclaux (Paris), Prof. H.

Euler (Stockholm), Prof. H. Freundlich, (Berlin-Dahlem), Prof. H. R. Kruyt (Utrecht), Prof. Wo. Ostwald (Leipzig), Prof. Wo. Pauli (Vienna), Prof. S. P. L. Sørensen (Copenhagen), and Prof. T. Svedberg (Uppsala).

THE Burmese earthquake of May 5 (NATURE, May 17, p. 752) was followed on the next day by an equally destructive shock in north-western Persia. The epicentre was in the Azerbaijan district and not far from Salmas, a town which lies about 80 miles west of Tabriz and 400 miles north-west of Teheran. The early reports estimate the loss of life as about 2000. The immediate neighbourhood of Salmas has been comparatively free for many years from destructive earthquakes, though near Tabriz there is a centre that has been the source of several great earthquakes during the last century and especially in 1879 and 1883. As is stated in the *Daily Science News Bulletin* (for May 10) issued by Science Service, Washington, D.C., there has been lately a period of seismic tranquillity unequalled in the recent annals of seismology. From Dec. 17, 1929, to May 5, 1930, only one rather strong shock (near Borneo on Mar. 26) has been recorded.

MANY friends of Dr. G. Claridge Druce assembled at the Great Central Hotel, London, on May 23, to offer him congratulations on the attainment of his eightieth birthday. Sir Maurice Abbot-Anderson, president of Flora's League, occupied the chair, and Viscount Grey of Fallodon gave an address on some aspects of outdoor natural history, the pursuit of which always brings delight and often leads to knowledge of significant scientific value. On behalf of the Botanical Exchange Club, Lord Grey presented Dr. Druce with a cheque which, it is understood, will be used by him to purchase a plot of land where a particular wild plant is found, and afterwards to hand over the land to the Society for the Preservation of Nature Reserves so that this rare plant may be preserved in England.

AT a preliminary meeting held at the Technical College, Cardiff, on May 21, it was decided to form a Microscopical Society of Wales, for the acquisition and diffusion of knowledge gained by microscopical research. The original suggestion was for a local body, but the preliminary inquiries brought so much support that a body on a wider basis was considered feasible. The committee appointed at the preliminary meeting met on May 23 and it was decided to hold an exhibition on June 2 and an inaugural meeting on June 4. The exhibition will illustrate the importance of the microscope in the sciences and will be open to the public. Meetings so far have been held at the Technical College, the authorities of which have put the biological laboratory of the College at the Society's disposal on one evening weekly throughout the year. Mr. A. E. Harris, 44 Partridge Road, Cardiff, has been appointed secretary and will organise the exhibition.

SIR EDWARD SHARPEY-SCHAFER will open the new buildings of the Department of Research in Animal Genetics of the University of Edinburgh at the King's Buildings, West Mains Road, on Monday, June 30, at noon.

MR. H. T. TIZARD, Rector of the Imperial College of Science and Technology, is to succeed Sir J. J. Thomson as president of the Association of Special Libraries and Information Bureaux, at the annual conference of the Association to be held at New College, Oxford, in September.

THE forty-first annual Conference of the Museums Association will be held at Cardiff on June 23–27 under the presidency of Sir Henry Miers. The provisional programme includes an address by Dr. Cyril Fox on the National Museum of Wales, and another by Dr. O. Lehmann, director of the museum at Altona, Prussia ; papers are to be read on the opportunities and difficulties of the parent museum in connexion with museum affiliation (Dr. Cyril Fox), rural services (Mr. W. C. Sprunt and Dr. T. W. Woodhead), geology and botany in relation to the small museum (Dr. F. J. North and Mr. H. Augustus Hyde respectively). Throughout the meeting there will be an exhibition of museum cases, fittings and appliances, etc., in the Engineers' Institute, Park Place, Cardiff. The local honorary secretary for the meeting is Mr. A. H. Lee, National Museum of Wales, Cardiff.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A radiologist at the Crumpsall Hospital, Crumpsall, Manchester—The Town Clerk, Town Hall, Manchester (June 2). A lecturer in electrical engineering at the Dudley Technical College—The Director of Education, Education Offices, Dudley (June 4). A part-time demonstrator in chemistry at King's College of Household and Social Science—The Secretary, King's College of Household and Social Science, Campden Hill Road, W.8 (June 7). An instructor in the electrical engineering and physics department of the School of Engineering and Navigation, Poplar—The Education Officer (T. 1), County Hall, S.E.1 (June 7). A lecturer in mathematics at the Portsmouth Municipal College—The Secretary, Offices for Higher Education, Municipal College, Portsmouth (June 7). An assistant marketing officer under the Department of Agriculture for Scotland—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (June 7). A graduate assistant in electrical engineering at the Wolverhampton and Staffordshire Technical College—The Clerk to the Governors, Education Office, North Street, Wolverhampton (June 9). A junior lecturer in the Department of Civil Engineering of the University of Liverpool—The Registrar, The University, Liverpool (June 10). A resident lecturer in hygiene at the Bangor Normal College—The Principal, Normal College, Bangor, North Wales (June 10). A head of the Department of Navigation at the Sir John Cass Technical Institute and Nautical School—The Principal, Sir John Cass Technical Institute, Jewry Street, E.C.3 (June 10). Two veterinary surgeons under the South-West Africa Administration—The

Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 11). A lecturer in charge of the Clowne Mining Institute and a lecturer in electrical engineering at two mining schools — The Director of Education, County Education Office, Derby (June 11). A lecturer in electrical engineering mainly at the Heanor Mining and Technical School — The Director of Education, County Education Office, Derby (June 11). A lecturer in science at the Ebbw Vale Mining and Technical Institute—The Director of Mining Education, County Hall, Newport, Mon. (June 12). A lecturer in geography at Birkbeck College — The Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E.C.4 (June 13). A Paterson Research scholar in the Cardiographic Department of London Hospital—The House Governor, London Hospital, E.1 (June 14). A junior lecturer in geography in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 14). A warden of the County Farm Institute, Moulton, and assistant county agricultural organiser; also a junior agricultural assistant, each under the Northamptonshire County Council—The Secretary for Education, County Education Offices, Northampton (June 14). A glass-blower in the National Research Laboratories of Canada—The Secretary-Treasurer, National Research Council, Ottawa, Canada. A Head of the Building Trades Department of the Bury Municipal Technical College; and a teacher of handicraft (woodwork and metal-work) in the Bury Municipal Secondary School and Junior Technical School (jointly)—The Director of Education, Education Offices, Moss Lane, Bury. A teacher of electrical engineering at the Watford Technical School—The Principal, Technical School, Watford. A research assistant at the Liverpool School of Tropical Medicine—The Hon. Dean, School of Tropical Medicine, Pembroke Place, Liverpool. An assistant to the adviser in economics at the Harper Adams Agricultural College—The Principal, Harper Adams Agricultural College, Newport, Salop. Two assistant entomologists under the Division of Economic Entomology of the Commonwealth of Australia Council for Scientific and Industrial Research—F. L. McDougall, Australia House, Strand, W.C.2.

ERRATUM.—The name of the author of the paper on "The Bavenda" delivered at the Royal Anthropological Institute on May 13, to which reference is made in NATURE of May 24, p. 789, is H. A. Stayt, and not H. A. Stuyt, as printed.

Our Astronomical Column.

The Lowell Planet.—It is announced from the Lowell Observatory that the name Pluto has been adopted for this planet.

The assumption that the image found on a plate taken at Uccle Observatory, Belgium, on Jan. 27, 1927, belongs to the planet enables fairly trustworthy elements to be deduced. The first of the following orbits is by Prof. Banachiewicz (*U.A.I. Circ.* 282); the second by Dr. A. C. D. Crommelin (*B.A.A. Circ.* 93): both are for the equinox of 1930·0.

T	1984 Oct.	1984 Dec. 5·4 U.T.
ω	108° 56′	106° 45′ 40·0″
Ω	109 22	109 21 23·6
i	17 12	17 5 34·5
ϕ	17 19	16 41 49·7
log a	1·6110	1·6158060
log q	1·4576	1·4687050
Period	260·9 y	265·2828 y

Both orbits place the perihelion point slightly inside Neptune's orbit. This is the first known instance (apart from the minor planets) of the orbits of two planets overlapping; the two orbits are separated by about 4 units, owing to the high mutual inclinations. It will be seen that according to these orbits the planet will be steadily growing brighter for the next 54 years, and will be brighter than at present for 108 years.

It is of interest to give for comparison the orbit predicted by Prof. P. Lowell in his memoir published in 1915, p. 105, and reduced here to the equinox of 1930: longitude of perihelion (that is $\omega + \Omega$), 205°; i, 10° (estimated); ϕ, 11° 39′; log a, 1·6335; log q, 1·5355; Period, 282 years; T, 1991 March. It will be seen that there is good accord both in the shape and position of the orbit and in the planet's place in it.

Lowell did not give a prediction of Ω, but Prof. W. H. Pickering in 1919 predicted Ω as 100°. i as 15°, both quite good approximations.

Large Fireball.—A large fireball was observed on May 16 at 9 h. 14 m. P.M. by Mr. R. Skelton from Washington Station, Workington. It appeared to be as bright as the full moon and it exhibited an orange colour. It was first seen in the south-south-west, travelling to west-south-west at altitudes from about 23° to 13°. The commencement of the flight was not witnessed, but the visible portion occupied about four seconds. When it came into view it showed a pear-shaped head which left a trail of bright sparks; no sound was heard and there were no stars visible to help in locating the path accurately. The brilliant object was also noticed by a boy at Seaton. From this place it was first seen in the south at about 25° altitude, and it passed across a window in its journey to south-west, where it glided behind trees, the tops of which are about 20° high. It was described as emitting a white light and shedding bright fragments as it traversed its course.

Tercentenary of Kepler's Death.—The tercentenary occurs this year of the death of Johann Kepler, and the May number of the *Scientific Monthly* contains an interesting review of Kepler's work by Prof. Florian Cajori of the University of California. Many of Kepler's original diagrams are reproduced, and we are reminded how unwearying was his search for harmonies connecting the planetary distances and periods. His success in deducing the three famous laws is well known, but there were very many other researches, notably the attempt to connect the spheres described on the planetary orbits with the five regular solids. The diagram in which the elliptical orbit of Mars was drawn for the first time is reproduced from "Astronomia Nova". The orbit is surmounted by a symbolical figure of Victory in a chariot.

We see how study of Tycho's beautiful series of observations led Kepler to seek for a much closer accord between theory and observation than that which he deemed satisfactory in his early researches.

Research Items.

Heredity of Polydactyly in Man.—An analysis of certain family trees showing polydactyly has been made by O. Koehler (*Biolog. Zentralbl.*, p. 705 ; 1929). He finds that, combining the total numbers of occurrences in the various families concerned, the abnormality has occurred 230 times in men and 188 in women. But this result, indicating that men are more subject to polydactyly, is due to the large numbers of males included in the older cases, and is contrary to Snyder's opinion. Whatever the incidence of the abnormality may be, it would seem that it is equally heritable through male or female lines, for the numbers of fathers and mothers who passed on the defect were identical, 56 each. Should further collections of data show that both sexes were equally capable of handing on the abnormality to their children, although it became manifest more often in males, this would support the view of the author.

Variation in Chinese Students.—A biometric study, analysing the physical measurements of a fairly representative group of Chinese students, has been made by Ju-chi Li (*Peking Soc. Nat. Hist. Bull.*, vol. 4, p. 93 ; 1930). The data consist largely of physical measurements of male gymnasium students aged between twenty and twenty-five, and comprise broad aspects, such as height, weight, width, and thickness. It was found that the student from northern China was decidedly taller in stature, thicker in chest capacity and heavier in weight. On the other hand, the southern Chinese had a slightly longer leg in relation to the total height, and proportionately slightly wider shoulders. On the whole, however, the northern type blends so gradually into the southern that it is scarcely justifiable to separate them on geographical grounds, except for such comparisons as are given in this paper. Within the individual body various correlations, more or less close, were found; width, for example, depending upon height, and girth upon width. Taken separately, the thickness of a person as measured by girth has the highest net correlation, height comes next, and width last. So that height ought not to be taken as the sole weight index, a combination of height and girth giving a much closer correlation with body weight.

Delayed Development of Embryonic Young in Martens.—One of the interesting points noted by F. G. Ashbrook and K. B. Hanson in the course of observations upon the normal breeding season and gestation period of martens (*Martes americana*), was that the embryo showed marked delay in development (U.S. Dept. Agr., *Circular* No. 10, 1930). Such a delay is unusual, but is familiar in the case of roe deer in Great Britain. Martens were observed to mate in midsummer (July and August). On Sept. 4 all females were isolated from the males, but the young were not born until April of the following year. Although it could not be determined to which of several matings conception was due, the gestation period ranged from 259 to 275 days or from 8½ to 9 months, a period excessively long compared with that of related animals of similar size and similar development at birth. Positive evidence of delayed embryonic development is suggested by the observation that female martens trapped and killed in the wild have not shown macroscopic signs of pregnancy until late in winter.

Sea Trout of South Uist.—Mr. G. Herbert Nall in his paper, "Sea Trout of South Uist. The Howmore, Kildonan, and Loch a Bharp Districts. Part 2" (Fishery Board for Scotland, *Salmon Fisheries*, 1929, No. 4), supplements his first paper of July 1928 (Fisheries, Scotland, *Salmon Fish.*, 1928, 7). Most of the former conclusions are here confirmed and the tables are brought up-to-date. The South Uist sea-trout differ from the mainland types in their rapid growth rate, shortness of life and consequently few spawning periods. The author again shows that there is no genuine spring run analogous to that of spring salmon, the fishes having almost all wintered in the loch or spent the greater part of the winter there. There is no sign of any definite movement from sea to fresh water in February or March, although occasional visits to brackish water may account for the good condition of some of them, and there may be a small interchange throughout the winter between small shoals of fishes from the coast and those from fresh water. These sea-trout do not remain in fresh water until the following autumn, but have returned to the sea by May. Of the marked fish only about 3·4 per cent were recaptured, mostly by the commercial nets.

Axial Gradients.—Dr. Silvio Ranzi in his paper "Embriogenesi e gradienti assiali" (*Memorie della Pont. Accademia delle Scienze—i Nuovi lincei*, Series 2, vol. 12, 1929) discusses the question of the axial gradients of Child—whether they truly exist in the course of embryonic development and regulate the growth, or whether they are the results of the unfolding of the embryo itself. He concludes after examining the evidence of many workers in this field that this last solution is probably right, especially in vertebrates, annelids and cœlenterates which have a cephalo-caudal or oro-aboral axis ; and, further, that the facts relating to differential susceptibility to toxic agents may be explained by the greater susceptibility of any organ at its most complex development. Dr. Ranzi's own observations have been made on the Cephalopoda, especially with regard to differential susceptibility, and he finds that the more complex the organ, the greater the susceptibility to toxic agents and the more easily and deeply are they inhibited. He failed to demonstrate in the Cephalopoda the presence of axial gradients in the susceptibility of the blastoderm to toxic agents. This paper reviews and criticises the work of various specialists on different groups of animals, ranging from planarians and cœlenterates to vertebrates. The general conclusions are (*a*) that in the embryo permeability and susceptibility are greater in those parts which are most complex and are the centres of highest metabolism, but this is limited to the period of development of these parts, and (*b*) with regard to the importance of the principal axial gradients in embryonic development, the principal gradient must be retained as an apparent result of the processes of development according to an axis (vertebrates, annelids, cœlenterates), for along this axis are centres of metabolism, the highest being usually anterior. However, the author is of the opinion that the metabolism does not increase or decrease gradually along the axis, but varies from time to time.

Tertiary Molluscan Fauna of Waiheke Island, New Zealand.—Early in 1927 a Tertiary deposit was discovered at Oneroa, Waiheke Island, near Auckland, New Zealand. Collections of the contained molluscan fauna were made and the results are now detailed in a joint paper by A. W. B. Powell and J. A. Bartram (*Trans. N. Z. Inst.*, vol. 60). The beds seem to have accumulated in small pocket-like hollows worn in the underlying Trias-Jura Greywacke terrain prior to Tertiary submergence. Owing to the large percentage of new species accurate correlation

of these beds with fossiliferous horizons in other parts of New Zealand is very difficult, but the authors give reasons for considering them to be the equivalent of the Hutchinsonian stage of the Upper Oligocene. The fauna is decidedly littoral, or shallow-water in character, two species of *Cominella* furnishing the most characteristic members. So far, 78 species have been found, of which five have been referred to recent forms and some 44 described as new. The seventeen plates, if not exactly artistic, give 109 sufficiently efficient figures which would have been more acceptable had the actual sizes of the originals been indicated beside them in some customary manner.

Duration of Eocene Time.—W. H. Bradley describes the varved sediments of the Green River formation (middle Eocene) of Colorado, Utah, and Wyoming in *Prof. Paper* 158-E of the U.S. Geol. Survey. The formation is a series of lake deposits averaging 2000 ft. in thickness. Many of the beds of marlstone, oil-shale, and fine-grained sandstone are varved, the dominant type being a pair of laminæ, one of which is markedly richer in organic matter than the other. The average thickness of the varves is about 0·18 mm., the range being from 0·014 mm. to 9·8 mm. The interpretation of the laminæ as varves is tested by analogy with modern lake deposits and by calculation of the annual thickness to be expected as judged from the data of present-day stream loads. The Green River epoch is estimated to have lasted between five and eight million years. From this and an estimate of the rate of accumulation of the fluviatile deposits above and below the Green River formation, the duration of the whole Eocene period is calculated to be between thirteen and thirty-three million years. This result is of the same order as that deduced from age determinations of radioactive minerals, but is entirely independent of them. Three cycles of greater length are suggested by fairly regular recurrences of thicknesses and characters : (*a*) averaging a little less than twelve years, probably corresponding to the sunspot cycle ; (*b*) about fifty years ; and (*c*) about 21,600 years, suggesting the average period resulting from changes of eccentricity in the earth's orbit and the cycle of the precession of the equinoxes.

Aeroplane Survey in Canada.—The use of the aeroplane for transport and reconnaissance in the North-West Territories of Canada has rapidly pushed northward for several hundred miles the area capable of development. During the last two summer extensive flights have been made in the Keewatin district to the west of Hudson Bay and in the Mackenzie district. Much preliminary prospecting of the ground has been done in this way. It is claimed that by a study of the country and especially by 'vertical' photographs examined stereoscopically the ground can be classed as promising or unpromising for more detailed investigation. The methods and routes are described in general terms in a pamphlet published by the Department of the Interior entitled "Preliminary Report on the Aerial Mineral Exploration of Northern Canada". Although the Keewatin area was found to be, on the whole, unpromising as regards minerals, a great deal of useful topographical information was obtained.

Settlement in Kenya.—The Agricultural Census of Kenya Colony (Tenth Annual Report, 1929) gives a statistical record of the progress of European settlement. The area occupied by Europeans reached about five million acres, showing an increase over that of the previous year of a little more than two per cent. The number of occupiers rose to 2035, and a further small addition gives a total of 2882 as the number of Europeans, including occupiers engaged on agricultural holdings. The numbers increase slowly and the rate has fallen from 10·37 per cent in 1924 to 3·25 per cent in 1929. Drought during the last two years is no doubt partly responsible. Nevertheless, the cultivated area of the occupied land continues to increase and is now more than eleven per cent. Maize continues to be the principal crop, but wheat has grown in importance. Sisal, hemp, and coffee promise well. A revival in the production of sugar is expected.

An Ice-Telemeter.—The necessity of recording the distribution of ice in waters frequented by vessels of commerce has led Prof. M. Kamienski to invent a simple instrument which he calls an ice-telemeter, and which is designed to afford a ready means of measuring the distance of floating ice from the observer. The instrument and its use are described in *Wiadomosci Matematyczne*, Vol. 32, and Report No. 8 of the Astronomical Observatory of Warsaw University. The instrument is a kind of sight rule about half a metre in length. A movable scale at one end is alined on the ice and the apparent horizon or a distant seacoast. The distance of the ice can then be read on the scale. Experiments over known distances have shown that the telemeter is not absolutely accurate, but near enough to accuracy for the purpose for which it is designed. It is intended for use in light ships and lighthouses of the Polish waters of the Baltic. The theory of the instrument is explained, but only a short summary of the paper is in English ; the text is in Polish.

Soil Corrosion.—Corrosion, particularly of the ferrous metals, presents a serious industrial and economic problem, and hitherto the available remedies have been quite impractical. An illustrated article by H. W. Hough entitled "Significant Developments regarding Soil Corrosion" has recently appeared in *The Scientific Monthly*, Feb. 1930, vol. 30, from which it is evident that the study of the subject has advanced materially. The electro-chemical theory of corrosion appears to be generally accepted, the rate at which hydrogen is evolved from the surface of the metal being actually proportional to the rate of corrosion. A method of soil corrosion surveys has been developed, in which soil samples are taken at intervals over the country through which a pipe line is to be laid. A topographical survey is also made, the amount of moisture, slope, and vegetation, and any local factors being taken into consideration. From a correlation of these data with the analyses of the various soil samples and their *p*H values, the degree of corrosive action in each district can be determined. The results obtained from such surveys agreed closely with those of some direct experiments carried out by the U.S. Bureau of Standards in which various metals, both treated with different paints and unprotected, were buried in different types of soil for two- or four-year periods. No one type of metal proved superior to all others in every type of soil, but it is clear that saving could be effected by a certain selection with regard to soil conditions. The inherent characteristics of the soil, however, are the dominating factors influencing corrosion.

Dependence of Raman Scattering on Frequency.—An analogy between the scattering of light without change in wave-length, and the modified scattering which constitutes the Raman effect, which is in sharp contrast to the general dissimilarity of these two processes, is given by Prof. Ornstein and J. Rekveld in the *Zeitschrift für Physik* for April 24 (p. 593). Quantitative intensity measurements were made on the Raman satellites produced by carbon tetra-

chloride on three strong blue and green lines of the mercury arc (λλ4047, 4358, and 5461). After allowing for the difference in intensity of the exciting lines, it was found that the intensity of a Raman line produced by a definite change in the molecule of carbon tetrachloride was proportional to the fourth power of the frequency of the exciting light, which is the same as Rayleigh's law for unmodified scattering. The measurements were not sufficiently exact to decide if the correct frequency to be considered was that of the exciting radiation, or that of the light which had suffered a change in wave-length in the scattering process.

Single Mirror Interference Fringes with X-Rays.—The issue of *Die Naturwissenschaften* for April 18 contains a note by W. Linnik, of the State Optical Institute of Leningrad, on the interference of X-rays in a Lloyd single mirror apparatus. A glass reflecting surface was used, as for the usual optical experiment, but the short wave-length of the X-rays made it essential to work with a slit source of very small width, and to place it unusually close to the plane of the mirror. Details of the experiment are not given, but it is stated that the slit used was only 0·1 μ wide, and that it was 2·2 μ from the mirror. Fringes of excellent definition were obtained with a spacing of 5 μ on a photographic plate at a distance of 15 cm. from the slit, from which the wave-length of the $K\alpha$ radiation of copper has been calculated to be 1·56 ± 0·03 A., Siegbahn's value for this being 1·54 A.

The Kata-Thermometer.—The applications of this instrument, invented by Prof. Leonard Hill, as well as full directions for its use, are set forth in a new pamphlet issued by the manufacturers, Messrs. James J. Hicks, Hatton Garden, E.C.1. The kata-thermometer has already proved itself to be the simplest and most useful means for checking the efficiency of ventilating systems and fully deserves its title of 'comfort meter and evaporimeter'. The pamphlet now contains a chart from which wind-velocity may be quickly derived once the reading of the dry kata-thermometer is determined. Though absolute standardisation in manufacture is impossible, each instrument is turned out with its own factor, thus rendering calibration by the purchaser unnecessary.

Mechanism of Reactions.—In a paper in the January number of the *Journal of Physical Chemistry*, by P. Robinson, the question of the mechanism of reactions is examined from the point of view of a rule proposed by the author. This states that in an isothermal system, where several reactions are possible, that reaction takes place first for which the products have the highest entropy. The rule is considered for two typical systems, namely, the sulphur system and the water system, with steam, water, and ice as the possible phases. In the latter case it is argued that if steam is brought into contact with excess of ice below the melting-point, liquid water is formed before ice, although the reaction to form ice is so rapid that the intermediate liquid phase cannot be observed. It is shown that two other rules which have been proposed do not agree with the facts in the case of some transitions in the two systems studied. These are Ostwald's rule, according to which that reaction takes place first, the products of which are least stable; and Tantzov's rule, according to which that reaction takes place first which involves the minimum change of entropy. The first does not hold when gaseous sulphur above the transition temperature passes directly into monoclinic sulphur without going to the rhombic form, and the second is in contradistinction to the fact that rhombic sulphur below the transition temperature passes directly into vapour without going through the monoclinic form. These exceptions are, however, to be expected on Robinson's rule.

Dissociation Constant of Water.—The value of the dissociation constant of water, $K_w=[H^+][OH^-]$, has been found by the conductivity of pure water, hydrolysis, and the e.m.f. of cells. The value found by the first method by Kohlrausch gave $1\cdot04\times10^{-14}$ at 25°, and this has usually been considered the most trustworthy figure, although other values, such as $1\cdot005\times10^{-14}$ found by Lewis and Randall by other methods, have more recently been put forward. In the March number of the *Journal of the American Chemical Society*, R. F. Newton and M. G. Bolinger describe some experiments on the e.m.f. of a cell containing mercurous bromide and mercuric oxide from which they have calculated the value of K_w. The result obtained was $1\cdot02\times10^{-14}$, from which it appears that the value of Kohlrausch is sensibly correct and that the newer values are somewhat too small.

Reduction of Carbon Monoxide.—Sabatier and Sanderens in 1902 showed that a mixture of carbon monoxide and hydrogen when passed over reduced nickel at temperatures above 180° was reduced, with the formation of methane: $CO+3H_2=CH_4+H_2O$. Further investigations of the reaction showed that liquid hydrocarbons were also formed in the reaction. In three papers in vol. 12 of the *Scientific Papers* of the Institute of Physical and Chemical Research, Tokyo, published in February, S. Kodama has given a summary of the literature on the subject and has described a number of important experiments on the reduction at normal pressure. Various catalysts were used, particular attention being directed to the catalytic decomposition of the monoxide with deposition of carbon. With nickel this decomposition did not occur, but it was found with other catalysts.

High Tension Testing.—Although our knowledge of the behaviour of aircraft during thunderstorms has been increased by reports on cases where they have been struck by lightning, yet there are many technical questions involved which are still difficult to answer. The hot exhaust from the engines is doubtless a likely path for the flash. The ignition system also may be broken down by the flash and the collapse or building up of a strong electrostatic field in the neighbourhood seriously adds to the fire risk. In a paper by A. O. Austin, engineer to the Ohio Insulator Company, read to the High Tension Congress held recently in Paris, an abstract of which appears in *Engineering* for April 4, an account is given of a novel equipment for open air experiments at electric pressures up to three million volts. Several years ago the company recognised that the cost of indoor tests on models at the necessary high pressures would be prohibitive. The laboratories have been built to enclose a courtyard one side of which is open and faces the testing ground, which is 1000 feet long and 400 feet wide. The high tension equipment consists of three 750 kilovolt transformers of identical types which can be connected in series. The bushing of the highest voltage transformer is fifty feet above the ground. They have been operated when the crest voltage is well over three million volts. It was found that at pressures greater than two million volts it was very difficult to prevent 'flash-overs' from the mains. For the artificial lightning tests the transformers charge a very large air condenser. By distance control the voltage of the generators is gradually increased until the flash-over at the impulse gap takes place.

The Tatem Laboratories at University College, Cardiff.

UNIVERSITY College, Cardiff, was honoured on May 21 by a visit from H.R.H. the Prince of Wales, Chancellor of the University of Wales, for the purpose of opening the new laboratories of chemistry and physics and inspecting the Advisory and Research Department of Agriculture and the Institute of Preventive Medicine of the Welsh National School of Medicine.

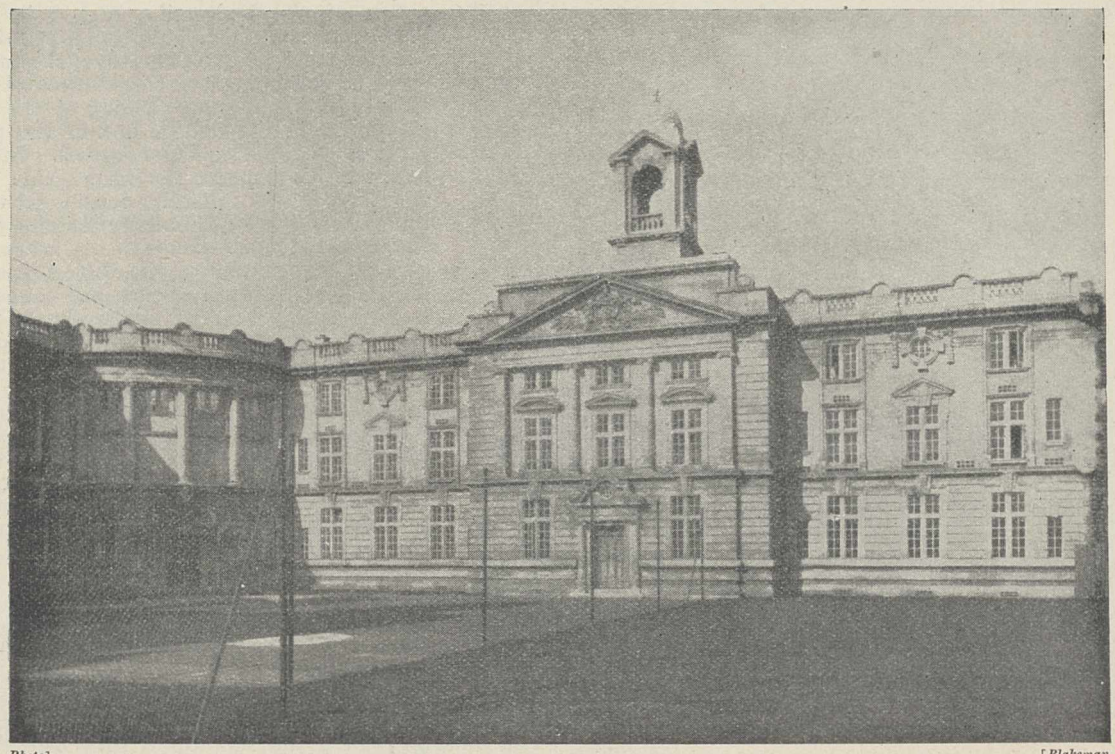
The laboratories of chemistry and physics constitute the north wing of the College buildings in Cathays Park, Cardiff, the civic quarter of the city, which is exclusively devoted to public buildings designed to form an harmonious ensemble. Long projected and long delayed by the great rise in the costs of building since the War, these laboratories are the culmination of an effort of local patriotism which the depressed state of industry in South Wales has made trebly difficult. Nevertheless, they are only an instalment of the completed plan. The arts and administrative sections of the College have been housed upon the Cathays Park site since 1909, but it yet remains to erect the south wing, to accommodate botany, zoology, and geology, which are still in their old quarters in Newport Road, as well as to put up the Great Hall of the College on the fourth side of the quadrangle.

The new wing which has been formally opened by the Prince, was designed by Mr. W. D. Caroë, the architect of the main buildings. In it, chemistry and physics are accommodated together in close association and in a manner really worthy of the intellectual and industrial importance of modern studies in these subjects.

The Department of Chemistry occupies the basement and the first and second floors. The first floor comprises a qualitative laboratory for 102 students, a quantitative laboratory for 60 students, two organic laboratories for 60 and 30 students respectively, three balance rooms, combustion room, an electrochemical laboratory, store and service rooms, a library, and staff private rooms.

On the second floor are two physico-chemical laboratories, a dark room, three research laboratories, a workshop, and two lecturers' rooms. The basement, approached by a cart-way from the street, provides a store for acids, solvents, and heavy chemicals, with communication by lift to the laboratories and to further capacious store rooms on the upper floors.

At the present moment the building of the chemical lecture theatres, preparation rooms, and museum is not being proceeded with, although the foundations of the whole block have been laid.



Photo] [*Blakeman.*

FIG. 1.—Physics and Chemistry Laboratories.

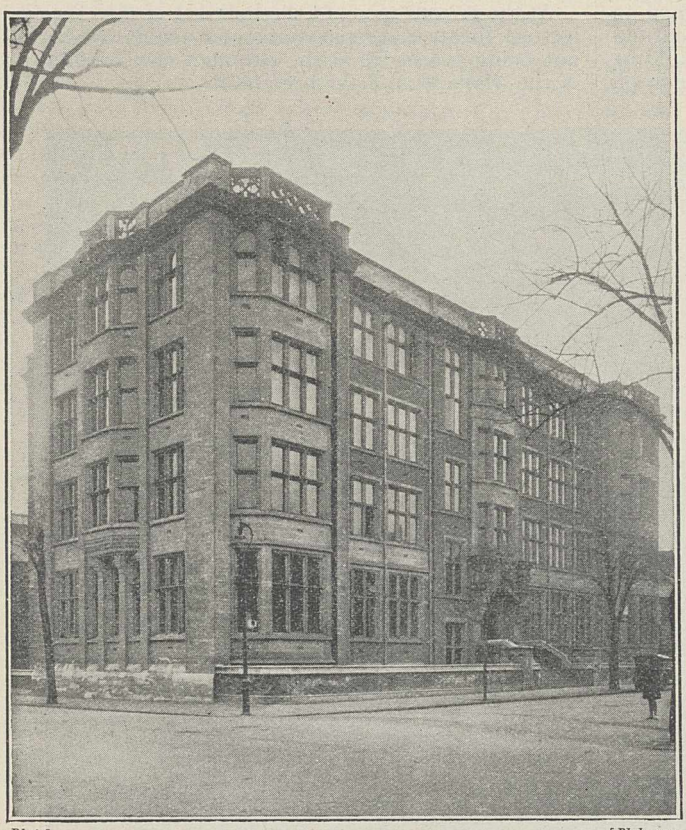
Special attention has been given to efficient ventilation. Each series of fume chambers is independently exhausted by fans to the roof, while the rooms are fitted with a specially designed system of air-flues, also connected to a large exhaust-fan on the roof. Accessibility of water, gas, electric, and drainage services has been secured wherever possible. In the larger laboratories, ridge and furrow top-lights have been employed, ensuring exclusively north lighting. The benches in the large laboratories have been arranged on the island principle and their low superstructures facilitate supervision of large classes.

The physics accommodation occupies the whole of the ground floor, with an additional six rooms on a mezzanine floor. As the new laboratories communicate directly with the ground and first floors of the Viriamu Jones Memorial Research Laboratories, the Physics Department is now, after many years, once more housed under one roof, with, obviously, very great advantage to all concerned.

As in the case of chemistry, the present accommoda-

tion represents only a stage in the complete scheme. Another wing is to be provided, with a large lecture room, workshop, additional research accommodation, and small laboratories for special research. The present building contains a small lecture room and a temporary workshop, which is, however, very well equipped. Other small rooms, originally planned for special experimental work, have had to be used for routine work by honours students, as a result of the large increase of the honours school.

The greater part of the physics for intermediate and final degree students is accommodated in three large, well-lighted rooms, each approximately 30 ft. by 50 ft.



Photo] [*Blakeman.*

FIG. 2.—Institute of Preventive Medicine.

Except in the case of the junior laboratory, large, fixed benches in the centres of the rooms have been entirely avoided. The essential gas and electric services are led to a series of light-posts, about 4 ft. high, around which working tables are grouped as required. This arrangement, with its obvious flexibility, has proved very satisfactory in practice.

The senior electrical work is provided for by two fairly large electrical laboratories. These were originally intended to be reserved for final and honours students respectively, but a certain amount of overflow has been inevitable. Four darkened rooms are provided for optical experiments and there are smaller rooms for experiments which cannot conveniently be carried out in the general laboratories.

Electrically, the laboratories are very well supplied with lighting and power points for 200-volt D.C., while 200-volt, 50-cycle alternating current is available also at a number of points. The galvanometer lamps are supplied with 12-volt A.C., stepped down from the municipal A.C. supply. Steady current for experimental work is derived from a battery of seventy 250 ampere-hour accumulators. This battery feeds, through a terminal board of special design, 28 points and sub-switchboards in the teaching and research laboratories. Any voltage from 10 volts to 140 volts, in steps of 10 volts, can be supplied to any point. Large currents over a wide range of voltages can be supplied through the same board, from either a large or a small motor generator, installed in the switchboard room.

The building of these laboratories on such a scale was made possible by the generosity of a number of public men in South Wales. The chief donors were Lord Glanely, sometime president of the College, and his successor in that office, Sir David Llewellyn, Bart.

His Royal Highness was received by Lord Treowen, president of the College; Principal J. F. Rees; The Hon. W. N. Bruce, Pro-Chancellor of the University of Wales, and others. He inspected the statues of His Majesty the King and of himself as Chancellors of the University, niched in the College facade, which had been unveiled by Lord Glanely prior to His Royal Highness' arrival. Lord Treowen then addressed the Prince, giving a short history of the development of the College and of the progress of its Building Fund Appeal. In the course of his response the Prince said: "At one time it was generally considered that the chief object of university training was the preparation of students for academic careers, but nowadays the importance of the relation between science and industry is more clearly realised, and we know how valuable a contribution scientific training makes to our commercial and industrial welfare. Close co-operation between leaders in academic life and the controllers of great business concerns is in the best interests of the country, and from its universities in future will go forth not only the teachers of the generations to come but also—and this is just as essential — young men well equipped by their training to maintain our vital supremacy in commerce and industry."

Lord Glanely then announced that he had decided to increase his benefaction by the sum of £20,000, which would wipe out the debt on the existing building and provide a capital sum for maintenance, while on behalf of himself and Sir William Reardon-Smith, he also announced the foundation of three new scholarships. The Prince then announced a further donation from Mr. Dan Radcliffe, treasurer of the College, of another scholarship and a capital sum of £5000.

Finally, the architect, Mr. W. D. Caroë, handed the key to His Royal Highness, who declared the building open. Prof. H. R. Robinson (physics) and Prof. W. J. Jones (chemistry) were then presented and accompanied the Prince in his inspection of the Laboratories.

Afterwards, a short visit was paid to the Advisory and Research Department of Agriculture, a block at the south end of the main facade of the College, which also owes its existence to the great generosity of Lord Glanely. Here there are three floors, containing the offices of the advisors in veterinary science, agricultural botany, and agricultural zoology respectively, together with a large joint Museum and three laboratories, as yet unfurnished, which it is intended to devote to research in problems ancillary to agriculture.

In the afternoon the Prince paid a visit to the Institute of Preventive Medicine of the Welsh National School of Medicine in The Parade. The foundation

stone of this Institute was laid by His Royal Highness in 1921, on the occasion of his installation as Chancellor of the University of Wales.

The present visit enabled Sir William James Thomas, Bart., the donor of the Institute, to hand over the title-deeds of the building to the University College of South Wales and Monmouthshire.

The Institute comprises four storeys and a basement, and contains, beginning at the top floor, first, the Department of Tuberculosis, supervised by Prof. Lyle Cummins, the David Davies professor of tuberculosis in the School of Medicine and Director of Research to the King Edward VII. Welsh National Memorial (Tuberculosis) Association. On the second floor is the Department of Pathology, at present in charge of Dr. J. B. Duguid, the chair being vacant. The first floor is devoted to the Department of Preventive Medicine, in charge of the Mansel Talbot professor, Dr. E. L. Collis, who is also Director of the Institute. Lastly, the ground floor is occupied by the joint City and County Laboratory of Public Health. This is a most valuable feature of the organisation, since it is housed here alongside of the Department of Preventive Medicine and the materials, equipment, and personnel of the public laboratory are available as part of the organisation of the teaching department.

The Research Scheme of the Institute of Brewing.

IF we except the research work carried out with the object of elucidating medical problems, there are no other investigations of so comprehensive a character as those concerned with malting and brewing. The problems here presented are connected with biology, chemistry, physics, and engineering, and the knowledge gained is of service, not only in the branches of technology for which they are undertaken, but they also find application in many other directions. To take but one instance, the study of fermentation has produced results of incalculable benefit to mankind in general; for cannot we trace our present knowledge of zymotic disease to the researches of Pasteur on wine, beer, and vinegar? It is therefore of the highest importance to review the knowledge that is being collected by those who are working under the Research Scheme of the Institute of Brewing, an outline of which is given in the Memorandum for 1930 which was issued a short time ago.

An important part of the researches on barley is concerned with the production of new varieties and the Institute is, in this connexion, closely associated with the National Institute of Agricultural Botany, Cambridge, as well as with the Rothamsted Experimental Station, Harpenden and Woburn; nor must we omit to mention the valuable work on barley breeding carried out by Dr. E. S. Beaven. The Institute is collaborating with the research staff of the Distillers' Company in tracing the changes that occur in the protein and carbohydrate constituents during the development of the grain and during the malting process. The metabolism of the proteins of barley in the germination process is being studied at Rothamsted by Dr. R. L. Bishop, whose results are of far-reaching importance and interest to both pure and applied science. Manuring experiments on barley and on hops are being carried out and the crops submitted to small-scale brewing trials in the laboratory. The breeding of new varieties of hops has for many years been carried out by Prof. E. S. Salmon of Wye College. Some of the new varieties obtained have been put through brewing trials by well-known brewery firms.

Methods for determining the brewing and antiseptic properties of hops have been devised by Mr. A. Chaston Chapman (chairman of the Research Committee), by Messrs. Ford and Tait, Prof. F. L. Pyman, Dr. T. K. Walker, and Mr. J. J. Hastings. The diseases to which hops are subject are being studied by Prof. Salmon and his colleagues. Mr. A. H. Burgess is engaged in experiments on the drying of hops, and he has specially studied the processes in vogue at Czechoslovakia.

Researches on yeast were commenced at the Imperial College of Science and Technology by the late Prof. S. B. Schryver. This work, as well as that on the nitrogenous constituents of wort, which was interrupted by the untimely death of Prof. Schryver last year, is being continued by other investigators.

The existing methods of estimating starch in barley and in malt are being revised by Prof. A. R. Ling and new methods are being devised. This work, it is hoped, will be published very soon. Prof. Ling is also working on the carbohydrates of barley and malt other than starch.

This activity in research, under the able direction of Mr. H. Lloyd Hind, must commend itself alike to all scientific workers.

University and Educational Intelligence.

CAMBRIDGE.—Mr. M. H. A. Newman and Mr. A. S. Besicovitch have been reappointed University lecturers in mathematics; Mr. W. M. Smart, of Trinity, and Mr. A. E. Ingham, of Trinity, have been appointed University lecturers in mathematics. Mr. T. G. Bedford, of Sidney Sussex, has been reappointed University lecturer in physics, and Mr. J. D. Bernal, University lecturer in structural crystallography.

Mr. E. B. Worthington, of Gonville and Caius College, has been elected to the Balfour Studentship.

The Vice-Chancellor has published a letter from the Universities Bureau of the British Empire in which it is stated that the executive committee of the Bureau has been asked by the Trustees of the Josefine and Eduard von Portheim Foundation to make grants to enable one or more graduates of universities of Great Britain and Ireland to take a post-graduate course or undertake research in the University of Heidelberg. Preference on the occasion of the first election will be given as between candidates of equal merit to a student proposing to work in mineralogy or crystallography in the Mineralogical Institute founded and directed by Prof. V. Goldschmidt.

New regulations for the Economics Tripos will come into effect next year. Under the new scheme, the first part of the Economics Tripos will become a one-year course and the second part will, normally, take two years, although candidates coming from another Tripos in their third year will be allowed, if they wish, to take it in one year but with a reduced number of papers. The objects of the change are to throw the emphasis more on the second part than it is at present, getting thereby a higher standard of advanced work, and to strengthen the political side by putting in a practically compulsory paper on the principles of politics.

LONDON.—The following appointments have been made: Prof. H. R. Robinson, since 1926 professor of physics at University College, Cardiff, to the University chair of physics tenable at East London College; Dr. J. W. Munro, who has since 1926 been responsible for the control of the Imperial College Biological Field Station at Slough and for the direction there of a research for the Empire Marketing Board, to the University chair of entomology tenable at the

Imperial College (Royal College of Science); Prof. P. G. H. Boswell, since 1917 Herdman professor of geology in the University of Liverpool, to the University chair of geology tenable at the Imperial College (Royal College of Science).

The following doctorates have been conferred: *D.Sc. in chemical technology:* Mr. D. M. Newitt (Imperial College—Royal College of Science); Mr. D. T. A. Townend (Imperial College—Royal College of Science and East London College); *D.Sc. in chemistry:* Mr. M. Q. Khuda (Imperial College—Royal College of Science); *D.Sc. in psychology:* Mr. A. S. J. M. Huggett (St. Thomas's Hospital Medical School); *D.Sc. in mathematics:* Mr. R. C. J. Howland.

MANCHESTER.—Prof. J. M. F. Drummond, Regius professor of botany in the University of Glasgow, has been appointed Harrison professor of botany and director of the botanical laboratories in the University on the retirement of Prof. F. E. Weiss. Prof. Drummond was educated at King's College, London, and at Gonville and Caius College, Cambridge. He gained a first class in Part II of the Natural Science Tripos in 1904 and was elected to the Frank Smart research studentship, which he held for two years while engaged on research on photosynthesis with Dr. F. F. Blackman. He was appointed as lecturer in botany at Armstrong College, Newcastle-upon-Tyne, in 1906, and became senior lecturer in plant physiology in the University of Glasgow in 1909. On the establishment in 1921 of the Scottish plant-breeding station at Corstorphine, Midlothian, he was appointed as its first director, and resigned in 1925 on appointment to the Regius chair of botany at Glasgow. While Prof. Drummond's botanical interests cover a wide range, his original investigations have been especially concerned with plant physiology and genetics. The University already possesses at the Firs in Fallowfield experimental grounds which it is hoped Prof. Drummond will be able to develop still further on lines useful to the promotion of horticulture and agriculture.

Dr. John Walton, lecturer in botany, has been appointed a senior lecturer as from September next.

The Council has gratefully accepted the offer of the Manchester Medical Society to present to the University its medical library. This library has been housed in the University since 1875, and for a number of years has been supported jointly by the Manchester Medical Society and the University. Provision has been made for the members of the Manchester Medical Society to continue their use of the library, and the Society has undertaken to make an annual grant towards the cost of maintenance.

At the celebration on May 23 of the jubilee of the University and the eightieth anniversary of the foundation of Owens College, the honorary degree of D.Sc. was conferred on Prof. J. Lorrain Smith, professor of pathology and dean of the faculty of medicine in the University of Edinburgh, and Prof. A. Smithells, director of the Salters' Institute of Industrial Chemistry, London.

THE Secretary of State for the Colonies will in June and July next award post-graduate scholarships in agriculture and agricultural science tenable for from one to two years, and post-graduate scholarships in veterinary science tenable for from one to four years. The annual value of each scholarship will be £250 plus a certain allowance for expenses. Application forms, etc., may be had from the Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1, to whom the completed forms must be returned before June 15.

Historic Natural Events.

June 1, 1924. Floods.—In consequence of heavy rains on the night of May 31–June 1, exceeding four inches in parts of Shropshire and Worcestershire, severe floods occurred in western England. Worcester was flooded and the Three Counties' Agricultural Show had to be abandoned.

June 2–4, 1666. Abnormal Audibility of Gunfire.—On June 2 Pepys wrote: "Into the Parke, and there we could hear the guns from the fleete most plainly". But the guns were not heard on the coast, and the yacht *Katherine*, which came into the Thames on that day, heard no firing. On June 4 Pepys added: "So walking through the Parke we saw hundreds of people listening at the Gravell-pits, and to and again in the Parke to hear the guns, and I saw a letter, dated last night, from Strowd, Governor of Dover Castle, which says that the Prince (Rupert) come thither the night before with his fleete, but that the guns which we writ that we heard, it is only a mistake for thunder; and so far as to yesterday it is a miraculous thing that we all Friday, and Saturday and yesterday, did hear everywhere most plainly the guns go off, and yet at Deale and Dover to last night they did not hear one word of a fight, nor think they heard one gun. This, added to what I have set down before the other day about the *Katherine*, makes room for a great dispute in philosophy, how we should hear them and they not, the same wind that brought it to us being the same that should bring it to them: but so it is." This is probably the first definite reference to the 'zone of silence' in the audibility of gunfire.

June 4, 1783. Honey Dew.—Under this date Gilbert White records ("Natural History of Selborne") "Vast honey dews this week. . . . My honeysuckles, which were one week the most sweet and lovely objects that eye could behold, became the next the most loathsome, being enveloped in a viscous substance, and loaded with black aphides or smother-flies."

June 5, 1692. Heavy Rain.—It is related that the capture of Namur on June 5, 1692, after a siege of only ten days, was largely due to heavy rains which prevented the English army from crossing the river and engaging the besieging French army.

June 5, 1784. Thunderstorm.—A violent thunderstorm is described in White's "Natural History of Selborne". It began about 2.15, moved from south to north, with convex pieces of ice three inches in circumference which did great damage to windows and tiles. At the same time a torrent of rain flooded the meadows; the hollow lane towards Alton was so torn and disordered as not to be passable, rocks being removed that weighed two hundredweight.

June 7, 1573. Hailstorm.—Between 1 and 2 P.M. a violent hailstorm broke over Towcester in Northamptonshire, in which six houses were destroyed and fourteen others greatly damaged by floods. The hailstones were square and six inches in circumference.

June 7–8, 1111. Torrential Rain in Belgium.—"On June 7, at the hour of nine, there broke above Robermont (near Liège) three of the blackest rain-clouds, which broke very suddenly, so that all was washed away in the city of Liège; it carried off houses, men and women into the River Meuse. And the next day, which was Sunday, there came great black clouds which broke over the great church." The lightning did a great deal of damage to the building, and killed a clerk who was reading from the pulpit, and a worshipper who was on his knees praying before the crucifix.

June 7, 1692. Earthquake in Jamaica.—Port Royal, then the capital of Jamaica, was destroyed by an

earthquake, 3000 lives being lost. Three-fourths of the buildings in the city and the ground they stood on sank entirely under water. Large storehouses on the harbour side were afterwards found 24-48 feet below the sea-level. A tract of land round the town, about 100 acres in area, sank during the first shock and the sea immediately flowed in.

June 7, 1922. Fata Morgana in Hungary.—At Nagyhortobagy, Hungary, across a grassy plain with huts, hills, and a well in the distance, all the objects were elevated and in great unrest. At several places water surfaces appeared in lively movement with waves moving from west to south-west. The huts and hills appeared above the water, and then disappeared from time to time. A herd of horses driven to the well appeared to advance and then back, and the herdsman and his horse seemed to make an undulating movement, whereas in reality they stood near the well. At the time the sky was one-third covered with cumulus cloud, and a light wind was blowing from the north.

Societies and Academies.

LONDON.

Royal Society, May 22.—G. H. Parker: The ciliation of the Fallopian tubes. In the rabbit, spermatozoa travel through the uterus by their own locomotory powers and ascend the Fallopian tube in the main by counter-currents (the return flow from the ciliary currents). The eggs press on the ciliated surfaces of the Fallopian tube and descend through this tube chiefly by ciliary action; peristalsis may also play a part. In the turtle and pigeon the oviduct is lined with cilia most of which beat toward the exterior; but there is also a narrow longitudinal band of cilia which beat toward the ovary and thereby carry spermatozoa to that organ.—D. Keilin: Cytochrome and intracellular oxidase. Neither component *c* of cytochrome from yeast cells, a clear solution of deep-red colour, nor oxidase of heart muscle preparation will oxidise cystein. The two together form a powerful catalytic system, which can rapidly oxidise cystein. The catalytic system thus reconstructed behaves like a true respiratory system of the cell.—L. E. Bayliss, E. Boyland, and A. D. Ritchie: The adductor mechanism of *Pecten*. The slow part of the adductor can be isolated from the nervous system in a completely relaxed state in *P. magellanicus*; stimulated electrically it gives twitches, which can be fused to form tetanus. Large tensions are developed. In *P. maximus* and *P. opercularis* different nervous connexions make it difficult to isolate the muscle without some 'contracture'; apart from this the muscles are similar to *P. magellanicus*. The state of 'contracture' is a result of reflex excitation which survives isolation, but may be abolished by direct faradic stimulation. Tensions in 'contracture' are much less than the maximum obtainable. Reflex movements of intact animals suggest that for the most part the muscle is contracting tetanically. The quick muscle with single induction shocks gives a rapid twitch that resembles normal reflex contraction.—H. E. Roaf: Visual acuity in light of different colours. Definition with short wave-lengths is less accurate than with medium or long wave-lengths. That relative intensities, chromatic aberrations, and scatterings of lights can be the whole cause of the observed poorness of visual acuity with short wave-lengths seems improbable. More likely a lesser density of specific receptors per unit of retinal area is involved. With colour filters in front of certain receptors, 'blue' may stimulate only some of them, whilst longer wave-lengths can stimulate a larger number per unit area; or the difference might be due to a number of rods being linked to a single ganglion cell, whilst there may be a separate ganglion cell for each cone. Evidence is given that the receptors limited to reception of short wave-length stimuli are the rods.—Sir Charles Sherrington and J. C. Eccles: Numbers and contraction-values of individual motor-units examined in some muscles of the limb. Contraction-tension for the average motor unit was examined by dividing tension of maximal contraction into number of nerve fibres in the muscle-nerve. Figures obtained were: *gast. med.*, 30·1 gm.; *soleus*, 9·9; *semitend.*, 5·5; *ext. l. dig.*, 8·6. In all nerves examined analysis of fibre sizes shows two peaks of numerical preponderance, centred on two fibre sizes rather far apart; thus *gast. med.* 15 μ and 6 μ, as measured. Of the group of efferent myelinate fibres entering the muscle, many exist several centimetres proximal to muscle; approaching the muscle additional myelinate fibres appear. Afferent fibres examined exhibit increase in number, as followed in nerve trunk before reaching muscle. Approximate estimates of number of motor units composing type muscles are: *gast. med.*, 430; *ext. l. dig.*, 330; *soleus*, 250.

Royal Meteorological Society, May 21.—Sir Gilbert T. Walker: Seasonal foreshadowing. Some applications of the tables of relationships given in previous studies of world weather. The southern oscillation affects the winter temperatures of south-west and north-west Canada as well as the summer rainfall of South Africa and Australia, and the total correlation coefficients found are 0·71, 0·72, 0·72, and 0·79; these would seem to justify prediction in general terms in nearly half the years of a long series.—A. C. Best: Instruments for obtaining dry and wet bulb temperatures. A modified form of the Casella type psychrometer is described in which the aspiration, effected by a small electric motor, has the value of 5 metres per second as compared with 1·5 m. per second in the usual instrument. This psychrometer will run for about eight minutes in air having a relative humidity of 33 per cent before the wet bulb dries up. The results of comparing the depressions given by these two psychrometers, two types of sling psychrometers and a Stevenson screen are given.

PARIS.

Academy of Sciences, April 14.—Ernest Esclangon: The position of the celestial body at present supposed to be a trans-Neptunian planet. Application of a parallactic method to observations made at the Paris observatory.—André Blondel: Symmetrical alternators connected with an unsymmetrical network or line.—Léon Guillet and Jean Cournot: Remarks on cold hardening and the annealing of metals and alloys. A discussion of two recent communications by Guichard, and by Claussmann and Billon.—F. Gonnessiat: The position of the Lowell planet obtained with the photographic equatorial of the Observatory at Algiers.—P. Pfeiffer: The operators of a complete system of linear and homogenous partial differential equations of the first order of an unknown function.—Radu Badesco: The distribution of the values of a holomorph or meromorph function.—Elie Cartan: The third fundamental theorem of Lie.—Nicolas Théodoresco: The determination of the velocities as a function of the vortices in the case of a fluid in two dimensions.—Basile Demtchenko: A method of calculation of surfaces of slipping.—P. Dupin and M. Teissie-Solier: Alternating vortices in non-turbulent and in turbulent regime.—F. Bordas and E. Roelens: Alcoholometric corrections for temperatures below 0° C. The range of temperature covered by the experiments was +15° C. to −30° C.—

J. Dorfman : The magnetic moment of the nucleus of the atom.—L. Andrieux : The preparation of thallium by the electrolysis of its oxides. Pure thallium can be prepared by electrolysing its oxides dissolved in boric anhydride (950° C.), in alkaline borates (855°-880° C.), or in mixtures of borates and fluorides of the alkali or alkaline earths (900°-950° C.).—Marcel Chatelet : Mixtures of vapours of iodine and of various solvents. The absorption spectrum of the gases arising from the vaporisation at 90° C. of a solution of iodine in benzene gives an absorption band which belongs neither to the vapour of iodine nor to that of benzene. A molecular association is assumed to explain the results. —René Dubrisay, René Arditti, and Charles Astier : Some transformations produced by the phenomena of absorption.—F. Vlès and N. Kyvelos : The spectral properties of the benzoate as a function of the concentration of neutral salts.—Jean Cournot : The influence of the treatment of steels in solutions of complex phosphates with subsequent varnishing, on their electrical insulating properties.—André Courty : Tests of casting, under constant pressure, of aluminium and alpax. The effects of temperature of the liquid metal, temperature of the mould, and time of heating before pouring were studied separately.—Jean Challansonnet : The dilatometric analysis of some synthetic cast irons with nickel, vanadium, and nickel-vanadium. These alloys were prepared in a high frequency induction furnace with five metals, and contained 0·08 per cent silicon and only a trace of phosphorus. Vanadium raises the temperature of graphite formation of a pure cast iron ; it counteracts the graphitising effect of nickel, one part of vanadium annulling the effect of four parts of nickel.—Pierre Urbain : A quantitative method of spectrographic analysis. The method described was designed to deal with quantities of gold of the order of 0·001-0·005 mgm. and is based on the simultaneous electrolytic deposition on a carbon rod of the gold and a known quantity of silver. This rod is used to obtain spark spectra, and the relative strengths of the silver and gold lines measured with a recording microphotometer.—L. Palfray and B. Rothstein : The 1·3 and 1·4 cyclohexanediols. Constitution of the halogen derivatives.—Jean Thibaud and F. Dupré la Tour : Study of the polymorphism of the crystals and the orientations of the fatty acids as a function of the temperature. From a study of the X-ray spectra it is concluded that the saturated fatty acids can be obtained in two principal well-defined crystalline forms presenting important differences in their physical properties, especially in the refractive index. —Henri Vincienne : The structural relations between the Rochers de Léaz (Ain) and the Vieux Château d'Arcine (Haute-Savoie) and the Vuache. Conclusions on the tectonics of this chain.—M. Loeper, A. Lemaire, and A. Mougeot. The function of the glycogen in the activity of the snail's heart.—André Giberton : The synthesis of fats in the presence of pancreas extracts.—Georges Blanc and J. Caminopetros : The transmission of the variole of birds by mosquitoes.

ROME.

Royal National Academy of the Lincei, Feb. 2.—Gino Fano : Nets of linear complexes of the space S_5.—G. Armellini : The modern theory of the evolution of the stars. Many data based on observation show that, during the first phase of their existence, stars are of great volume, very low density, and intense brightness. The latter diminishes slowly and continuously, and the density increases, whilst the effective temperature of the photosphere, measured spectrophotometrically, rises to a maximum and then begins to fall.—C. Somigliana : The external gravitational field of the ellipsoidic geoid. The determination of the lines of force in the field external to the ellipsoidic geoid by integration of the differential equations of these lines is difficult, since the potential function is not harmonic, so that neither Beltrami's ordinary theory of symmetrical potential functions for the case of the ellipsoid of rotation, nor Jacobi's theorem is applicable. Various properties of the field may, however, be developed by comparatively simple calculations.—U. Cisotti : Plane electrostatics. —A. Tonolo : Intrinsic form of the equations of the equilibrium of elastic media (1).—R. Cacciopolli : A question of stability.—S. Cherubino : Observations suggested by a theorem on real Abelian varieties.—Rina Baldoni : Systems of principal normals to a variety in its π_3 (2).—Pia Nalli : Generalised derivations and classification of Riemannian spaces.—M. Brelot : The notion of a point source of heat in a radiating plane in thermal equilibrium.—J. Geronimus: A formula of Tchebycheff.—N. Théodoresco : Steps in a theory of the functions of a complex variable in the general sense (1).—E. Gugino : The incipient motion of systems with reversible linkings.—E. Carafoli : Theoretical considerations on 'flat spinning' (aerodynamics).—U. Barbieri : Astronomico-geodetic station of Eremo di Cherasco (1).—A. Quilico and M. Freri : A new method of formation of pyrrole blacks. One of the most striking facts on which the analogy between phenol and pyrrole is based is the ease with which pyrrole and its homologues couple with diazo-compounds. This analogy is strengthened by the observation that addition of pyrrole to an alcoholic or glacial acetic acid solution of a diazonium salt, cooled and stirred, results in a very dark, reddish-violet solution, which soon deposits a deep black powder resembling pyrrole blacks but, unlike these, almost insoluble in alkalis.—R. Masini : The Rhætic in the Valle della Lima.—G. B. Cacciamali : Possible investigations in the subsoil of Lombardy.—M. Fenoglio : Presence of nesquehonite in the serpentine of Viù in Val di Lanzo. The possibility of a genetic connexion of the comparatively rare mineral, nesquehonite, with other hydrated magnesium carbonates is considered. It is, however, regarded as more probable that nesquehonite is formed at the ordinary temperature and pressure, and that artinite and hydromagnesite are produced at somewhat higher temperature and pressure.—G. Mezzadroli and E. Vareton : Action of ultra-violet rays on the germination of seeds and on the growth of plants. Ultra-violet rays of short wave-lengths—less than 3000 A.— exert a harmful influence on the germination of seeds and on the development of plants. At short range, the total ultra-violet rays emitted by a quartz mercury vapour lamp exhibit a similar injurious action, even when the exposure is of only brief duration. If the seeds and plants are placed at an oblique distance of 50 cm. from the lamp, short exposures of 1-5 minutes produce favourable effects, but more protracted exposures, unfavourable effects.—M. Comel : Can strontium be fixed by the tissues ? The results of experiments with hens and rats fail to indicate any appreciable fixation of strontium in the tissues.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 1, Jan. 15).—E. S. Castle : The light-sensitive system as the basis of the photic responses of *Phycomyces*. The relation of the 'light-growth' response and the phototropic response is investigated by noting the variation of latent period, which is common to both effects, with change of duration of exposure. The changes of each response are similar and it is concluded that they have the same functional basis.—

H. C. Ramsperger and R. C. Tolman: The rate of decomposition of nitrogen pentoxide at very low pressures. A 45-litre flask was used and a pressure gauge depending on the change of capacitance of a condenser, one plate of which is attached to a mica diaphragm in contact with the gas the pressure of which is to be measured. The rate of homogeneous decomposition is of the first order, but when glass tubing is introduced into the reaction vessel to increase the surface, there is a falling-off of specific reaction rates.—James A. Beattie: A new equation of state for fluids. (4) An equation expressing the volume as an explicit function of the pressure and temperature.—George L. Clark and Lucy W. Pickett: Crystal structures of some derivatives of diphenyl. X-ray studies of diphenyl, dimesityl and *o*-tolidine.—Oliver R. Wulf: The temperature coefficient of the photochemical formation of hydrogen chloride.—E. L. Nichols and Frances G. Wick: Ozone in luminescence. Several thermo-luminescent substances activated by X-rays or cathode rays, after treatment with ozone, suffer diminution in brightness. Activation by X-rays is a reducing effect; when the reduced product is comparatively stable at room temperature but oxidises rapidly and spontaneously on heating, thermo-luminescence occurs. The effect of ozone is hence due to partial re-oxidation.—Paul S. Epstein: Geometrical optics in absorbing media. A general discussion which has particular significance in the transmission of radio waves in the upper atmosphere.—Edwin H. Hall: Recent progress in the dual theory of metallic conduction. The numerical results, with recent data, of applying the theory to the relation between electrical conduction, thermal conduction, and Thomson and Peltier effects in eighteen metals, including two alloys.—F. S. C. Northrop: Two contradictions in current physical theory and their resolution. A theoretical examination, as a result of which a macroscopic atomic theory is proposed whereby the electrons and protons of the whole of Nature are surrounded by one large finite spherical macroscopic atom. Among the consequences are that the universe is finite, there is a physical ether, a new geometry is required, the motion of the microscopic atoms in the macroscopic atom is absolute and the second law of thermodynamics cannot be valid for the whole of Nature.—H. E. White: Theoretical interpretation of hyper-fine structure in singly ionised thallium, Tl II.—Theodore Lyman: The distribution of light intensity in a Fresnel diffraction pattern from a straight edge. A diffraction system was illuminated by monochromatic light and intensities registered on a photographic plate measured by a photometer. The agreement between theory and experiment are within the limits of error.—Frank Morley and Henry A. Robinson: Note on range-finding. A mathematical discussion for obtaining the co-ordinates of the source of sound.—Ernest W. Brown: Applications of an expansion theorem to the development of the disturbing function.—Hillel Portisky: On certain polynomial and other approximations to analytic functions.—G. A. Miller: Groups which admit two-thirds automorphisms.—Aristotle D. Michal: Differential geometries of function space.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society. Series A, Vol. 127, No. A805, May 7. Pp. 239-479. (London: Harrison and Sons, Ltd.) 8*s*.

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1929, presented to the Annual Meeting, February 10th, 1930. Pp. 43+13. (York.)

Department of the Interior: North West Territories and Yukon Branch. Preliminary Report on the Aerial Mineral Exploration of Northern Canada. By G. H. Blanchet. Pp. 32. (Ottawa: F. A. Acland.)

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 2, No. 8: A Case of Intersexuality in *Bos indicus*, with a Theory of the Significance of the Genetic Male Intersex. By D. R. R. Burt. Pp. 113-129+2 plates. 2*s*. Vol. 50, Part 2, No. 9: Studies in Translocation. No. 1: Movement of Food-materials in the Swedish Turnip. By John Caldwell. Pp. 130-141+1 plate. 1*s*. 6*d*. Vol. 50, Part 2, No. 10: The Morphology of *Trichomanes aphlebioides* Christ, with special reference to the Aphlebioid Leaves. By Dr. S. Williams. Pp. 142-152+1 plate. 1*s*. 6*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

FOREIGN.

Field Museum of Natural History. Anthropology Memoirs, Vol. 1, No. 2: A Sumerian Palace and the "A" Cemetery at Kish, Mesopotamia, Part 2. By Ernest Mackay. (Field Museum—Oxford University Joint Expedition.) Pp. 65-215+plates 21-62. (Chicago.)

Second Bibliography and Catalogue of the Fossil Vertebrata of North America. Vol. 2. By Oliver Perry Hay. (Publication No. 390.) Pp. xiv+1074. (Washington, D.C.: Carnegie Institution.) 8 dollars.

Plant Competition: an Analysis of Community Functions. By Frederic E. Clements, John E. Weaver and Herbert C. Hanson. (Publication No. 398.) Pp. xvi+340+32 plates. (Washington, D.C.: Carnegie Institution.) 3.25 dollars.

CATALOGUES.

Watson's Microscope Record. No. 20, May. Pp. 32. (London: W. Watson and Sons, Ltd.)

Early English Literature, 15th to 17th Centuries. (New Series, No. 6.) Pp. 128+15 plates. (London: Francis Edwards, Ltd.)

Clearance List, at Bargain Prices, of Books on the Subjects of Entomology, Geology, Mineralogy and General Zoology, including Mammalia, Invertebrates and Ornithology. (No. 177.) Pp. 20. (London: Dulau and Co., Ltd.)

Diary of Societies.

FRIDAY, MAY 30.

ROYAL SOCIETY OF MEDICINE (Disease in Children Section) (Annual General Meeting), at 5.—H. A. T. Fairbank: Osteogenesis Imperfecta (Presidential Address).

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. R. Ricardo: The Development and Progress of the Aero Engine (Wilbur Wright Memorial Lecture).

ROYAL SANITARY INSTITUTE (in Public Halls, Blackburn), at 7.—Dr. J. J. Buchan and others: Discussion on The Re-organisation of Poor Law Hospitals under the Local Government Act.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—S. Hall: A Study of the Coastal Geology between Marazion and Porthleven, Cornwall (Lecture).—Dr. W. G. Shannon and L. G. Anniss: The Igneous Intrusions of the Stoke Fleming Area, South Devon.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir H. C. Harold Carpenter: The Metal Crystal.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Dr. N. K. Adam: Some Aspects of Lubrication.

SATURDAY, MAY 31.

ROYAL SANITARY INSTITUTE (in Public Halls, Blackburn), at 10.45 A.M.—Dr. V. T. Thierens and others: Discussion on The Need for Further Legal Powers with Respect to Ice-Cream.—H. W. Webb and others: Discussion on The Provision and Maintenance of Dustbins—Private or Municipal.

MONDAY, JUNE 2.

ROYAL SOCIETY, EDINBURGH, at 4.30.—O. F. T. Roberts: On Radiative Diffusion in the Atmosphere.—Dr. D. Jack: A Simple Spectrum Comparator.—W. O. Kermack, R. H. Slater, and W. T. Spragg: Certain Quinoline and Benzacridine Derivatives yielding Coloured Adsorption Compounds with Iodine.—S. G. Jones: A Study of Apothecial Development in the Leaf-Spot Disease of Red Clover.—E. L. Ince: Tables of the Elliptic Cylinder Functions.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Mrs. E. Norman: Some Observations on the Speech of a Young Child.

ROYAL SOCIETY OF MEDICINE (Odontology Section) (Annual General Meeting) (at Royal College of Surgeons), at 8.—Sir Frank Colyer: Demonstration on Specimens in the Odontological Museum.—G. Harborow: A Complex Odontome.—J. G. Turner: A Histological Report on the Odontome.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—B. Thomas: A Journey to the Centre of the Rub al Khali.

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting at Irish Centre) (*June* 2-6).

TUESDAY, JUNE 3.

SOCIETY OF GLASS TECHNOLOGY (jointly with Deutsche Glastechnische Gesellschaft) (at Institution of Mechanical Engineers), at 10 A.M.—Prof. W. E. S. Turner: A Study of the Chemical Reactions in the Making of Soda-Lime-Silica Glass.—Prof. E. Zschimmer: On the Theory of the Constitution of Glass.—T. C. Moorshead and E. A. Coad-Pryor: Some Experiments on the Cascade Method of Melting Glass.—Dr. E. Berger: Influence of Thermal History on the Properties of Glass.—At 2.—Prof. W. L. Bragg: The Structure of Silicates.—Prof. G. Gehlhoff: Currents and Temperatures in the Glass Tank.—H. W. Howes: Volatilisation from Soda-Lime-Silica Glass.—Gehr. Reg. Rat. Dr. A. Wendler: Development and Trend of the Mechanical Production of Colourless Hollow Glassware.

RESEARCH DEFENCE SOCIETY (Annual General Meeting) (at 11 Chandos Street, W.1), at 3.15.—Mrs. E. Mellanby: Diet and Dental Disease (Stephen Paget Memorial Lecture).

MINERALOGICAL SOCIETY, at 5.30.—Dr. L. J. Spencer: On a New Meteoric Iron from Piedade do Bagre, Minas Geraes, Brazil.—Miss Jessie M. Sweet: Notes on British Barytes.—M. H. Hey: On Face- and Zone-symbols referred to Hexagonal Axes.—Dr. L. J. Spencer: Biographical Notices of Mineralogists Recently Deceased (fourth series).—Dr. F. Walker: On a Tholeiitic Phase of the Quartz-dolerite Magma of Central Scotland.—M. H. Hey: On Pink Epsomites and Fauserite.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. G. C. Low, D. Dewar, T. H. Newman, and G. A. Levett-Yeats: A Classification of the Original Watercolour Paintings of Birds of India by B. H. Hodgson, S. R. Tickell, and C. F. Sharpe in the Library of the Zoological Society of London.—P. E. P. Deraniyagala: Testudinate Evolution.—Margaret C. Steen: The British Museum Collection of Amphibia from the Middle Coal Measures of Linton, Ohio, U.S.A.—A. Girgis: The Development of the Heart in the Rabbit.—Dr. G. S. Sansom and Dr. J. P. Hill: Observations on the Structure and Mode of Implantation of the Blastocyst of *Cavia*.—Agnes E. Miller: Note on the Tail Skeleton of *Lepidosiren paradoxa*, with Remarks on the Affinities of *Palæospondylus*.

LONDON NATURAL HISTORY SOCIETY (at Winchester House), at 6.30.—E. R. Taylor: The Pyramids and the Sphinx.

ILLUMINATING ENGINEERING SOCIETY (Annual Meeting).

WEDNESDAY, JUNE 4.

PHYSICAL AND OPTICAL SOCIETIES (Joint Discussion on Photo-electric Cells) (at Imperial College of Science and Technology), from 3 to 5.30.—Prof. H. S. Allen: The Early History of Photo-electric and Selenium Cells (Introductory Lecture).—Dr. N. R. Campbell: A Theory of Selective Photo-electric Emission with Special Reference to Thin Films of Cæsium on Silver.—D. H. Loughridge: The Manufacture of Photo-electric Cells and their Use in Sound Reproduction.—T. W. Case: (*a*) The 'Thalofide' Cell; (*b*) Barium Photo-electric Cells.—P. Selényi: The Manufacture, Properties, and Use of Sodium Photo-electric Cells.—J. Kunz: Photo-electric Cells and Some Applications.—Major C. E. S. Phillips: The Manufacture of Selenium Cells.—From 5.30 to 7.—Demonstrations.

FARADAY SOCIETY (at King's College), at 5.30.—Prof. T. H. Laby: Quantitative and Qualitative Analysis by X-Rays.—J. T. Calvert: The Determination of Potassium in Soil Samples by the Application of an X-Ray Method.

THURSDAY, JUNE 5.

PHYSICAL AND OPTICAL SOCIETIES (Joint Discussion on Photo-electric Cells) (at Imperial College of Science and Technology), from 10.30 to 1.—Dr. N. R. Campbell: The Standardisation of Photo-electric Cells.—Dr. N. R. Campbell and L. G. Stoodley: Time-lag in Gas-filled Photo-electric Cells.—E. B. Moss: A Complete Electrostatic Method for the Measurement of Photo-electric Currents.—Prof. G. M. B. Dobson and D. S. Perfect: A Method of Comparing Very Small Amounts of Light by Means of a Photo-electric Cell and a Valve Amplifier.—N. L. Yates-Fish: A Theoretical Investigation of the Use of a Photo-electric Cell with a Valve Amplifier.—H. A. Thomas: A Theoretical Study of the Amplification of Photo-electric Currents by Means of Thermionic Valve Amplifiers.—H. Geffcken and H. Richter: Distortion in the Amplification of Photo-electric Currents and a Remedy.—Prof. G. M. B. Dobson: A Spectrophotometer for Measuring the Amount of Ozone in the Upper Atmosphere.—D. S. Perfect: A Method of Measuring Small Angles.—C. H. Sharp: Notes on Photo-electric Photometry.—T. H. Harrison: The Photo-electric Cell as a Precision Instrument in Photometry.—From 3 to 5.30.—Drs. W. R. G. Atkins and H. H. Poole: On the Photo-electric Measurement of Daylight.—Drs. J. H. J. Poole and H. H. Poole: The Neon Discharge Tube Photometer.—P. P. Koch: Die Photoelektrische Zelle als Hilfsmittel der Registrier-photometrie.—E. A. Baker: Some Factors Affecting the Speed of the Koch Micro-photometer.—K. S. Gibson: The Use of the Photo-electric Cell in Spectrophotometry.—D. S. Perfect: Spectrophotometric Absorption Measurements.—H. D. Griffith: Photo-electric Photometry in Relation to Phototherapy.—V. E. Shelford: The Use of Photo-electric Cells in Biological Work.

CHEMICAL SOCIETY, at 8.—A. W. Chapman: The Influence of a Soluble Fluoride on the Corrosion of Iron.—G. B. Harrison: The Application of a New Type of Triode Valve to the Determination of Hydrogen Ion Concentration with Glass Electrodes.—E. H. Farmer and T. N. Mehta: Properties of Conjugated Compounds. Part X. Variability in the Mode of Ester-addition to Butadiene Esters and Ketones.

FRIDAY, JUNE 6.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.

SATURDAY, JUNE 7.

GEOLOGISTS' ASSOCIATION (*June 7 to 10*) (at Star Hotel, Helston).—A Study of the Coastal Geology between Marazion and Porthleven, Cornwall.

PHYSIOLOGICAL SOCIETY (in Physiology Department, Edinburgh University).

PUBLIC LECTURE.

THURSDAY, JUNE 5.

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON), at 5.—Prof. G. E. Gask: The Value of Radium in Surgery.

CONGRESSES.

MAY 28, 29, 30, and 31.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Portsmouth).

Friday, May 30, at 10 A.M.—H. Dewey: Cornish Geology and Scenery, with a Few Remarks on the Isle of Wight by Way of Comparison.

At 11 A.M.—Lt.-Col. J. H. Cooke; Origin of Scenery in the Portsmouth District, Geologically Considered.

At 12 noon.—Prof. L. S. Palmer: Recent Geology of the Portsmouth District.

At 10 A.M.—J. F. Marshall: The Organisation of Mosquito Control Work.

At 11 A.M.—Miss G. F. Selwood: Observations on Fauna Changes in a Bog at Bembridge, I.W.

At 8 P.M.—L. B. Benny: Progress in Astronomy.

Saturday, May 31, at 10 A.M.—G. E. Hutchings: Some Applications of Regional Survey in Education.

At 10.45 A.M.—A. Farquharson: A Regional Survey of Chichester.

At 11.30 A.M.—D. H. Thomson: Springs, Streams, and Wells in the Portsmouth District.

JUNE 3 TO 5.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting and Conference) (at Town Hall, Leeds).

C. F. Broadhead: The Preparation of a New Road Binder.

Dr. Margaret Fishenden: Heat Transmission with Particular Reference to Modern Methods of Expressing Convection Data.

Dr. E. W. Smith: Gas Dehydration.

E. G. Stewart: The Functions of Coke Ovens.

F. Prentice: Experiences with a Waterless Gasholder.

W. H. Hoffert and G. Claxton: Benzole Recovery with Particular Reference to Gas-Works Practice.

JUNE 4 TO 9.

ROYAL INSTITUTE OF PUBLIC HEALTH (at Portsmouth).

Thursday, June 5, from 9.30 A.M. to 1.—Prof. H. R. Kenwood: The Reduction of Preventable Disease—A Few Observations Thereon.

D. Aukland and others: Discussion on National Health and the Local Government Act of 1929.

Dr. C. F. White: Plague Prevention in English Ports.

S. Cade: Radium and Cancer Clinics.

Prof. R. J. A. Berry: Heredity in Relation to the Nation's Problem of Mental Deficiency.

H. C. M. Williams: Port Administration.

Prof. Sir Thomas Oliver: The Health of the Worker of To-day.

Dr. W. Hanna and others: Discussion on Health in Sea-faring Occupations.

Dr. W. J. O'Donovan: Occupational Skin Diseases with Special Reference to Cheiropompholyx.

E. G. Bowen: Some Geographical and Anthropological Factors in the Study of Industrial Diseases.

Dr. A. W. Sanderson: The Health of Women and Girls in Industry.

Lady Keyes: The Voluntary Worker in Relation to the Public Health Service.

Dame A. Louise McIlroy and others: Discussion on The Prevention of Sickness and Death in Motherhood.

Dr. L. Dorothea Taylor: The Health of the School Child.

Dr. M. Critchley: The Problem of the Epileptic Child.

B. Purse: The Care of the Blind Child.

Col. R. K. White: Post-Puerperal Disabilities in Women.

Sir Henry Gauvain: Sun Treatment in England.

Dr. H. M. Davies and others: Discussion on The Present Position of Surgical Treatment of Pulmonary Tuberculosis.

Dr. J. Gravesen: The Early Phases of Tuberculosis and their Treatment.

O. Amrein: The Development of Pulmonary Tuberculosis and the Differential Diagnosis.

Thursday, June 5, from 10 A.M. to 1.—Surg. Rear-Admiral H. C. Whiteside: Some Problems Old and New of the Seafaring Doctor.

Major H. S. Blackmore: Points of Contact—The Medical Officer in Charge of Effective Troops links up with the Regimental Officer.

Major H. N. Stafford: The Service Doctor and Medical Science—His Contribution.

Surg. Capt. F. C. B. Gittings: Has the Naval Service any Ophthalmic Sequelæ?

Major D. T. Richardson: Experimental Work on Three Types of Stretcher Slings.

Prof. R. Cruchet: Post-Encephalic Parkinsonism and Military Pensions.

Friday, June 6, from 9.30 A.M. to 1.—Dr. C. K. Millard and others: Discussion on The Slum Problem.

Dr. C. O. Stallybrass: Variations in Virulence during the Course of Epidemics.

Col. R. J. Blackham: Acid Milks in Health and Disease.

Brig.-Gen. J. Charteris: The Design and Requirements of Slaughter-houses.

A. Moore Hogarth: The Rat Menace.

W. Buckley: National Health and our Milk Supply.

Surg. Commdr. H. D. Drennan and others: Discussion on The Health of Dockyard Workers.

Dr. H. M. Vernon: New Methods of Heating Buildings and their Influence on Comfort.

Dr. R. P. White: Sensitisation of the Skin.

Dr. Letitia D. Fairfield and others: Discussion on The Slum Child.

Miss Doris M. Odlum: Home and the Adolescent.

W. Clarke Hall: The Problem of the Delinquent Child.

Miss B. M. Johnson: The Hygiene of the Domiciliary Labour Room.

Dr. Olive B. Sharp: Ante-Natal Treatment in Connexion with Venereal Disease.

Dr. J. Watt: The Provision of Institutional Treatment for the Tuberculous.

Dr. R. R. Trail: The Results of Sanatorium Treatment; Immediate and Ultimate.

Dr. Rollier: The International Factory Clinic for Indigent Patients suffering from Surgical Tuberculosis.

Friday, June 6, from 10 A.M. to 1.—Squadron Leader A. F. Rook: Sanitation in Desert Operations.

Surg. Commdr. J. A. O'Flynn: The Control of Malaria at H.M. Naval Base, Singapore.

Surg. Capt. L. M. Morris: Recruiting—Review of Modern Requirements.

Wing Commdr. H. A. Treadgold: The Conditions of the Heart found in Recruiting.

Dr. G. C. Low: Climatic Bubo—Its Diagnosis and Treatment.