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Science and Philosophy

THERE was a blissful time when human knowledge was not formally differentiated. Without going far back into history, we may recall the wise men of ancient Greece, who never thought of drawing a distinction between mathematics and natural science, psychology and moral science. So Thales and Pythagoras are hailed as the true founders of practically every major branch of knowledge. Indeed, the early Greek thinkers were at the same time not only philosophers and social reformers, mathematicians and physicists, but also politicians and soldiers, engineers and traders—a fact which suggests a special conception of the unity of knowledge, if not of knowledge and action as well. Even the teaching of the Academy and the Lyceum, following the Pythagorean tradition, had a universal character, though some members of these schools specialised in particular branches of learning. It was not until the Alexandrians that the various sciences were really differentiated and studied separately.

This unitarian conception of knowledge was developed in a most remarkable and inspiring way. To take but one example, the Pythagoreans considered number not only as the basis of abstract science but also of music, ethics and religion. Such doctrines as that of the harmony of the spheres, or of the correspondence between certain numbers and the moral virtues, may appear fantastic. Yet, they have a profound meaning; and strange as it may seem to be, mathematics was one of the fundamental causes which influenced the social activities of the Pythagorean order. Indeed, the discovery of the irrational quantities was the spiritual cause of the breakdown of the Brotherhood. But the spirit and the method remained: it was the necessity of 'explaining' the irrationals which led Plato to build up a philosophical system in which mathematical and scientific ideas were freely used, for the justification of both Nature and the world of ideas.

It was only natural that all knowledge should be one when the particular sciences were in their infancy. There is, however, a deeper meaning in the unitarian attitude of the Greek mind: it illustrates the fact that the growth of mathematical and scientific ideas is intimately interwoven with the threads of philosophy proper. This attitude can be traced all through the ages up to the cosmological disquisitions of Copernicus, of Kepler, of Newton himself. Again, we find the

mathematical and physical discoveries of Descartes influencing his 'method', his philosophy, his cosmology and even his biology, and suggesting to Spinoza a geometrical proof of the dictates of conscience. With Leibniz we can see how the idea of the 'infinitesimally small' is made the basis not only of the calculus, but also of his conception of substance, of monads and their pre-established harmony, of psychology, ethics and theology. Further, though Kant's philosophy opens with this fundamental question 'How is pure mathematics possible ?', its collapse was largely due to the discovery of non-Euclidian geometry and to the invention of imaginary quantities which could not be easily explained with that system.

Kantian philosophy was, however, responsible for the definite estrangement of science and philosophy in the nineteenth century. Science was firmly attached to the realm of pure reason, while the major values of reality were left to the charitable conclusions of practical reason, the arbitrariness of which ultimately cast doubts on the relevance of philosophical issues to the claims of positive knowledge. The alliance of the sciences with reason and the remarkable scientific developments of the time, led the Positivist school to discard philosophy from the sphere of human concerns. With philosophy at a discount, the way was clear for a mechanist and materialist interpretation of the universe and of life. The notion that to be real a thing must be of the same nature as a piece of matter, became the predominant axiom upon which was based any explanation of scientific results ; and as matter can be seen and touched, whatever was real ought to be seen and touched, at least theoretically. The analysis and description of a thing in terms of molecules and atoms and their movements was the sole condition of dealing with reality ; all else, such as metaphysical values and religious experience, was a pointless incursion into a world of shadows. Yet, it is a curious fact that the further analysis of the objects perceived finally exploded the very 'reality' they represented.

This is, however, the epic of the contemporary development of our knowledge. With matter considered as a hump in space-time and gradually vanishing into nothingness, the obvious and solid foundation of nineteenth century science has disappeared. The imaginative conception of reality no longer being restricted by its likeness to the objects of perception, there could be no reason why the promptings of moral, æsthetic and religious experience should be still considered as unreal, and the way was thus open for a reconsideration of the philosophical interpretation of the universe on its merits. The immediate effect of this new situation was to narrow the gulf between science and philosophy. Physicists began to look for a solution of their particular problems in the boundless extent they discovered beyond the traditional horizon of physics. In reaching out to these inquiries, philosophers became more and more interested in the methods and results of the special sciences, and brought down metaphysics into the laboratory and the market place.

What are the results of this welcome co-operation ? Eminent astronomers and physicists like Eddington, Jeans, Planck and Einstein, do not conceive the world of matter as something existing independently of the mind. Not only does scientific thought affect the nature of the things it studies, but also matter itself becomes simply an appearance of the mental or spiritual unity which alone is real. Compared with the dogmatic pronouncement of their predecessors fifty years ago that matter alone was real, the present attitude of these scientific thinkers is its extreme opposite. This complete reversion is the more arresting when one considers that matter which, in the past, was subject to the blind laws of classical mechanics, is now endowed with something almost like free-will, thanks to the implications of Heisenberg's principle of indeterminacy. With Whitehead, Russell, and the idealist philosophers, this peculiar character of matter is further emphasised.

The important consequences of such views in the field of biology are that life is not a by-product of blind processes of dead matter, but something fundamental and creative, exhibiting its own purposes and ends. Hence arise theories of creative evolution in which the processes of life continually bring to birth something new. Even those who refuse to accept a fundamental distinction between matter and life have to talk of emergent evolution, of 'organism' and of 'holism'. Whitehead, for example, considers the universe as an organic whole of which the living organism is a pattern ; while Smuts assimilates biological progress with the integration of more and more elements to form larger and larger organic wholes.

When we reach psychology, however, we find the position again reversed. Two generations ago, psychology was not acknowledged to be a science, on the ground that it was mainly introspective,

and therefore subjective; it gave too much importance to mind as against matter, which was, as we have seen, the ultimate basis of reality. To-day, however, psychology is becoming more and more objective; and with the advent of behaviourism or the conditioned reflexes, it describes the processes of the living organism in terms appropriate to a highly complicated automatic machine. We are thus faced with the conclusion that freedom, which physics allows to dead matter, is refused by psychology to thinking organisms. Indeed, while the highest achievement of physics is to have become subjective, the last word in psychology is to give that science an objective character.

Between such extreme views, of course, a number of intermediate theories have taken their place; and though the most prominent properties of physics and biology, in the minds of some of their brilliant exponents, are their subjectivism, there are a number of physicists, biologists and philosophers who still hold mechanistic or dualistic views on the interpretation of these sciences. Again, behaviourism, the doctrine of conditioned reflexes, and psycho-analysis, are not the only representatives of psychological theories: idealism and dualism have still a strong following in this field. This chaos of values indicates clearly that science does not tell us the whole truth about things, but only partial truths about those aspects of things which can be subjected to its methods. In other words, science is not the only guide which can help us in the exploration of the universe and in the interpretation of our findings. On the other hand, without the theoretical and practical data of the sciences, philosophy alone could neither undertake its scrutiny of reality, nor carry our minds to the highest flights of purposive thinking.

This mutual dependence of science and philosophy is one of the major characteristics of the intellectual atmosphere of our time. Neither of them is a detachable unit in an unorganised aggregate, or an independent agent which is not itself acted upon: they are both living members in the organic whole of knowledge. Science and philosophy have emerged from man's contact with Nature, and have become social habits; but they are customs so geared with the world about us that they must run smoothly, irrespective of climate, race or creed. As man is a social as well as a rational animal, the vast complex of social, emotional and intellectual behaviour he has inherited from society, cannot be simply dismissed in the name of science if it cannot be described in abstract formulæ. On the other hand, as science is a social outgrowth serving social ends, all attempts to isolate any aspect of it from the intellectual and social movement, of which it is an integral part, can lead to nothing but false and dangerous conclusions. It is true that the scientific analysis of the universe of experience requires its division into a series of differentiated compartments, and the isolation of subjects and objects from their original context; but it would be improper and misleading to build up elaborate structures on these isolated groups, as if there were originally water-tight compartments of knowledge, each having its own independent criteria of importance. On the whole, our schools and our universities seem to be designed to accentuate the practice of isolation, though the pursuit of any one thing cannot be a complete end in itself.

The reconciliation of science and philosophy we witness to-day ought to change the practical conditions of such an outlook if we believe in the constant progress of civilisation and in the greatness of human destiny. An important step in the right direction would be for the academic authorities to introduce the study of philosophy and scientific method as compulsory subsidiary subjects in the official curricula for a first degree. But this brings us back to the attitude of the wise men of ancient Greece, who naturally thought of human knowledge as essentially one, as against the atomised outlook of most thinkers of to-day. Whatever be the specialised fields of scientific workers, they should know how to turn to philosophy for the connecting links between their diverse interests, so as to be able to discuss with competence the true significance and value of their results. On the other hand, it should be the business of philosophers not only to inquire into the higher values of life, but also to subject to a critical analysis all the presuppositions and results of science, and to build up synthetic systems of the whole realm of knowledge and experience. At every new step in human progress, we find men of genius able to make synthetic attempts of this kind. But while to-day science may rightly claim to have performed its part, philosophy is still in the expectation of actual systems which will provide a comprehensive explanation of the results of science and an adequate justification of the periodical and progressive changes in the material conditions and mental outlook of the human race.

The Eighteenth Century Scene*

By DR. ALLAN FERGUSON

WHAT is the secret of the fascination which the character of Johnson has exerted on his friends, his contemporaries, and all lovers of England for nigh on two centuries? There are no half measures about it—if you know your Johnson, you like or dislike him heartily—and the great-hearted sturdy figure has to-day, even as in his lifetime, far more friends than enemies. It is curious, too, and a reflection in some measure of his powerful personality, that his is one of the few great names in our English life and literature of whom it can be said that their reputation never suffers from the swing of the pendulum. We hear little of Carlyle and Ruskin to-day; Tennyson, after suffering a temporary eclipse, is coming into his own again; following a period of obscurity, the personality and achievements of Gladstone have provided material for half a dozen recent monographs. But since the day of Johnson's death the stream of comment and of criticism has never run dry. Apart from the work of the compilers of *Ana*, successive editions of Boswell by Malone, Croker, Napier, Fitzgerald, Birrell, and greatest of all, Birkbeck Hill, not to mention the misguided efforts of one or two editors to present us with a 'bovrilised' Boswell from which the 'longueurs' have disappeared, are milestones through the nineteenth century.

Year after year sees our knowledge of Johnson now growing, now darkened by the efforts of some thesis-mongering critic who attempts to sound the depths of his complex personality with a wholly inadequate plumb and line. But whatever may be our estimate of the attempts, the volume of contemporary criticism shows, eloquently enough, the interest which he provokes in any age. What is at the root of it all? Let us at once anticipate the drawing-room critic by admitting the worst which can be said of him. He could be, at times, violent and overbearing; he was occasionally uncouth and absent-minded; his literary fame and greatness of mind brought small consolation to the housewife who saw her best carpet disfigured by the moralist's habit of turning his candle upside-down to make it burn more brightly; he was indolent by nature; he would argue for victory; and his temperament had a hypochondriacal and melancholy side.

All this is true enough, but it must be remembered that our critical reading is not only coloured by what we term our judgment, and our friends our prejudices, but also that the very account which we read is as much a reflection of the mentality of the writer as it is an appreciation of the figure mainly concerned. Johnson has suffered somewhat at the hands of conventional commentators, more skilled to pick out faults than to see the nobility behind them, or to realise that Johnson without his scars ceases to be Johnson. He *was* indolent; and the mass of sound work behind his name should put to shame the most industrious of his critics; he *was* overbearing and inclined to use the butt-end of the pistol in argument—as when, finding himself worsted in a discussion on the virtues of medicated baths, he cried: "Well, sir, go to Dominicetti, and get thyself fumigated; but be sure that the steam be directed to thy head, for *that* is the peccant part."

Johnson was, however, so frank in apology, so ready to take the first opportunity of reconciliation, that incidents, which loom large in the minds of critics of the feebler sort, were seen in their correct perspective by those friends who knew him far better than we can hope to do; who were competent to assess at its true value the wisdom and goodness of him who, giving small weight to conventional expressions of sympathy. ("Sir . . . you will find these very feeling people are not very ready to do you good. They *pay* you by *feeling*"), took on his back a poor woman of the town whom he found lying ill in the street, carried her to his house and "had her taken care of . . . till she was restored to health and . . . put . . . into a virtuous way of living"; who not merely passively endured, but cheerfully sustained for years a nondescript household of dependents with whose queerness and bickerings Shaftesbury himself would have had small patience. He would argue for victory, and would, in the mood, stubbornly maintain a completely wrong-headed attitude. Yet few men have shown in discussion such cogency of argument, such genuine humour, such force and precision of language, such aptness of illustration. Could the matter be more neatly put than in his comment on the assertion that a *congé d'élire* had only the force of a recommendation? "Sir, it is such a recommendation as if I should throw you out of a two-pair of stairs window, and recommend you to fall soft". To the vague and woolly phrase and mind he was an uncompromising enemy ("Poll is a stupid slut; she was wiggle-waggle, and I never could persuade her to be categorical"). He had his melancholy fits and feared to be left in solitude. Yet none could be a gayer companion, witty and charming, welcome and at his ease in any company.

More than anything, Johnson was an amateur of life in all its phases. His nature could extract a high and candid philosophy of life from keen observation of men and books, and, with one exception, he was utterly fearless, physically and morally. When, an elderly man, he was bathing with Langton and was cautioned against a dangerous

* "Johnson's England: an Account of the Life and Manners of his Age". Edited by Prof. A. S. Turberville. Vol. 1. Pp. xxiii+405+72 plates. Vol. 2. Pp. ix+404+60 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 42*s*. net.

pool, he thereupon swam directly into it; and—a higher virtue—he was never afraid to recognise aspects of human nature which the demands of conventionality tend to ignore. A remark made by Reynolds, in Johnson's hearing, to ladies lamenting the loss of a benefactor—"You have, however, the comfort of being relieved from a burden of gratitude"—first attracted him to Reynolds; and it is an odd commentary on changing social values that this remark, recognised by Johnson in the eighteenth century as exhibiting a fair view of human nature, drew from Morley the comment that "no moralist with a reputation to lose would like to back Reynolds's remark in the nineteenth century" and is quoted by a twentieth century critic of Johnson as "the sort of thing which everyone knows to be true, but which very few venture to say".

No man saw more clearly the vast gulf which lies between life as it is, and life as we endeavour to cheat ourselves into believing it to be. It is this clarity of vision, despite his prejudiced views on many questions of the day, which makes Johnson's writings so rich a storehouse of those compressions of thought and observation which we term aphorisms. His advice to Boswell—advice applicable to weightier matters than are exhibited in the illustrations—sums up the matter: "My dear friend, clear your *mind* of cant. You may *talk* as other people do. You may say to a man, 'Sir, I am your most obedient-humble servant'; you are *not* his most humble servant. You may say, 'These are bad times; it is a melancholy thing to be reserved to such times'; you don't mind the times. You tell a man, 'I am sorry you had such bad weather the last day of your journey, and were so much wet'; you don't care sixpence whether he is wet or dry. You may *talk* in this manner, it is a mode of talking in Society; but don't *think* foolishly."

With this practical wisdom, goes a boyishness of spirit, and a very endearing capacity for exhibiting certain human weaknesses. Witness Mrs. Thrale when "I had teized him for many weeks to write a recommendatory letter of a little boy to his schoolmaster; and after he had faithfully promised to do this prodigious feat before we met again—'Do not forget dear Dick, Sir,' said I, as he went out of the coach; he turned back, stood still two minutes on the carriage step—'When I have written my letter to Dick, I may hang myself, mayn't I?'—and turned away in a very ill-humour indeed." Most reluctant performers of allotted tasks will recognise a kindred spirit here, and in that illuminating entry in the diary of his Welsh tour which records that "We then went to see a Cascade. I trudged unwillingly *and was not sorry to find it dry*".

What were the characteristics of the scene in which Johnson played so dominating a part? To obtain a faithful picture of his personality we have to realise, not only the broad outlines of the events of his times, but something of that detail—*ce superflu, si nécessaire*—so dearly loved by Austin Dobson. We know that the stage played a large part in the life of the town—we may even know something of the line of development of the eighteenth century drama; but it adds much to the vividness of the portrait if we know that the audience were seated on backless benches, which could not be booked in advance; that the system of dropping the curtain between the acts was not introduced until the mid-century; and that Garrick revolutionised the whole system of stage-lighting by substituting unobtrusive wing-lights for the chandeliers which heretofore had hung *in front* of the stage, obscuring the view, and only half-illuminating the scenery.

In the long tale of man's conquest of Nature there is no more fascinating story than that of the slow degrees by which he improved his means of communication with his fellows. We know that roads were vile at the beginning of the century, and tolerable at its close—so much improved indeed that the railway at its inception had only small advantages to offer. But such knowledge has little value; we need to be able to visualise the coaches, waggons and post-chaises by which our ancestors travelled and, in the spirit of Lord Kelvin's dictum that we begin to know something of a quantity when we can say how much of it there is, we find our notions of the roads of the period clarified when we realise that about the mid-century a journey of fifty miles was a good day's work, and that towards the end of the century about a hundred miles could be covered in a day. Indeed, Arthur Young remarks about 1770, "The power of expeditious travelling depopulates the kingdom. Young men and women in the country villages . . . enter into service . . . to raise money enough to go into London . . . no easy matter when a stage coach was four or five days creeping a hundred miles. *But now!* A country fellow, a hundred miles from London, jumps on to a coach box in the morning, and for eight or ten shillings gets to London by night; which makes a material difference." *Plus ça change*—we seem to remember similar remarks made but recently concerning the effect of the motor bus on village life.

The study of the daily habits of our ancestors provides material of never failing interest. What and when they ate and drank, the type of house in which they lived, the clothes they wore, the books they read, the manner in which they farmed their land. It is so very easy to visualise the century as one of a highly artificial civilisation, an age of panniers and hoops, of affected compliments and heroic couplets, of grand tours and olympic statesmen; or, at the other extreme, as one of gaol fever, of stinking streets and ditches, of Hogarth's Gin Lane, of highwaymen, street thieves and melancholy processions to Tyburn. It is perfectly true that these extreme elements form part of the picture. But a part only; and it is the province of the volumes under discussion to correct such facile and distorted views. Nowhere is this correction more effectively made than in

the section which deals with town life in the provinces. Many readers of to-day are apt to project their present knowledge of, say, Leeds or Birmingham, back into eighteenth century conditions, and it is with something of surprise that we learn that, outside London, the only considerable English city at the middle period of the century was Bristol with a population of a hundred thousand. Norwich came next, with a population of about fifty thousand; then Manchester and Liverpool in the region of thirty thousand. The populations of Hull and Sheffield were between twenty and thirty thousand, those of Nottingham, Leeds, Shrewsbury, Chester and Worcester between ten and seventeen thousand. Such towns as Bolton, Bradford and Newbury were not greater in population than five thousand souls, and most of the flourishing market towns of the period were no more than large villages of two to four thousand inhabitants. Their problems of lighting, paving and sanitation were not markedly different from those which face corresponding English villages to-day. Perhaps their solution was not so very much lower in point of efficiency; at the moment of writing, we hear news of deaths caused by the failure of water supply in villages under the stress of the drought of 1933.

The furniture of the houses of the period is known in minute detail. The topographers of the age catalogued the more striking of the contents of the mansions of the nobility and gentry, and legal inventories and auctioneers' catalogues are not unknown. One striking feature of the interior furnishings of the period is the small part which the bath and the bathroom play therein. Johnson himself remarked to the Lichfield draper showing him his cold bath, "I hate immersion", admonishing him to "let well alone, and be content"; and we are told of the eleventh Duke of Norfolk that he was "never thoroughly washed except when he was so drunk that his servants were able to place him in his bath without his being sensible of it".

The section which deals with the house interior is remarkably full in its account of the furniture of upper class houses. Beautiful examples of period furniture are described and illustrated, but we would willingly have sacrificed some of this in order to obtain more knowledge of farms, cottages, alehouses and the village inn with

"The whitewashed wall, the nicely sanded floor,
The varnished clock that clicked behind the door,
The chest contrived a double debt to pay,
A bed by night, a chest of drawers by day;
The pictures placed for ornament and use,
The twelve good rules, the royal game of goose,
The hearth, except when winter chilled the day,
With aspen boughs, and flowers and fennel gay;
While broken teacups, wisely kept for show,
Ranged o'er the chimney, glistened in a row."

The paucity of this information is not fully compensated by an extract from Southey descriptive of an early nineteenth century farmhouse, or a brief description of the plates of "Marriage *à la mode*". One inventory which has escaped the author's notice—a catalogue of very deep interest to the readers of NATURE—is that which describes the contents of the house in the parish of St. Martin's-in-the-Fields, in which Sir Isaac Newton died. Newton died intestate and, as was discovered by Lieut.-Col. de Villamil, a very detailed inventory of the contents of his house was taken at the instance of the Prerogative Court of Canterbury. The records of this court are preserved at Somerset House, and a close search revealed the inventory in the form of a vellum roll some five inches broad and seventeen feet long. The detail is remarkable, so much so that it would not be a difficult matter to refurnish every room in a reproduction of Newton's house in the exact style in which he lived. The inventory would seem to fill a gap in the literature; it gives a very complete picture of a middle class house in the year 1727. Here again, despite an astonishing particularity of description which includes certain articles of bedroom furniture in silver, and descends to a tabulation of "a leaf of a table two old coats two old hatts . . . a pair of tongs a perriwig block two leaden flower pots" in the stable, the only mention of a bath is found in the inventory of the "fore room two pair of stairs", where we read of "three globes a copper plate a silver watch a Bath mettle case of instruments a shagreen case Do. a small penknife an embroidered purse two plaistered heads and two small pictures". We fear that the word *Bath* here refers to the alloy (three or four ounces of zinc to a pound of copper) of which the case is composed.

It would be an impossible task to summarise adequately the contents of the twenty-seven sections of these volumes—sections which cover almost all of the activities of the age, and furnish us with a picture, most skilfully conceived and carried out, in which the immense detail necessary for any accurate scholarship is introduced into the main structure in so thoroughly interesting a fashion that its presence is never felt to be overwhelming, nor permitted to obscure the main outlines. We have seen that daily life and habits in the metropolis and in the provinces are adequately treated. The Church, the Army, the Navy, trade and rural life, travel and discovery, sports and costume, all find representation. We are introduced to a study of the law of the period, a mass of queer, interesting and archaic technicalities wherein, for example, under a writ of debt, a defendant could wage his law, that is, could "swear that he did not owe the money . . . and produce eleven compurgators to swear that they believed him"; and the defendant could escape scot free if he managed to find eleven such hard swearers! True, the lawyers had discovered subtle ways to make the process difficult, but so late as 1824 such a case occurred, and the possibility was not finally disposed of until the Act of 1833.

The arts of painting, engraving, sculpture, architecture, the drama and music have each a section devoted to them, and three very important

divisions deal respectively with medicine, education and science. The last-named section gives, as is natural, much of its space to the story of phlogiston and to the discovery and manipulation of gases. Sections on authors and booksellers and on the newspaper close a study which provides material of most absorbing interest, and which may fairly be called indispensable to a student of the period. It will none the less prove attractive to the general reader and will receive an unstinted welcome from all sound Johnsonians. We hope that Prof. Turberville will continue the good work—a study of Tennyson's England covers almost the same period in the nineteenth century that is covered in the eighteenth by the present study, and it has its possibilities.

Manufacture of Sheet and Plate Glass

IN a Friday evening discourse delivered at the Royal Institution on December 8, Major R. M. Weeks, of Messrs. Pilkington Brothers, Ltd., described, and illustrated by lantern slides and films, the methods in use for the manufacture of sheet and plate glass.

The principal raw materials used in the manufacture of sheet and plate glass are sand, soda ash and limestone. These materials, perhaps with the addition of arsenic, anthracite, alumina or magnesium carbonate, all in a finely divided condition, are intimately mixed prior to melting. There are two well-known processes for melting this mixture. (1) The older method, in which the materials are melted in clay pots, and a definite time–temperature schedule is allotted to melting, founding, refining and cooling off to the working temperature. As many as twenty melting pots are sometimes accommodated in one furnace. (2) The more modern method, in which the mixed raw materials are fed on at one end of a tank furnace where they are melted. The molten glass then flows through controlled temperature zones which ensure the founding and refining, and finally arrive at the working end at the required temperature. Such tanks contain anything up to 900 tons, and the temperatures may vary from 1450° to 1200° C. in different zones.

Sheet glass was first made by a blowing and spinning process. Such glass, known as 'crown glass', was characterised by the 'bull's eye' in the middle of each disc. This method was followed in 1832 by the 'blown' process, in which the gathering of glass was blown into the form of an elongated cylinder. After separating the cylinder from the blowing iron, the ends were cut off, and the cylinder split down its length and flattened into a sheet. In 1909, a mechanical method of drawing cylinders of a larger size was introduced from the United States. By this method, cylinders 40 ft. long and about 3 ft. in diameter are drawn (Fig. 1). Such cylinders are cut up into sections before flattening and annealing.

Since 1900, three processes for the drawing of flat sheet glass have been developed commercially : (*a*) Fourcault process, (*b*) Colburn or Libbey-Owens, and (*c*) Pittsburg process. In the Fourcault process, glass is drawn as a sheet vertically from a slot in a depressed fireclay float. In its early days, devitrification was a source of trouble. In the Libbey-Owens process the sheet is drawn from an open bath of molten glass, and thus excessive devitrification troubles are avoided, but the sheet when formed is reheated and bent to the horizontal by being passed over a bending roller. The Pittsburg process is a modification of the Fourcault process, the chief difference lying in the use of a bar of fireclay submerged beneath the surface of the glass to define the position of generation of the sheet.

The making of plate glass involves two distinct

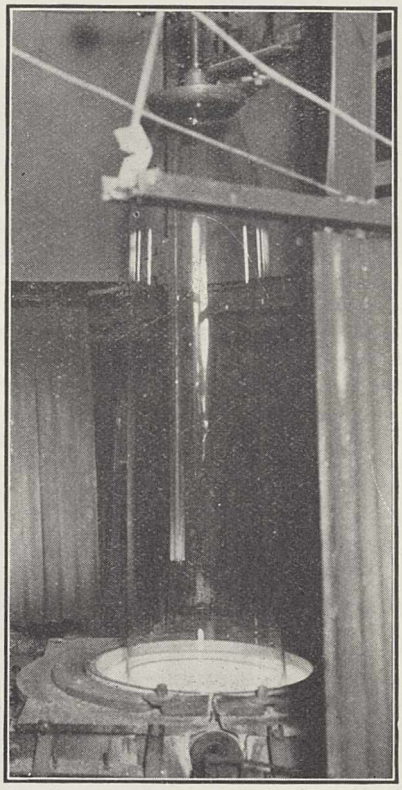

FIG. 1. Drawing sheet glass cylinders mechanically.

processes : (1) manufacture of rough glass blanks ; and (2) grinding and polishing of these blanks. Since 1774, plate glass blanks have been cast from glass melted in pots. Typical melting pots contain about a ton of glass and yield plates of about 300 square feet, at a thickness of 7/16 of an inch. The casting consists in taking the pot from the furnace and pouring the molten glass on to a smooth iron table in front of a roller. The rolled blank is then annealed, a process which in earlier times occupied three

days, but now, for a blank $\frac{1}{2}$ in. thick, occupies $2\frac{1}{2}$ hours.

A modern modification of this process, due to Bicheroux, consists in pouring the molten glass between two rollers on to a moving table (Fig. 2). The irregular beginning and end of the sheet are cut off while still hot by a guillotine and the trimmed sheet is then passed into an annealing lehr, from which it later emerges ready for cutting and polishing. This process gives a smoother and flatter sheet than the older single roller process; consequently, there is less loss of material and a reduced time required for the grinding process.

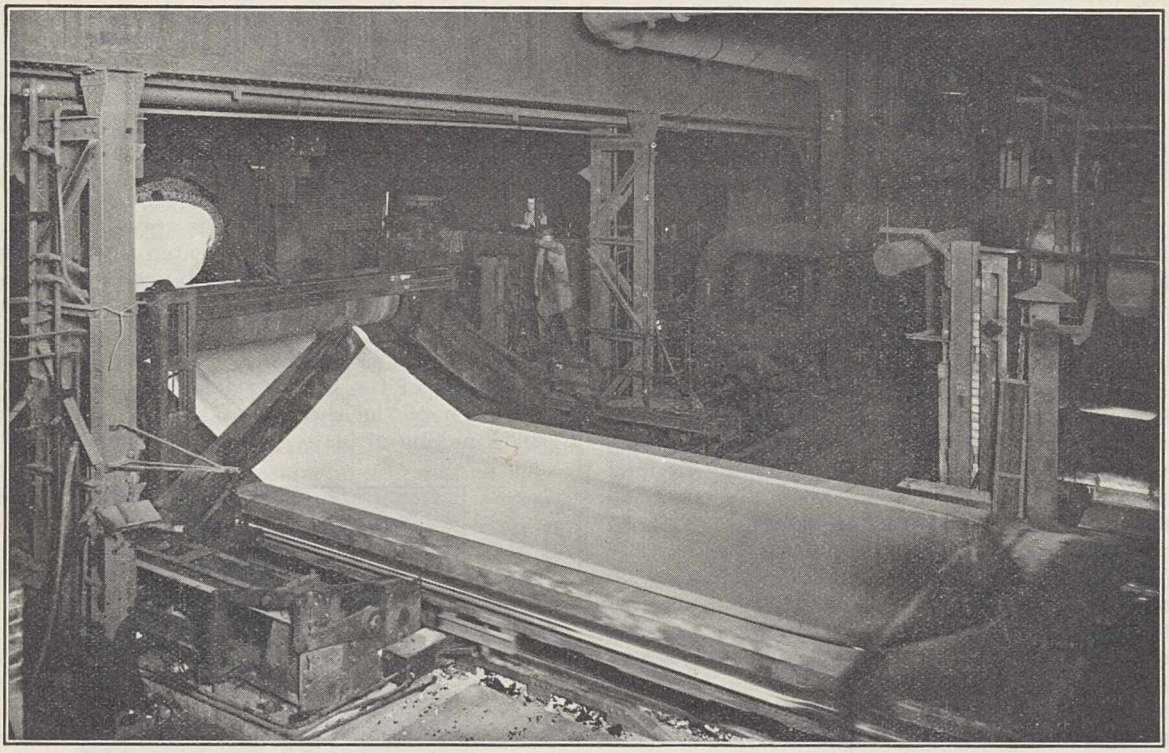

FIG. 2. Casting plate glass blanks by the Bicheroux process.

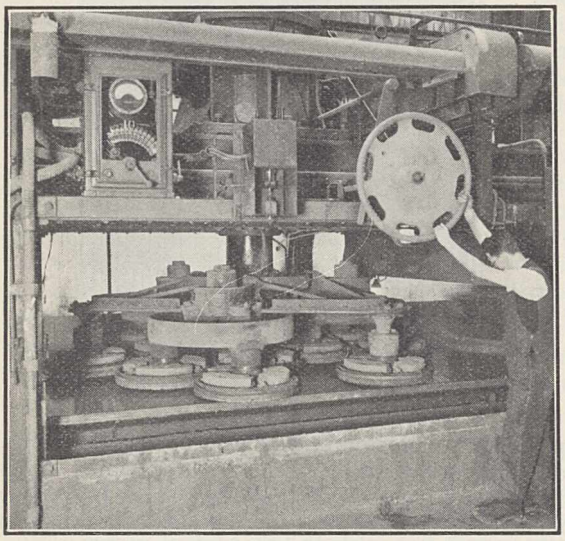

FIG. 3. Polishing plate glass.

The most modern process of all is a modification of the Bicheroux process, and consists in the continuous discharge of a stream of glass from a tank furnace between a pair of forming rolls, from which it issues in the form of a continuous ribbon or sheet, which passes over a roller bed and through an annealing lehr.

In the second stage of the process of preparing plate glass, namely, grinding and polishing, the grinding is accomplished by using progressively finer grades of sand fed with water, under cast iron runners. This is continued until a frosted surface of the finest possible texture is obtained. The polishing process is then begun and consists in rubbing the glass with felt discs fed with carefully prepared rouge (Fig. 3). All plate glass used to be, and much still is, ground and polished on rotating tables on which the glass is embedded, but this method has been superseded by a continuous process.

Machines used in this continuous grinding and polishing process are very large and expensive units; some are so much as 800 ft. long by 15 ft. wide.

Two recent developments of note in flat glass manufacture are (1) coloured opaque glass known as "Vitrolite" and (2) toughened plate glass known as "Armourplate". The latter is made by the suitable heat treatment of ordinary plate glass.

S. E.

Obituary

PROF. FRITZ HABER

BY Fritz Haber's death, chemistry loses one of its outstanding personalities. He was one of the greatest of academic chemists, of industrial chemists, and of leaders of research, while in his combination of these three rôles he was unique; at the same time he remained the most unaffected and kindest of men.

Haber was born in Breslau on December 9, 1868. His early education as a chemist was unusual, and indeed, as he would often say, he was as nearly as possible a self-made man of science. He attended courses in Berlin, Heidelberg, Charlottenburg, Zurich and Jena; he worked under Hofmann, Helmholtz, Liebermann (with whom he published his first paper on some derivatives of piperonal), Lunge and Ludwig Knorr, yet he never obtained from their courses the satisfaction which he desired. As a young man he spent some months in various industrial works; he was even for a time in his father's office before he returned finally to science. When he was twenty-six years old, he obtained a post as assistant to Bunte in the Institute of Chemical Technology at Karlsruhe, where his real work began, and where he remained for seventeen years.

At Karlsruhe, Carl Engler and Bunte encouraged him to develop his own school of research. Though Haber had received no formal instruction in physical chemistry, it was in this field that his main interests lay, and in a few years papers were appearing under his name on the combustion of hydrocarbons, the water-gas equilibrium in the Bunsen flame, and aspects of textile chemistry; but above all his main interests lay in the field of electro-chemistry. His classical studies on electrolytic oxidation and reduction belong to this period; these began with his demonstration of the stages of the reduction of nitrobenzene (1898). This was followed by work on the electrolysis of solid salts (1904), on the glass electrode, on the velocities of electrode processes (1902–8) and on gas and carbon cells, all work showing him at the height of his powers. Throughout the same time he was also engaged on his classical work "Thermodynamics of Technical Gas Reactions" (1905). His laboratory was filled with students from all parts of the world; unhampered by administrative cares, it was the most productive phase of his career.

To this period also belongs the beginning of Haber's work on the synthesis of ammonia from its elements, work which led to the discovery of one of the most important of all industrial processes. His first paper on the equilibrium constants of this reaction appeared with Van Ordt in 1904, and in 1906, with Le Rossignol, he undertook a repetition of the measurements, over a much wider range of temperature and pressure. It was then apparent that a catalyst which would operate satisfactorily at 600° C. would make this process possible industrially, and to a man of Haber's breadth of vision the significance of the fact must have been immediately obvious. An unremitting search was made for such a catalyst, and uranium and osmium were found to be effective. A small technical high-pressure apparatus was constructed, and in June of 1908 two directors of the Badische Anilin- und Soda-Fabrik were invited to Karlsruhe to witness the first demonstration of the model at work. After an initial failure, liquid ammonia was produced, and a process of enormous importance to Germany and to the world was launched. Bosch and Mittasch undertook the task of converting the model into a full-scale plant, and with the constant shrewd co-operation of Haber the process was ultimately brought to the highest pitch of efficiency. Haber received the 1918 Nobel prize for chemistry for this work.

In 1906, at the age of thirty-eight years, Haber succeeded to Engler's chair, but left five years later to undertake the direction of the newly founded Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie at Berlin-Dahlem. Under his guidance this became the greatest research institution of its kind in the world; groups of research workers were left with the fullest freedom to develop their own ideas, while Haber gathered around him a devoted and talented staff whom he provided with every material and moral facility for the unhindered progress of their work. No man ever had a more devoted band of colleagues, and no man ever spoke of them more appreciatively than he did.

Haber's interest in the applications of the newer physics to chemistry was reflected in many papers at this time. His work with Just, on the emission of electrons during chemical reaction, had been published from Karlsruhe; and after the War he continued in the same vein with his pioneer work on the physical meaning of chemi-luminescence, and on the applications of the methods of spectroscopy to the analysis of the processes of combustion.

At the outbreak of the War, Haber was impressed by Germany's need for expert organisation of all her industrial resources. He offered his services to the Prussian War Ministry, where he was soon installed as head of the Chemical Warfare Department. There he worked unremittingly throughout the War. His advice and personal service were constantly in demand from all quarters, and such were his unrivalled knowledge and sanity of judgment that his name at this period became almost legendary throughout the country. He never sought to disclaim the responsibility for the use of poison gas, which was indeed the direct concern of his Department, but it should be remembered that latterly he gave up much of his time to serving on the League of Nations Committee on Chemical Warfare.

The War years left him with shattered health,

faced with the difficulties of reorganising an institution the funds of which were already dwindling owing to the monetary inflation, but with the secure conviction that only by the encouragement of research could German industry hope to regain its former position in the world. He played a leading part in the foundation of the Notgemeinschaft der deutschen Wissenschaft, and though some of his plans for the expansion of the Kaiser Wilhelm Institut had to be abandoned, it was not long before it was again in the forefront of research organisations. Meanwhile he himself was organising an attempt to pay the German War debt in gold won from sea-water, an attempt which failed yet yielded scientific results of importance.

The last years at Dahlem brought cares in plenty, but Haber's many industrial and administrative troubles were never allowed to interfere with the output of research from his private laboratory. The greater part of his work now was concerned with chain reactions and the mechanism of oxidation; perhaps his early association with Engler was responsible for this, and on this subject he worked with his assistants until the time of his death. He remained what he had always been, the ideal director of research, approachable, interested in everything, but above all the leader of the work of his Institute. His health was bad, but his industry enormous. Two honours he much appreciated were his election as an honorary fellow of the Chemical Society in 1931; and the award of the Rumford medal of the Royal Society in 1932.

The political situation in the spring of 1933 led to Haber's resignation. Almost all his staff and pupils were forced to look elsewhere for opportunities to continue their work, and he gave up his post rather than remain at Dahlem without them, in a country the political temper of which was so foreign to his own liberality of outlook. He spent himself unsparingly in helping his assistants and colleagues to find opportunities for continuing their work, and ultimately himself accepted an invitation of laboratory hospitality at Cambridge. He went to Cambridge in October and remained there to within a few days of his death. He had left for a short holiday on account of his health, intending to return to reside permanently at that University; but he died during the journey, at Basle, on January 29, 1934.

Haber was equally outstanding as a man and as a chemist. His amazing knowledge of politics, history and economics, as well as of science and industry, and his superb gift of expression made him a fascinating conversationalist. It was always a joy to hear him tell a story, whether it was an anecdote of the War or one of his famous medieval romances. After a paper or a colloquium he showed his powers at their fullest. Never at a loss, whatever the subject, he would always open the discussion with some characteristic contribution of his own, in a way which showed his complete grasp of the subject. One of his outstanding characteristics was his pride in his work; the final preparation of a paper was a work of infinite labour, but once it was completed he found it hard to accept any alteration in its conclusions; and though he was quick to acknowledge any mistake it was a source to him of acute mental discomfort. To his pupils he remained always courteous and affectionate, and to them his death is a great personal loss; but the world also is the poorer by the loss of one of its great benefactors and one of its great men. O. H. W.-J.

Dr. F. L. Kitchin, F.R.S.

Dr. Finlay Lorimer Kitchin was appointed palæontologist to the Geological Survey of Great Britain in 1905. He was attacked by sudden illness on January 17, 1934, and died in St. Thomas's Hospital on January 20. The post which he held for nearly thirty years was one which required an accurate and wide knowledge of the whole field of palæontological science, and he filled it with distinction and marked success. As a successor to such eminent men of science as Huxley, Salter, Etheridge, Shannon and Newton, he recognised the necessity of maintaining a high standard of performance and in no respect did his endeavours sink below the level of his predecessors.

Devoted to his subject, Kitchin was meticulously accurate, and at the same time he was able to co-operate freely not only with his official assistants but also with academic and other palæontologists who sought his advice. Being in charge of one of the largest collections of British fossils, on the curation and growth of which he had spent a large part of his working life, he acquired an experience of British stratigraphical palæontology which was probably unique. But he spared no efforts to secure the most accurate determinations, and he grudged neither time nor trouble, though often working on material which had less morphological value than stratigraphical interest. In this respect the value of his services to British geologists working in the field was unprecedented.

Kitchin's special sphere of work was in the province of Mesozoic palæontology. His earliest thesis, for the degree of Ph.D. at the University of Munich, where he studied under Zittel, was on Indian Jurassic Brachiopoda, and among his most important contributions to British palæontological stratigraphy were the two memoirs which he wrote with Dr. John Pringle on the Mesozoic rocks penetrated by borings in the coalfield of Kent. He also investigated the stratigraphy of the British Gault and contiguous formations, on which he wrote a number of useful papers. But he was very largely occupied by the preparation and editing of the palæontological chapters of memoirs on British geology, and the value of his services in this direction cannot be measured in terms of the amount of output which can now be attributed to his name.

For thirty years Kitchin held a leading place in the esteem of all his fellow workers, and his thoroughness and critical ability gained the confidence not only of his colleagues but also of all stratigraphical palæontologists both in Britain and abroad.

Dr. Kitchin was born in Whitehaven in 1870 and educated at St. Bees School and at St. John's College, Cambridge. After graduating at Cambridge he studied at Munich for several years. For a short period he worked unofficially at the British Museum, and in 1898 he joined the Geological Survey as an assistant to E. T. Newton. He became palæontologist in 1905. He was a vice-president of the Palæontographical Society and a fellow of the Royal Society. He took the degree of Sc.D. at Cambridge in 1923. For many years he had served on the council of the Geological Society, which in 1934 awarded to him the Lyell Medal, an honour which he did not live to receive.

Dr. Kitchin had a very wide circle of friends who were attracted to him by his obvious sincerity and great willingness to help all earnest scientific workers. Of a retiring disposition, he was passionately fond of music and was himself no mean executant. He was twice married and leaves a widow, two sons and one daughter. On January 23, at Golder's Green, a large assembly of colleagues and scientific friends paid their last respects to a man of science, who was not only personally beloved, but had also taken an important part in the scientific activities of British palæontologists for nearly forty years. J. S. F.

Mr. Douglas W. Freshfield, D.C.L.

Mr. Douglas Freshfield, who died in his eighty-ninth year on February 9, was prominent as a promoter of the serious study of geography for more than fifty years. As an Eton boy he made several ascents in the Alps and his love of mountains grew with his growth. He was recognised as one of the greatest mountaineers of the Alpine Club ; but his attitude was that of an explorer and student of mountains rather than that of a sportsman, keen on records of first ascents. He broke new ground in the Alps, the Caucasus and the Himalayas, and in his sixtieth year he started from Mombasa with the intention of making an ascent of Mt. Ruwenzori, and he reached 12,000 ft. before turning. He wrote many books of much charm ; the two largest, "The Exploration of the Central Caucasus" (1896) and "Round Kangchenjunga" (1903), are permanent works of great value, masterpieces of the literature of travel and illustrated with superb photographs. His biography of the great Swiss mountaineer and man of science, H. B. de Saussure (1920), was recognised as a classic.

Mr. Freshfield was admitted a fellow of the Royal Geographical Society in 1869 by Sir Roderick Murchison, and became a member of the council in 1878. Except for the ten years following 1894, when he withdrew from the affairs of the Society as a protest against certain retrograde tendencies, he served throughout his life as honorary secretary, vice-president, president (during the difficult War years 1914–17) and finally in the high office of trustee. He was always a force for progress and in continuous opposition to the tyranny of old tradition. His reserved nature and fine taste led him to shun publicity ; but when the occasion demanded it, as in the fight for the admission of ladies as fellows in 1893, he took a prominent part and conducted controversy with cogent argument and caustic wit.

Freshfield made no pretence of being a scientific man ; but he preached and practised the doctrine of acute observation and accurate description. He rendered noble service to the science of geography by his encouragement of research and of higher education. In 1884, recognising the futility of the Society's scheme of encouraging geographical education by offering prizes to the public schools, he initiated an inquiry into the state of geographical teaching on the Continent and secured the appointment of the late Sir John Keltie for that purpose. The resulting report started the modern revival in British geography. Mr. Freshfield continued to urge that the best way to improve school teaching of the subject was to secure the recognition of the high cultural value of geography by the universities. Starting with his own University of Oxford, he secured the appointment of Sir Halford Mackinder as reader in geography in 1887 when there was no chair of geography in any British university, and he lived to see professors and honours schools of geography in practically every one as the direct result of his initiative.

For thirteen years Mr. Freshfield acted as president of the Geographical Association, the activity of which in its special province of education he watched over with an interest only exceeded by his devotion to the work of the Royal Geographical Society and of the Alpine Club.

Freshfield's life was a fine illustration of the tradition of service which has led so many men of wealth and culture in England to toil for great ideals as strenuously as most men have to work for their living. Hugh Robert Mill.

We regret to announce the following deaths :

Mr. E. G. B. Meade-Waldo, an original member of the Society for the Protection of the Fauna of the Empire, on February 24, aged seventy-nine years.

Dr. F. C. Purser, president of the Royal College of Physicians of Ireland and professor of medicine in the University of Dublin, on February 28.

Mr. William Barlow, F.R.S., known for his early work on the relation of crystal structure to chemical composition, on February 28, aged eighty-eight years.

Prof. S. F. Oldenburg, for twenty-five years permanent secretary of the Russian Academy of Sciences, on February 28, aged seventy years.

News and Views

New Fellows of the Royal Society

THE following have been selected by the Council for election to the fellowship of the Royal Society :— Mr. A. S. Besicovitch, Cayley lecturer in mathematics, University of Cambridge ; Prof. W. E. Curtis, professor of physics, Armstrong College, Newcastle-on-Tyne ; Dr. L. L. Fermor, director of the Geological Survey of India ; Dr. Paul Fildes, research bacteriologist, London Hospital ; Dr. R. T. Grant, lecturer in cardiac pathology, University College Hospital Medical School, London ; Mr. M. A. C. Hinton, deputy keeper of zoology, British Museum (Natural History) ; Dr. E. L. Hirst, senior lecturer in organic chemistry, University of Birmingham ; Dr. E. L. Kennaway, director of the research laboratory, Cancer Hospital, London ; Mr. A. G. M. Mitchell, consulting engineer, Melbourne ; Prof. W. A. Parks, professor of geology and head of Geology Department, University of Toronto ; Prof. H. Raistrick, professor of biochemistry, University of London ; Prof. A. O. Rankine, professor of physics, Imperial College of Science, London ; Lieut.-Col. R. B. Seymour Sewell, leader of the John Murray Expedition to the Arabian Sea, and director in 1925–33 of the Zoological Survey of India, Calcutta ; Prof. S. Sugden, professor of physical chemistry, Birkbeck College, London ; Mr. William Taylor, mechanical engineer, managing director of Messrs. Taylor, Taylor and Hobson Ltd., Leicester ; Dr. H. Hamshaw Thomas, University lecturer in botany, University of Cambridge ; Rev. Alfred Young, mathematician, rector of Birdbrook, Essex.

New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 5, H.R.H. the Duke of York was elected an honorary fellow. The following ordinary fellows were also elected : Dr. D. Bain, lecturer in technical chemistry, University of Edinburgh ; Dr. P. Brough, lecturer in botany, University of Sydney ; Prof. I. de Burgh Daly, department of physiology, University of Edinburgh ; Dr. F. F. Darling, chief officer of the Imperial Bureau of Animal Genetics, University of Edinburgh ; Prof. D. R. Dow, Department of Anatomy, University of St. Andrews (University College, Dundee) ; Mr. W. L. Edge, lecturer in mathematics, University of Edinburgh ; Dr. I. M. H. Etherington, lecturer in mathematics, University of Edinburgh ; Mr. G. Fraser, chartered civil engineer ; Prof. J. Glaister, Department of Forensic Medicine, University of Glasgow ; Dr. R. M. Gorrie, Forest Research Institute, Dehra Dun, U.P., India ; Mr. D. Haldane, senior geologist, H.M. Geological Survey (Scotland), Edinburgh ; Dr. J. V. Harrison, geologist, Glasgow ; Mr. J. Jeffrey, Under-Secretary of State for Scotland, Edinburgh ; Sir William Johnston, Deputy Keeper of the Signet ; Dr. R. Cranston Low, formerly lecturer in dermatology, University of Edinburgh ; Brigadier-General Magnus Mowat, secretary of the Institution of Mechanical Engineers, London ; Mr. W. G. R. Murray, technical assistant, Department of Chemistry, University of Edinburgh ; Prof. A. R. Normand, Department of Chemistry, Wilson College, Bombay ; Prof. R. K. Pal, Department of Physiology, Prince of Wales Medical College, Patna, India ; Dr. H. J. Plenderleith, Research Laboratory, British Museum, London ; Dr. D. E. Rutherford, Carnegie Teaching Fellow in mathematics, United College, University of St. Andrews ; Capt. H. K. Salvesen, shipowner, Edinburgh, formerly fellow of New College, Oxford, 1923–28, and lecturer in economics ; Dr. M. S. Thomson, physician for diseases of the skin, King's College Hospital, Belgrave Hospital for Children, London : Dr. J. Weir, lecturer in palæontology, University of Glasgow ; Mr. W. Whyte, cashier and general manager, Royal Bank of Scotland, Edinburgh ; Dr. W. P. D. Wightman, science master, Edinburgh Academy ; Prof. B. M. Wilson, Department of Mathematics, University of St. Andrews (University College, Dundee) ; Dr. A. Winstanley, engineer to Safety in Mines Research Board, Edinburgh.

Sir James Jeans : President of the British Association

ON account of the lamented death of Sir William Hardy, it became necessary to elect a new president of the British Association for the meeting to be held at Aberdeen in September next. The General Committee of the Association, which met for this purpose on Friday, March 2, elected Sir James Jeans to this office, and we understand that he has accepted the invitation to serve. It is scarcely too much to say that no man of science now living is better known than he is to intelligent readers—both scientific and lay—through his brilliant expositions of complicated physical and mathematical conceptions. These rare qualities have enabled him to open new realms of thought and inquiry to philosophers as well as experimentalists, and also to interest laymen in the development of ideas relating to the universe. These involve explanations of relativity, quantum and wave mechanics and other novel aspects of cosmogony with their philosophical implications. In literary style and scientific substance these works are among the best of their type ever produced ; and their widespread circulation is a gratifying sign of public interest in intricate scientific subjects when made intelligible by artistic expression. What renders Sir James Jeans unique, however, is that he should possess this gift and at the same time be a leading authority in the field of mathematical physics and the author of those substantial contributions to the dynamical theory of gases and the mathematical theory of electricity and magnetism and dynamical astronomy, which led to his election into the Royal Society in 1906 and the award of a Royal medal in 1919. We may confidently anticipate that his presidential address to the British Association will enrich the literature of science and be worthy of the intellectual outlook of the great university and city in which it will be delivered.

Dr. H. Moore

DR. HAROLD MOORE, who has just taken office as president of the Institute of Metals, was born in 1878, and began his metallurgical career as a pupil of the late Dr. J. E. Stead. In 1901 he became research metallurgist at the Parkhead steel works of William Beardmore and Co., Ltd., where his work in connexion with the manufacture and heat-treatment of armour-plate developed his interest in alloy steels. Rapid progress was then being made in the application of nickel-chromium steels for this and other purposes. Later work has shown that some of the methods of heat-treatment then developed empirically must have had the effect of suppressing temper brittleness, a trouble that was not clearly defined until some years later. In 1904 Dr. Moore joined, as chief metallurgist, the Research Department at Woolwich Arsenal, where he remained for twenty-eight years, from 1919 until 1932, being director of metallurgical research. As chief metallurgical adviser for many years to the War Office and the Ordnance Department of the Admiralty, Dr. Moore had a wide experience of Service problems both on the manufacturing and the applications sides. In 1922 a research on the casting of brass ingots was undertaken under his direction for the British Non-Ferrous Metals Research Association, and this led to a gradually increasing co-operation between the Association and the Research Department, Woolwich, which undertook work on lead cable sheathing (in the course of which the widely used B.N.F. ternary alloys of lead were developed), electrodeposition of nickel, tin coatings, etc. In 1932 Dr. Moore accepted the offer of the post of director of the British Non-Ferrous Metals Research Association, which had become vacant through the election of Dr. R. S. Hutton as Goldsmith's professor of metallurgy in the University of Cambridge.

Prof. William Buckland, 1784-1856

MARCH 12 marks the one hundred and fiftieth anniversary of the birth of the Rev. William Buckland, geologist and father of the famous naturalist, Frank Buckland. William Buckland was born at Tiverton, Devonshire, on March 12, 1784. He went up to Corpus Christi College, Oxford, from Winchester in 1801 and was elected a fellow of his College in 1808. Five years later he was appointed Oxford reader in mineralogy and was elected a fellow of the Geological Society, of which body he was twice president. He was elected a fellow of the Royal Society in 1818, in which year he was appointed first professor of geology at Oxford. Upon the discovery of the Kirkdale Cave, Pickering, Yorkshire, in 1821, in which the fossil bones of numerous Tertiary animals were found, Buckland made a careful examination, and in 1822 the Royal Society awarded him its Copley medal for his account of the study of the remains found in the cave. In 1823 he supplemented his observations on Kirkdale Cave by publishing "Reliquiæ Diluvianæ". A century ago he was working at his well-known Bridgewater Treatise (awarded for an essay "On the power, wisdom, and goodness of God, as manifested in the creation"), "Geology and Mineralogy considered with reference to Natural Theology", which was published in 1836. After his appointment as Canon of Christ Church in 1825, he lived at the House for twenty years, and it was in a wall in the Canon's garden that he tested the power of toads to live when immured in rock cavities. In 1845 he was made Dean of Westminster. The strain of his new work at Westminster undoubtedly shortened his life, and he died and was buried at Islip in August 1856.

Research on Influenza

THE extermination of the polecat in Great Britain was carried out with deplorable success in the eighteenth and early nineteenth centuries. It is fortunate for the progress of knowledge that it survived in the domesticated form of the ferret, which was of immense service in solving the problem of the cause and prevention of dog distemper, and now promises to be of equal value in studying human influenza. The facts so far ascertained at the National Institute for Medical Research at Hampstead are not conclusive but they are certainly very suggestive. Dr. P. P. Laidlaw, Dr. C. H. Andrewes and Dr. W. Smith have found that washings from the noses of human cases of influenza, after passing through a bacteria-proof filter, cause a characteristic febrile and catarrhal attack when instilled into the noses of ferrets, which by similar means can be carried on to other ferrets in series. No other animal which has been tried is susceptible in the same way, and no other method of inoculation will infect the ferret—so much does progress rest on technique. Recovered ferrets are immune and their blood will neutralise the infective material, as will the blood of human beings who have passed through an attack. The facts fit in well with the idea that uncomplicated human influenza is relatively a trivial disease and that when the cyclical epidemics fall in the summer months they attract no great attention: if they come in the winter they give a severe affection with a substantial mortality due to the secondary invasion of the lungs by Pfeiffer's bacillus, streptococci and perhaps pneumococci. In the 'influenza' of pigs studied by Shope in America, the virus causing the primary disease is of practical importance only because it allows infection by the secondary bacillus.

Petrol from Coal

THE liquid products of the carbonisation of coal at low temperatures have been disappointing because they lack the chemical characteristics which give special value to high temperature products. Thus, low temperature tar oils have had to be used as boiler fuel oils—which is the lowest use to which a manufactured oil can be put. It is, however, satisfactory to know that the Admiralty has been able to use such oils as fuel and thus satisfy its needs from British coal. Researches now proceeding may provide new outlets for low temperature oils. As a source of motor spirit, low temperature products are also at a disadvantage, the crude spirit being troublesome to refine owing to a high proportion of unsaturated compounds liable to form gums on the

engine. Moreover, the spirit, when refined, lacks the aromatic compounds which give to benzole its high 'anti-knock' value. The necessity for removing the unsaturated compounds is regrettable because they also possess 'anti-knock' qualities. Modern methods of refining benzole permit the retention of the unsaturated compounds while inhibiting their tendency to form gums. It is noteworthy that the spirit produced in the manufacture of coalite has given such satisfaction in use by a squadron of the Royal Air Force that, according to the *Times* of March 1, the Air Ministry has awarded a new contract for this spirit to cover the requirements of seven squadrons.

24-Hour Time System

We are glad that the subject of the 24-hour system of time reckoning has again been raised in the House of Commons. In a written reply on March 5 to a question asked by Sir Arnold Wilson, the Postmaster-General stated: "I understand that the British Broadcasting Corporation intend at an early date to adopt the 24-hour system of expressing time for general use and on an experimental basis. This will afford an opportunity for testing the attitude of public opinion, and I propose therefore to await the result of the experiment before coming to a decision."

University of Durham

The Prime Minister announced in the House of Commons on March 6 that a Royal Commission has been appointed to inquire into the affairs of the University of Durham and its constituent colleges. Its terms of reference are:—"To inquire into the organization and work of the University and its three constituent colleges and into the relation of the University to these colleges, and to report in what respects the present organization can be improved and what changes, if any, are desirable in the constitutions, functions, and powers of the University and its three constituent colleges." The members of the Commission are Lord Moyne (chairman), Countess Grey, Sir Ross Barker, Major A. G. Church, Dr. H. R. Dean, the Rev. F. Homes Dudden, Dr. T. F. Sibly, and Mr. W. Spens.

Research in Engineering

In his Friday evening discourse delivered at the Royal Institution on March 2, on "Some Current Research Problems in Engineering", Dr. H. J. Gough, superintendent of the Engineering Department of the National Physical Laboratory, described the main group of researches in progress in his department. As representative examples, researches on wind pressure on structures, impact forces between vehicles and the road and failure of metals in relation to crystalline structure were discussed and demonstrated. An investigation of the wind pressures acting on a shed, 100 ft. by 42 ft. by 33 ft., was described, air flow conditions being rendered visible by using a small wind tunnel and models of buildings in conjunction with an optical system employing the *Schlieren* method. An interesting feature of the investigation was the existence of dangerous suction effects tending to lift off roofs and suck out leeward walls. The importance in engineering service of the particularly dangerous and insidious type of failure known as 'fatigue' was discussed; the problem is also one of considerable scientific interest as it affords a convenient line of attack upon the general problem of the cohesion of matter. The use of large metallic single crystals has opened up a new field of study on both the practical and scientific aspects of fatigue. Fatigue in ductile metals is closely bound up with the effects of plastic distortion, or 'slip', upon the crystalline structure of these metals. The normal form of metals—consisting of crystals of varying orientations each composed of definite arrangements of atoms—was briefly described and the general and particular mechanisms of slip were demonstrated, employing lattice and other models. The effect of slip upon the actual crystalline structure, as deduced from X-ray data, was discussed, reference being made to 'crystal break-up' and lattice distortion, in relation to hardening. A tentative explanation of the cause and location of the initiation of fatigue cracks was described.

In addition to the demonstrations given during Dr. Gough's discourse, exhibits relating to other researches in progress in the Engineering Department of the National Physical Laboratory were on view in the Royal Institution Library. The effect of the conditions of the surface on such engineering components as wrought iron chain, springs for vehicles, etc., is often of considerable influence on the resistance to impact loading or to repeated cyclical loading. In investigating the latter effect, a machine for applying cycles of torsional stresses was shown at work; this machine also demonstrates that quasi-elasticity is exhibited by materials even when subjected to repetitions of a range of stress which will *not* lead to fracture. Characteristic examples of fatigue failure in engineering service were exhibited, and the first high speed machine for investigating the behaviour of metals under combined fatigue stresses was shown in operation. Another machine demonstrated the characteristics of film lubrication between surfaces undergoing relative reciprocating motion; the coefficient of friction is independent of load but varies with speed and temperature, hence the friction is not of the true boundary type but relates to a thicker film. The skidding characteristics of road vehicles were demonstrated by models showing that: (*a*) with locked rear wheels the vehicle turns round while, if the front wheels are locked, the path of the vehicle is straight; (*b*) the turning effect arising from locked back wheels is caused by lack of directional control at the rear of the vehicle; (*c*) 'steering into the skid' tends to preserve a straight path; also, that over-correcting or delay leads to a series of swerves; (*d*) equal breaking on all four wheels can result in rotation of the vehicle and may be dangerous.

Elements Old and New

The historical development of the conceptions of 'atom' and 'element' were outlined by Prof. James

Kendall, professor of chemistry in the University of Edinburgh, in delivering the twenty-fifth Bedson lecture in Newcastle-upon-Tyne on March 2. He pointed out that there have been four great periods of chemical discovery, corresponding quaintly with the four 'elements' of the Greeks, fire, air, earth, and water. The first was the phlogistic period, ending with Lavoisier; the second, the great period of research on gases; the third, the gradual rounding off of the chemistry of the rare earths; and the last opened up by the discovery of heavy water. It was mentioned that there should be nine kinds of water, and more than a hundred varieties of ethyl alcohol "some perhaps more exhilarating". Of great interest was the account of a research just concluded in the Edinburgh laboratories in which calcium from a mineral rich in potassium has been shown to have a slightly higher atomic weight owing to the isotope derived from the radioactive isotope of potassium, K^{41}. This has been confirmed by Allison in the United States, using his magneto-optic method. Two pegmatites of very different ages, but of which the younger contains much less calcium than the older, have indicated a half life period of 9×10^{11} years for potassium in agreement with one of two measurements by direct physical methods. The lecture was enlivened by numerous amusing reminiscences and suggestions, especially concerning the new element D (or, according to Prof. H. E. Armstrong, Ww !).

Institute of Chemistry

AT the fifty-sixth annual general meeting of the Institute of Chemistry held on March 1, the president, Prof. Jocelyn Thorpe, in moving the adoption of the annual report of Council, said that the register of the Institute contains the names of 6,176 fellows and associates, and more than 750 students. The number of members known to be disengaged is not more than 3 per cent, so that the profession does not appear to be seriously overcrowded. Rather than endeavouring to restrict entrance to the professions generally, he believes in insistence on a high standard of entrance examinations to the universities and colleges in order to eliminate those who are not likely to make really good professional material. The Legal and Parliamentary Committee, under the chairmanship of Sir Christopher Clayton, has rendered useful assistance in matters of public importance in which the profession was concerned. The new Pharmacy and Poisons Act has placed beyond doubt the right of those who practise chemistry, as well as those who practise pharmacy, to use the title 'chemist'. The examinations for National Certificates in Chemistry, conducted jointly by the Institute and the Board of Education and the Scottish Education Department respectively, are having a beneficial effect on the training in science afforded in technical institutions throughout the country. Lately, the Council has discussed the place of chemistry in general education. It seems that in some places chemistry is regarded as too difficult a subject for boys less than sixteen years of age, and that physics and biology should be given the preference as school subjects; the Council proposes to publish the discussion and to invite members to express their views thereon. Prof. Thorpe was re-elected president of the Institute.

Associated Learned Societies of Liverpool and District

AN important stage in the history of amateur scientific circles on Merseyside was a reception at the University of Liverpool on March 3 of the Associated Learned Societies of Liverpool and District, which represents some twenty amateur societies with a membership of about 4,000. The Vice-Chancellor of the University, Dr. H. J. W. Hetherington, who is also president of the Associated Societies, welcomed the gathering, while the Pro-Chancellor of the University, Mr. C. Sydney Jones, said the University is always to be looked upon as a friend and encourager of the amateur scientific bodies of Liverpool. The chairman of the Associated Societies, Mr. W. Mansbridge, in passing a vote of thanks, told how in the past the co-operation of amateur and professional scientific workers that existed in the societies has been to the benefit of each, and the societies have often been of help to the research workers at the University. A tour was then made of the various departments, where exhibits and demonstrations had been arranged. The Associated Learned Societies of Liverpool and District was formed in 1922 to promote co-operative undertakings between the various learned societies, to stimulate the interchange of ideas to the benefit of the societies or of knowledge, and to promote cordial relations between them and the University, the local education authorities and the municipal institutions. The committee has, in the past, arranged a number of joint soirées and scientific exhibitions, lectures and excursions to places of scientific interest.

The Autodial for Telephones

TELEPHONE subscribers connected to automatic exchanges who use their instruments frequently will soon be able to obviate in many cases the necessity of making the dialling operations. On the London automatic exchanges, the ordinary number of operations to be carried out is seven. By means of the new autodial, these operations can be reduced to two. The device is contained in a small box on the face of which there is an index of the names of the subscribers most frequently called. When anyone whose name is on this index has to be called, all that has to be done is to set the pointer of the instrument opposite the name required and depress a lever. There is no change-over switch and the instrument does not in the least interfere with the normal use of the telephone. Any number not on the index can be called by the usual method of dialling. The index names correspond with toothed discs, the teeth of which are cut away to form a transmitting code of impulses corresponding to the number selected. The discs clip on to a rotating cylinder so that the combination can be easily changed when necessary. The depression of the lever winds the cylinder sufficiently for one revolution and this is sufficient to generate the train of impulses necessary for completing the call. We understand that subscribers will

be able to hire an autodial for a few shillings quarterly. It is made either for 25 or 50 names. For business houses and intercommunication systems, special forms are made. The distribution of the instruments for private installations is made by Dictograph Telephones Ltd., Aurelia Road, Croydon.

Life on the Planets

IT is highly unlikely that there is any life on any planet in the solar system except the earth. Dr. W. S. Adams, who has himself made some spectroscopic investigations of our fellow planets, has enumerated the factors which preclude the possibility of life on each of them (Science Service, Washington, D.C.). In the case of Mercury, the planet is too hot and too small to hold an atmosphere. Venus has neither oxygen nor water above the dense clouds which hide its surface, but it does have carbon dioxide, which shows that plants, if any, are not numerous. The possibility of life is least remote in the case of this planet, but without plant life there can be no animals or human beings. Mars is so small, and its gravity so weak, that its atmosphere is thin. It has polar caps suggesting water, but the spectrum shows no free oxygen. The outer planets have temperatures far below zero: their great masses enable them to hold dense atmospheres, containing gases which are rare in the earth's atmosphere: the poisonous gas ammonia is a fairly abundant constituent of their atmospheres, but oxygen has not been found in any of them. Imaginative enthusiasts who project interplanetary journeys in rockets, must envisage a complete departure from the solar system, and conduct an extensive search among the satellites—if any—of some of the nearer stars, if they wish to find a landing place at which they can avoid suffocation at the end of their journey.

British Spas and Health Resorts

WE have received the 1934 edition of the official handbook of the British Health Resorts Association, edited by Dr. R. Fortesque Fox ("British Spas, Inland and Seaside Resorts". London: Messrs. J. and A. Churchill. 1*s*. 0*d*. net). The book has expanded and contains several new features. The section on spa treatment and particulars of British spas has been extended, and health attractions of New Zealand, South Africa and Canada are detailed. Full information is also given respecting seaside resorts, and of the medical values of some of them as winter resorts for convalescents and delicate persons, and a full guide to hotels, hydros, etc., is included. The Minister of Health, Sir E. Hilton Young, contributes a foreword.

Announcements

SIR HENRY GEORGE LYONS, lately director of the Science Museum, South Kensington, has been appointed a Trustee of the National Portrait Gallery, in succession to the late Sir William Hardy.

MR. H. T. TIZARD, rector of the Imperial College of Science and Technology, has been appointed to be one of the Development Commissioners.

THE following appointments in the Colonial Agricultural Service have been made by the Secretary of State for the Colonies: Mr. L. L. De Verteuil, to be assistant agricultural officer, Antigua; Mr. S. M. Gilbert, assistant director of Agriculture, Trinidad, to be chief scientific officer, Coffee Research and Experimental Station, Tanganyika; Mr. R. O. Williams, economic botanist, to be assistant director of agriculture, Trinidad.

THE Council of the Royal Society of Edinburgh has made the following awards: Keith prize for the period 1931–33, to Dr. A. Crichton Mitchell, for his paper on "The Diurnal Incidence of Disturbance in the Terrestrial Magnetic Field" published in the *Transactions* within the period of the award; Neill prize for the period 1931–33, to Dr. G. W. Tyrrell, for his contributions to the geology and petrology of sub-arctic and sub-antarctic lands. These prizes will be presented on July 2.

IT is reported in the *Moscow Daily News* that a conference is to be held in Leningrad in April at which the study of the stratosphere is to be discussed. It is anticipated that some 350 scientific workers will attend this conference, including Profs. Joffe, Vavilov, Molchanov and the crew of the stratostat *USSR*. It is stated that the Geophysical Observatory has issued a symposium on the first Soviet flight into the stratosphere summarising the scientific material obtained.

A USEFUL bibliographical list of geographical books both for university and school use has been issued by Messrs. W. Heffer and Sons, Cambridge (Catalogue No. 422). It contains more than 700 entries classified under various headings for easy reference. New as well as relatively old but standard works are included. The list should prove useful to all students of the subject.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A woman lecturer in needlework, hygiene and household science at Bingley Training College—The Education Officer, County Hall, Wakefield, Yorkshire (March 13). Mechanical and automobile engineers in the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (March 15). A district live stock officer and an assistant marketing officer in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (March 19). An electrical inspector of factories—The Industrial Division, Home Office, London, S.W.1 (March 20). A resident lecturer in science, chiefly biology and gardening, at St. Hild's College, Durham—The Principal (March 28). Examiners in various subjects of the Matriculation and General School Examination of the University of London—The Secretary to the Matriculation and School Examinations Council, University of London, South Kensington, S.W.7 (April 4). Professors of medicine and pathology at the British Post-Graduate Medical School—The Academic Registrar, University of London, South Kensington, S.W.7 (May 4).

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Reviews

The Scientific Spirit of the Greeks

The Heroic Age of Science: the Conception, Ideals and Methods of Science among the Ancient Greeks. By Prof. William Arthur Heidel. (Published for the Carnegie Institution of Washington.) Pp. vii+203. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 12*s.* 6*d.*

"WE must endeavour," wrote Plato in the "Timæus", "to construct the four forms of bodies which excel in beauty, and then we shall be able to say that we have sufficiently apprehended their nature." To wrest this sentence from its context, and to take it as a characteristic expression of a prominent aspect of Greek science, is to do no great violence to truth. The modern conception of science scarcely becomes recognisable until the days of Galileo, and in any judgment of early science we should remember that our present standards of sufficient apprehension of the nature of a body do not necessarily apply. That we believe them to be better is not strictly relevant; the essential factor in judgment must be: given the contemporary standards, what results might have been expected, and what were actually achieved?

There are certain problems that the world seems inevitably to present to the thinking man. For some centuries past, it has been the custom—a custom justified by its success—to attack these problems piecemeal rather than by a grand general onslaught. An initial slowness of advance gradually changed to rapid progress, and we now have a body of well-established knowledge unparalleled in the history of the race. The ancient Greek was of too fiery an intellectual spirit to wait for the patient accumulation of facts; he took such meagre stock as was available, supplemented it by an acute power of observation, and proceeded with unconquerable enthusiasm to the sufficient apprehension of himself, the earth and the heavenly bodies.

It was a necessary consequence of this uncontrollable burgeoning of the mind that the problems we now segregate into theology, philosophy, science, mathematics and other conventional folds should be fused by the Greek into a single mass; and if the mass appears to us to be of a terrifying heterogeneity, we are not to suppose that it so presented itself to him. On the contrary, if Greece has one lesson more than another for modern science, it is that devotion to analysis should not lead to neglect of the synthetic outlook that, in Athens, extracted such brilliant results from such scanty material.

In an age when the principal intellectual aim was to solve the universe to-day, or at latest to-morrow, we must not expect to find a humdrum corpus of scientific knowledge increasing by imperceptible degrees, but steadily. As Prof. Heidel justly remarks, in the epilogue to his valuable and extremely interesting book, the Greek "seems to have felt, as did Wordsworth, that 'the world is too much with us'; its very jostlings gave him a sense of being an alien until he could, as it were, keep it at arm's length long enough to glimpse its meaning. Its significance and relations fascinated him—if he could discover these, the brute facts interested him little". It was this imperious passion to unriddle the major enigmas that gave Greek thought both its sublime successes and its gravest shortcomings.

Among the latter, a general failure to appreciate the vital importance of experiment is that which the modern man of science will most condemn. There is a remarkable unanimity of historians (a body not commonly given to speak with one voice) that the art of experiment, though by no means unborn at that time, was despised rather than encouraged by the educated Greek; and it is certainly true that even Aristotle relates many things as facts that he might easily have disproved by the simplest of experiments. It is not that powers of observation were lacking—indeed, few peoples have equalled the Greeks in keenness and accuracy of observation—but that the deliberate arrangement of events for the purpose of defining or extending knowledge appears to have been regarded by them as too slow, too cumbersome or too undignified a method for the intelligent man.

Let the craftsman, the artisan, the slave, deal manually with reluctant matter, while the philosopher employs his time to better advantage with the things of the mind.

Prof. Heidel has much to say that is new and illuminating upon this verdict. He makes the point that, in evidential value, as in principle, there is no reason for giving experiment the preference over observation, and that in some sciences, which are (or may be) quite as exact as the experimental, there is little or no possibility of experimenting. "What distinguishes the best scientific procedure of modern times," he says, "is chiefly the refinement of technique, and, in a few outstanding sciences, the recognition of the methodological principles which require an elaborate technique. This refinement of technique is due principally to the progressive definition of problems as science has pushed its inquiries farther and farther." While this point of view might be disputed, and while Prof. Heidel might be reminded that even astronomy is, in numerous and important respects, an experimental science, we may readily grant him the conclusion he wishes next to draw, namely, that since the Greeks were pioneers, we ought not to expect the same refinement of experiment from them that we demand of modern science.

The conclusion is a weighty one, and not the less so for becoming self-evident when thus baldly stated. We are made to reflect that, far from being a ready-made tool, the art of experimentation had to be chipped and hewn for long ages before reaching its present Saladin-sword efficiency. Our former question recurs : What were the contemporary standards, and what relation do the results bear to what might have been achieved ? Prof. Heidel shows us that the standards were necessarily low, and that the results were in fact by no means so negligible as is popularly supposed. He is able to quote many genuine experiments from Greek authors, and to bring forward evidence that the basic nature of experiment, and its importance, were widely recognised. He admits that for the most part such experiments as were made were simple, and served to answer simple questions, and that apparently they were generally undertaken to test theories rather than to discover facts upon which to found theories. But he has certainly established the thesis that, within limits, the Greeks knew how to experiment and appreciated the confirmation which a successful experiment provided. Since, moreover, he does not overstate his case, but frankly agrees that there is a great difference between modern science and the achievements of the Greeks, we may the more happily revise our estimate of the 'heroic age of science', and admit a greater debt to Hellas than we had previously acknowledged.

In his preface, Prof. Heidel says that he hopes to make further contributions to the history of Greek science in various fields. That hope will be echoed heartily by all who have the good fortune to read the present volume. E. J. Holmyard.

The Thyroid Gland

The Thyroid Gland : its Chemistry and Physiology. By Prof. Charles Robert Harington. Pp. xiii + 222 + 8 plates. (London : Oxford University Press, 1933.) 15*s*. net.

THERE will be few more interesting chapters in the history of science than that which includes the development of our knowledge of the chemistry and physiology of the thyroid gland. Prof. Harington's book offers an excellent basis for that chapter. He reviews early conceptions of the nature of thyroid function, the gradual definition of ideas through the study of myxœdema, operative and experimental removal of the gland, and replacement therapy, to Magnus Levy's demonstrations in 1895 of the characteristic effect of the thyroid on metabolism.

The concurrent story of the study of goitre is outlined from the earliest records to the present day. The curious persistence throughout the story, from Pliny, about 2000 years ago to the present time, of certain tendencies, for example to associate goitre with certain drinking waters, is of great interest. Geographical, and age and sex, distribution, are discussed in relation both to older theories and to more modern knowledge. The inspired attempt of Chatin, early in last century, to correlate the incidence of goitre with low iodine supply, without any idea that iodine is an essential constituent of the gland secretion, has been amply justified by recent work.

The chemical study of the thyroid secretion and the exact study of its metabolic action date from much more recent times and follow the discovery of iodine in the thyroid. The preliminary studies showed that "the organic iodine compound is attached to a characteristic globulin which, together with a small proportion of an iodine-free nucleo-albumin, constitutes the colloid with which

the follicles of the normal thyroid are filled". From there, the account is of work done by Prof. Harington and his collaborators. They have shown that the iodine in the thyroid is divided between diiodotyrosine and the characteristic thyroid amino-acid, thyroxine, the former being regarded as precursor of the latter. Thyroxine exerts all the effects on metabolism of thyroglobulin but, on the basis of equivalent iodine content, in less degree. It is further shown that a peptide containing thyroxine as one of the constituent amino-acids, isolated from thyroglobulin by enzymic digestion, is more active than thyroxine alone. Prof. Harington believes, therefore, that such a compound, possibly one more complex and more active than that isolated, represents the true active principle.

On the physiology side the book is perhaps somewhat less satisfying than on the chemical. While it will possibly be agreed that "the immediate cause of goitre is failure of the thyroid gland to obtain an adequate supply of iodine", it is doubtful whether it will also be accepted as settled that "environmental deficiency is the sole cause of most endemic goitre". It seems possible, assessing all the available evidence, that the deficiency, in many cases, may be not primary but conditioned by a multiplicity of factors. It would be of great, and not purely academic, interest to find a satisfactory explanation for the persistent popular association of goitre with water or with lime. Such beliefs may be as well founded as the ancient use of burnt sponge as a remedy. But the water belief cannot yet be shown to bear any relationship to the iodine deficiency theory.

There are other questions, too, that might be asked. If the dysthyroidism theory of Graves' disease, as enunciated by Plummer, be rejected on the basis that "no derivative of thyroxine containing less than the full complement of iodine either approximates to thyroxine in activity or exhibits any toxic properties whatever", may it not immediately be reformulated on the basis of Prof. Harington's own statement that "variations may occur in the amino-acids with which thyroxine is combined to form the active secretion, so that the physiological properties of the secretion produced by different glands and under different conditions may not be quantitatively constant" ?

Prof. Harington contends that there is reason to seek the origin of the "thyroid diarrhœa" of Graves' disease outside the gland itself. Anterior pituitary, with its recently discovered thyrotropic hormone, offers itself as an obvious scapegoat at the moment. But then there is the question of whether abnormality of the pituitary is, in fact, associated with Graves' disease. The riddle is still to read. Those who are interested will find in this book the fundamental chemical and physiological facts with which any theory of Graves' disease must conform. I. Leitch.

Human Reproduction

The Science of Human Reproduction : Biological Aspects of Sex. By Prof. H. M. Parshley. Pp. 319. (London : George Allen and Unwin, Ltd., 1933.) 12*s.* 6*d.* net.

THE author of this book is an American professor of zoology, and from his preface we learn that a large proportion of the population (of the United States ?) refuse to accept religious guidance in sexual matters, and that he aspires to substitute for this guidance the supreme authority of science. He has succeeded in giving a readable account couched in comparatively simple language of the structure of the reproductive organs in man, which should be quite intelligible to the average educated person.

A very interesting point is the author's explanation of how at the same time the ova are wafted *down* the Fallopian tube and the sperm propelled up it. Parker's investigations (published in the *Phil. Trans. Roy. Soc.*) seem to show that spermatozoa are quite incapable of such a feat as swimming upwards in the face of a down-flowing current. Apparently they adhere to the walls of the tube, swimming slowly in all directions, and are carried upwards in folds of the wall by an upwardly directed peristalsis. The ova, on the contrary, lie free in the lumen and are carried downwards by the current produced by the cilia lining the walls.

Like many Americans, the author is a wholehearted supporter of the Morgan theory of the determination of sex by the 'random' passage of sex-chromosomes into one cell or another. This theory, so facile and at first sight so plausible (especially when represented by simplified diagrams in which all awkward details are left out), threatens to become a dogma in the United States. Yet a wide survey of the animal kingdom shows it to be radically false. Sex, one of the most fundamental phenomena of life, must be essentially the same thing wherever it occurs. As a matter of fact, the eggs and spermatozoa of sponges, the lowest

Metazoa, are not very different in their histology from those of man, the highest. There are, however, very many cases where sex is 'determined' entirely independently of any possible intervention by sex-chromosomes. In the bee, for example, the male possesses all the kinds of chromosome which are present in the female but they are haploid in the male and diploid in the female. In *Rana esculenta*, the edible frog of northern Europe, a large proportion of the tadpoles metamorphose into young females, but of these nearly half change into males during the period of their adolescence, which lasts four years. They develop seminal tubes from the peritoneal covering of the ovary, which grow into the ovary and completely destroy it, replacing it by a testes. Then there is the classical case of Prof. Crew's aged hen the ovary of which was attacked by tuberculosis, and as a result the animal became a cock and produced viable spermatozoa. It seems clear that there are fundamentally opposed male and female constitutions, but that the constitution of every individual is a mixture of the two, and that the structural manifestations of sex depend on the proportion of these constitutions and on which gains the upper hand in development.

When the author approaches the vital subject of sexual behaviour, he makes some very sensible remarks on birth-control and the necessity of regulating the population. But in dealing with eugenics he is less happy. He arrives at the conclusion that the object to be aimed at is not the breeding of intellectual men (there might be too many of them and they might become discontented with the positions available for them) but of good men, and that goodness is a heritable quality! He points out that human sexual behaviour both normal and abnormal presents many analogies with the sexual actions of the higher primates and the same fundamental 'urges' are common to both. Here he relies on the work of Dr. S. Zuckerman on the sexual life of baboons. Zuckerman was until recently prosector of the Zoological Society of London and his work is based on observations on the "Monkey Hill" in the Zoological Gardens and on knowledge gleaned during a six months' tour in Africa. Some who, like the reviewer, have had long periods of service on the Council of the Society will not agree with the author and Dr. Zuckerman that the ecology of Monkey Hill presents a fair copy of the natural conditions under which these apes live.

When we further consider the amendments which the author suggests to the old code of morals prescribed by the "taboos of religion", such as the recognition of sexual promiscuity before marriage, and the permission (to the male) of a certain amount of promiscuity after it, we are enabled in some measure to understand the rise and progress of 'Fundamentalism' in the United States.

E. W. MacBride.

Agricultural Organisation

The Planning of Agriculture. By Viscount Astor and Keith A. H. Murray. Pp. xvii + 186. (London: Oxford University Press, 1933.) 6*s*. net.

BRITISH agriculture is unquestionably in a very serious position, and few will disagree with the assertion of the farmers that they are not mainly to blame. The essential features of farming that mark it off from other industries are that its programme of production must be definitely settled many months ahead, that the programme, once begun, cannot be modified, and that the amount of production is subject to large and uncontrollable fluctuations from one season to the next. In the past few years, these inherent difficulties have been intensified by the rapid fall of prices due to world economic conditions and by the numerous corollaries of that fall. It is no longer possible for the landlord to act as a buffer between his tenant farmers and their difficulties, and the State has, of necessity, taken over a portion of this task.

State-aid inevitably implies some measure of control by the State. The development of the quota system is, presumably, regarded by the authorities as the best way of providing assistance without unduly restricting the initiative and freedom of action of the farmers. Viscount Astor and Dr. Murray criticise this policy on both agricultural and economic grounds. They believe that the future of British farming lies in live-stock, fruit, and vegetables, and feel that the present policy will slow up the change-over to these branches of farming, and is therefore to be avoided. They consider that any protection needed by this industry is better given by tariffs, since they are capable of rapid adjustments when necessary; further, tariffs bring in revenue that can, if circumstances necessitate, be distributed to the home farmer as a subsidy or bounty. Finally, quotas, in their opinion, tend to 'canalise' trade to an excessive degree, since some form of bottle-neck

organisation is necessary if they are to be worked successfully.

Economists are in too many camps nowadays for these views to find universal acceptance. The system under which the production of the nations of the world was complementary has, in the opinion of some thinkers, been ended by the discoveries of science and the development of nationalism. If the nations are becoming less interdependent economically, the old methods of trading and of financing trade can no longer apply unaltered. The evolution of new methods will take some time and there are bound to be initial mistakes. Whatever the policy finally adopted, it must take into account one feature of the present depression that distinguishes it from all previous ones : its association with abundance—potential, if not actual. Those who hold these views consider that the basic problem is how to use abundance to improve the lot of mankind instead of to menace them with recurring unemployment.

B. A. K.

Geography of Asia

The Continent of Asia. By Prof. Lionel W. Lyde. Pp. xxii+777. (London : Macmillan and Co., Ltd., 1933.) 16*s.* net.

ASIA covers one third of the land-surface of the globe, and half the world's population is packed into the Indo-Pacific hinterland, the territories between the Indus and the Amur. An author attempting to sketch its bewildering varieties of relief, climate and natural resources, and, at the same time, to summarise coherently the effects of geographical control on its products and the activities of its peoples, must be equipped with an immense detailed knowledge and possess literary ability of an exceptional kind.

Prof. Lyde's earlier work—"The Continent of Europe"—displayed these essential qualifications and they are conspicuous again in the completion of this greater task. The book is divided into "General" and "Regional" sections. The former, occupying a quarter of the volume, contains the mature reflections of a lifetime on the relations of Asia with the rest of the world, on its orography, its eastern and western lobes and central portion. Essays on climate as a whole and in its special aspects are followed by accounts of twelve climatic provinces, the classification being based on genetic control rather than precise statistics. These lead naturally to surveys of the vegetation and faunas, of man and his Asiatic differentiations. A final chapter is entitled "Some Controls", and "control" is defined as "the tendency of certain geographical conditions to favour or disfavour certain human responses", while "response" itself may lead to action as well as reaction. Amongst other subjects introduced here are the types of social polity which the continent presents on so grand a scale, and its curious deficiency, with few exceptions, in large deposits of those minerals on which European and North American civilisation largely rests.

Into such a framework the regional chapters, dealing systematically, but in proper proportion, with each country, are skilfully fitted. They have been revised periodically for twelve years before publication and they bear a corresponding finish which reflects the author's mind and its purposes. Standardisation of treatment is avoided, the construction of each chapter being determined by the decisive human aspect of the unit concerned. Thus though the ways of approaching each country may differ, they converge towards the same object, the correlation of the social, economic and political life of a people with the physical background of their environment and the vagaries of the climate in which they exist. Russian Asia, the Lands of the Five Seas, the Anatolian Plateau, Mesopotamia, Syria and Palestine, Arabia, the Iranian Plateau, India, Ceylon, the Indo-Pacific Fan, China and its dependencies, Japan and Manchuria are so studied in turn, and it is unfortunate that a definition of a continent elastic enough to include Ceylon and Japan was not stretched across the South China Sea to embrace those other islands, often grouped together as the East Indies, as well. This section is characterised throughout by a critical insight finding expression in incisive conclusions, which, particularly in matters of political geography, do not always coincide with other contemporary views.

Short, selected references to literature are given, but those recommended in the case of India and mentioned on p. 435 do not appear. The book is illustrated with 143 maps and diagrams, and these together with the index, letterpress and binding leave nothing to be desired.

It would be very remarkable if an occasional slip in minor detail was not to be found in such an encyclopædic collection of facts, but they are rare and of little account, though the Shan plateau, crossed as it is by two railways and traversed in all directions by good motor roads and busy mule tracks, should not be described as "very imperfectly known" (p. 500).

The unique character of this important book should assure its systematic use in the geography schools and universities of both Western and Eastern lands. To a reader desiring enlightenment on the grave movements which disturb the whole of Asia to-day, from Kashgar to Colombo in one direction and from Mecca to Mukden in the other, it can be thoroughly recommended. Finally, a place must be made for it at once in the front row of authoritative works of reference on Asiatic questions generally.

J. Coggin Brown.

The Coal Problem

(1) *Coal in the New Era.* By Ivor Thomas. Pp. 224. (London and New York : G. P. Putnam's Sons, 1934.) 5*s.* net.

(2) *Smoke and the Atmosphere : Studies from a Factory Town.* By Dr. J. R. Ashworth. Pp. xii + 131. (Manchester : Manchester University Press, 1933.) 7*s.* 6*d.* net.

MAN digs up certain black stones from the bosom of the earth and says to them, "Go forth and make heat, power, light, gas and electricity".

Modern civilisation has been largely built up on coal : the fall in the demand for coal is perhaps the most serious industrial problem with which Great Britain is faced. The reasons for the decline are numerous ; they include industrial depression, more economic use of coal in industry, smaller domestic purchasing power, competition with foreign coal in export markets and with imported oil in the home markets. The coal question is a tragic example of mishandling ; mistakes political, social, economic and technical, have been made of every kind. Even yet there is chaos where there should be order, in spite of repeated attempts by the State and by private bodies to help the industry to better days. Raw coal regards gas and electricity as its enemies, and these two great industries are at each other's throats, instead of all three working for the common interests. Each section is to-day undertaking costly propaganda on its own whereas they should be working together in the closest harmony. We are repeatedly told that a new era for coal and its products has arrived and that the raw coal sent to the pit-mouth is to be transformed into a variety of more useful and more valuable products, but though the disease has been diagnosed the doctors quarrel as to the remedy.

(1) Mr. Thomas, writing from the point of view of the intelligent man interested in scientific progress, has sought to set out the coal problem and its solutions. "Science to the Rescue" is his chapter heading, explained by such subsidiary titles as "From Pit to Petrol Tank" and "Gas as a Motor Fuel". He is right in his assumption that only science can save the coal industry, though with coal it requires far more than the usual eloquence and sincerity of the missionary to make converts to applying science. There is, alas, too much human nature among the ingredients which go to make up the problem. Mr. Thomas has the courage to set out the political and financial aspects of the question, as well as to advocate the reconstruction of coal as a rationalised industry under a National Power Board. His treatment of this question deserves thoughtful consideration, for it represents a growing opinion widely held among the younger generation.

Individual capitalistic organisations of moderate size are on their trial, for they have generally failed to overcome post-War difficulties : the idea of control of production by the State is growing in favour as countries grow more nationalistic, just as the great advantage of operating an industry as a unit of national size, with unified buying and central selling, is being recognised by many of the nationals.

This is obviously a controversial subject but it is one well worth examining ; the drift is undoubtedly in the direction indicated.

The coal mining industry has many vexed questions to settle—including wages and royalties. Its quota system finds few friends among the users, whose grumblings so far have been largely stilled for patriotic considerations, but the complaints of the excessive price charged to the gas industry should be noted. This is making gas dearer than it otherwise need be and retarding the development of gas and the consequent elimination of smoke and dirt and fog from our cities. Far too many colliery managers consider that it is their sole duty to bring coal to the surface without any consideration of its quality or ultimate use. Perhaps, however, we should remember, as Mr. W. G. Gordon has reminded us recently, that a few years ago it was coal that the world wanted and that the utilisation of coal which we are all concerned with to-day is a comparatively new idea.

In consequence of its disorganisation, the returns of the coal industry are very inequitably distributed. According to Mr. Thomas, whereas the

miner gets 9*s.* per ton for his arduous work, the ultimate seller of household coal, after deducting selling and delivery expenses, received 13*s.* 9·94*d.* in 1932.

The more technical portion of the book is marred by a good many inaccuracies and over-statements, but these are minor blemishes in a work which should be widely read. For the future, Mr. Thomas pins his faith on the use of coal to produce oil by hydrogenation, on the extension of low temperature carbonisation replacing raw coal, on the development of electricity, and on the use of gas as a motor fuel. The amount used in industry, as locomotive fuel and on ships, is expected to diminish.

(2) Dr. Ashworth deals with another, though in our opinion anything but minor, aspect of the coal problem, the formation of smoke and soot in a manufacturing town—Rochdale—which is particularly unfortunate in this respect. He has devised apparatus to measure various features of the evil, in particular the deposited impurities, the horizontal pollution and the suspended matter. The hourly and other records taken over a period have enabled a number of interesting deductions to be drawn.

Perhaps the most interesting of these has relation to the influence of smoke and hot gases from factory chimneys on rainfall, which is apparently less on Sundays, when the factories are not working, than on the other days of the week. A very considerable amount of statistical evidence is cited in support of this conclusion. Equally Monday has continuously high rainfall values from 6 a.m. until 3 p.m., when the smoke emission due to starting up the factories is at its greatest. In clean areas there is no such unequal distribution of the rainfall on particular days of the week.

The influence of atmospheric pollution on light has also been studied, the iodine, methylene blue and photographic methods being carefully studied and compared. Sunday being the cleanest day is also that of highest light intensity in Rochdale, whereas in Ventnor and even in London there is little or no difference between the various days of the week in light intensity. Rochdale has only an average light intensity per day of 0·5 compared with 1·6 for London and 6·3 for Ventnor. The average deposit per month per square kilometre at Rochdale is 17·2 metric tons, which compares with a figure of 6·4 tons in a residential town like Cheltenham. It is estimated that more than 60 per cent of the total deposit in Rochdale is from factory chimneys.

It is most valuable to have careful records of this kind, and it is to be hoped that they will be collected in many centres. Seeing that most of the smoke is preventable, and considering the harm its presence does to health and property, it is a striking indictment of our habit of accepting a state of affairs which no civilised body of men should tolerate.

Somehow everything connected with coal has its dingy side in restless, grimy, utilitarian, man-made England. E. F. A.

Atomic Collisions

The Theory of Atomic Collisions. By N. F. Mott and Dr. H. S. W. Massey. (The International Series of Monographs on Physics.) Pp. xv+283. (Oxford : Clarendon Press ; London : Oxford University Press, 1933.) 17*s.* 6*d.* net.

THIS book gives a very complete account of the quantum theory of collisions. In an introductory chapter, some theorems of wave mechanics are stated. The following four chapters are devoted to such collisions in which the internal state of the colliding particles is not changed, even during the collision, that is, so to speak, collisions of rigid particles. First of all, the general formula for the scattering by a central field of force is derived. The case of a Coulomb field is discussed in greater detail. Then a chapter on electron spin is included, in which great care has been taken to explain the peculiar spin-wave-functions. Finally, the collision of two identical free particles and the important rôle of exchange therein is treated.

The main part of the book deals with the collisions of electrons with atoms. The first chapter supplies the necessary mathematical tool, namely, the calculation of a solution of a given differential equation which represents an outgoing spherical wave. As a special case, Born's approximation is derived. The connexion of the exact formula for the scattering by a central field of force with the Born formula as well as with the classical theory is discussed. Then a very valuable summary of the methods available for treating collisions with atoms is given, special attention being paid to the more complicated processes such as electron exchange, etc. Afterwards, the various kinds of collisions are treated in detail. For elastic collisions of fast electrons, Born's approximation can be applied, whereas for medium velocities the distortion of the electron wave by the field of the atom has to be taken into account. In both cases the theory compares favourably with experiment,

For slow electrons, however, the theory appears to be still far from complete, mainly because there is no approximation for the exchange effect which is sufficiently accurate and at the same time sufficiently easy to handle. Even the conditions under which exchange becomes important are not yet exactly known.

The theory of inelastic collisions of fast electrons with atoms appears to be almost complete. The probability for excitation and ionisation of the atom, the stopping power, the angular distribution of scattered and ejected electrons, can be calculated from Born's method in accordance with experiment. More of a qualitative nature are the theoretical predictions about the inelastic scattering of slow electrons by heavy atoms. The scattering of electrons by molecules can be calculated with fair accuracy by adding the scattering amplitudes from the constituent atoms. The discussion of the various types of excitation, ionisation and dissociation occurring if a molecule is bombarded by electrons is very clear.

Much has still to be done upon the collisions of two heavy particles such as atoms and molecules. The book states many important questions, especially in the field of chemical kinetics, and gives the methods for treating them and the results obtained up to the present.

The last two chapters deal with Dirac's method of variation of parameters, with the relativistic scattering formula and the calculation of the field of a nucleus from the anomalous scattering of α-particles.

There is, we think, no collision problem of any importance which is not mentioned in the book, and for most of them at least a qualitative theory is given. But it is of even more value that the book not only compiles the results and theoretical methods, but also points out clearly the conditions under which each method is applicable. The standard of the book is rather high, and there are some sections that will appear not easy to read. This is, however, only natural, because some of the collision problems, especially those involving slow particles, require rather complicated mathematics. The development of the mathematical methods apart from the physical application will be found helpful. It is of special value that many results of the authors hitherto unpublished are included in the book, elucidating points that have not been clear even to the expert.

The book will, without doubt, be indispensable for everybody doing research on collisions either theoretical or experimental. The experimentalist will draw much information from the great number of tables and figures representing the theoretical results. Moreover, it will be of great interest to all those who, having a sound general knowledge of wave mechanics, wish to know more about this specially attractive application of it.

H. A. Bethe.

Electrical Measurements

(1) *High-Frequency Measurements.* By August Hund. (International Series in Physics.) Pp. xi+491. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1933.) 30*s*. net.

(2) *Advanced Electrical Measurements.* By Dr. William R. Smythe and Dr. Walter C. Michels. Pp. x+240. (London: Chapman and Hall, Ltd., 1933.) 15*s*. net.

(1) THE casual reader may be surprised by the easy confidence with which the publishers imprint "First Edition" on the title page of this book. But they are certainly justified; there can be no reasonable doubt that the work will run through many editions, for it is excellently done, and is very easily the best that has yet appeared on this complex subject. It would be difficult to find any type of problem in high-frequency measurement which escapes mention. This catholicity, indeed, brings with it one disadvantage which might well be corrected in a later edition: the range of methods covered is so wide that critical comparison, on which the reader might base a choice of method, is insufficiently provided. It would be genuinely helpful if the author would follow "Baedeker" and the "A.A. Handbook" in attaching stars to recommended methods.

In the eighteen chapters of the book, the author deals, with a great deal of wisdom and helpful inter-relating comment, with the special technique of measurements at high frequency, giving special attention to the wide range of physical phenomena which must be kept in mind if the ultimate indication is to be truly interpreted in terms of the quantity to be measured. The first chapter deals with fundamental relations and circuit properties, and the second with high-frequency sources and other useful laboratory apparatus. In the third the author quite illogically, but quite rightly, includes the measurement of minute direct currents in his discussion of measuring systems for high-frequency currents; later chapters deal with the measurement of voltage, frequency,

capacitance, self-inductance, mutual inductance and coupling, effective resistance, high-frequency power and losses, decrement, power-factor, phase difference and sharpness of resonance, and ferromagnetic properties. A very satisfactory chapter on tube measurements deals with a wide range of thermionic tubes and associated circuits, and this is followed naturally by a chapter on modulation measurements.

Amongst the most valuable and novel sections of the work are the treatment of determinations on aerials and lines, and on wave propagation. On both these aspects of high-frequency measurement it has been extremely difficult for the student to find safe guides without a wide search of the literature. Should he require more information than can be compressed into these chapters, he will find the author's selection of references at once generous and judicious. The two remaining chapters deal with piezo-electric apparatus and with miscellaneous measurements and data.

The first edition of a work, by one man, on this heroic scale, cannot be free from minor blemishes. The language frequently has a flavour of incomplete translation from the German ; the 'thermo-cross', the 'stoic metal', the 'step-over resonator', the 'space condenser' and the 'spacious pole' are unfamiliar and a little disturbing. There are occasional lapses from the generally high level of clarity, precision and care ; the statement that "this alloy has a high temperature coefficient" comes to an untimely end before we have learned what property it is that varies so rapidly with temperature. Similarly "a sensitive galvanometer (10^{-10})" is mysterious. But these flaws, such misprints as those in the formulæ of pp. 22, 43, and 211, and the inadequate explanation of "bisymbolic multiplication" by mere reference to a paper of 1920 are amply offset by corresponding high peaks in the book. As typical peaks we may cite the matter of pp. 98, 103, 124, 131 and 230, and we may rejoice that on p. 185 the author has given the circuit values that are required to preserve the circuit diagram of a beat-frequency generator from being a snare and a delusion. The next edition will doubtless recognise the cathode ray oscillograph as a photographic recorder and not as a merely visual device. Meanwhile the first edition is a great work.

(2) Drs. Smythe and Michels have produced a useful handbook for the instructional laboratory, but the title which they have chosen is somewhat too wide for the scope of the work itself. The conventional methods for the measurement of resistance, current, potential difference, quantity of electricity, and magnetic properties are adequately discussed, without any revolutionary improvement in exposition over previously available works.

Measurements on vacuum tubes (that is, diodes to tetrodes) and on high-frequency circuits are treated in a summary and rudimentary way, while the chapters on alternating current work are likely to leave the student a good deal to unlearn on the relative merits of different devices. The remaining chapters, on electricity in gases, electrical thermometry, radiation measurements and electrochemical measurements are more useful than the others, because they are less readily found elsewhere.

Review of Physical Chemistry

(1) *Introduction to Physical Chemistry.* By Prof. Alexander Findlay. Pp. vii+492. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1933.) 7*s.* 6*d.*

(2) *Recent Advances in Physical Chemistry.* By Dr. Samuel Glasstone. Second edition. Pp. viii+498. (London : J. and A. Churchill, 1933.) 15*s.*

(1) PROF. FINDLAY'S book includes all that a student beginning the systematic study of physical chemistry requires, and is of such a standard that it can serve as an introduction to the more advanced parts of the subject, the references to the literature which are given also being very useful in the latter respect. The historical method is generally followed, yet in all parts the treatment is thoroughly modern, the recent developments of the subject being adequately dealt with. The mathematics required goes no further than the elements of the calculus, without which no progress can be made in the study of physical chemistry.

The book commences with a chapter on the constitution of matter, including atomic numbers, isotopes, radioactivity and the electronic theory of valency. The following chapters deal with the properties of gases, liquids and crystalline solids, including crystal structure. The explanation of the Joule-Thomson effect on p. 56 requires modification, since a gas may obey Boyle's law and yet exhibit a Joule-Thomson effect. The study of dilute solutions follows, all the fundamental equations being deduced ; and here, as in the rest of the book, an excellent feature is the adequate

discussion of experimental methods and apparatus. This section includes electrolysis. Thermochemistry, homogeneous equilibrium, reaction velocity, catalysis and thermodynamics, including an elementary account of Nernst's theorem, follow. The book then deals with strong electrolytes, activity, hydrogen ion exponent, hydrolysis, indicators, titrations and buffer solutions, and this part of the book is deserving of special commendation for the clearness of the treatment and the adequacy of the information conveyed in a reasonable space. In the thermochemical sections it would perhaps have been better if the author had used the modern abbreviations 'g.cal.' and 'k.cal.' instead of 'cal.' and 'Cal.', which sometimes lead to error.

The chapter on electromotive force is carefully written and comprehensive, although an example of the introduction of the equation for liquid junction potential in the case of an actual cell would have been useful, since this matter is one which often proves difficult to students, particularly in the signs. The rest of the book contains chapters on photochemistry, heterogeneous equilibrium, the phase rule (which is illustrated by a very well-chosen set of examples), adsorption and the colloidal state. A good collection of numerical and other exercises is given at the end of the book.

Prof. Findlay's book is an excellent introduction to its subject. Without suffering from the defect of many elementary works, that of being too sketchy and avoiding difficult matters, it is yet well within the comprehension of the student. Anyone who masters the course provided will be well on the way to a sound knowledge of modern physical chemistry, and since this subject now has such important bearings on other sciences, the book should make an appeal to a wide field of users. It is excellently produced and the price is very moderate.

(2) Dr. Glasstone's book, which has reached a second edition after two years, appeals to the more advanced student, who has already mastered the contents of such a book as the preceding. After the fundamentals have been dealt with, the teacher or student is faced with a large field of more recent and more advanced work which it is impossible to cover in the part of the year generally devoted to advanced physical chemistry in university courses. Some selection is necessary and Dr. Glasstone has made a popular choice of subjects.

The first chapter deals with the structure of the atom and the modern theory of valency. In the new edition a section on wave mechanics appears, and although the treatment is extremely sketchy and on the lines of the "Annual Reports" of the Chemical Society, it may serve to give an idea of the possible meanings of expressions now used rather vaguely by some chemical authors. Recent work on nuclear disintegration, the neutron and the positive electron is mentioned. The chapter on the parachor illustrates the applications in the determination of structure. The chapter on dipole moments has been extended to include an elementary treatment of rotation; that on molecular spectra now contains a discussion of potential energy curves, and as in the first edition also deals with the Raman effect. Homogeneous gas reactions are dealt with in more detail, including a discussion of activation energy and reactions in solution. The chapter on photochemistry has been improved by a fuller discussion of reaction mechanism. Surface potentials are now dealt with in the chapter on the properties of surfaces. The chapter on heterogeneous catalysis covers the field very well in a limited space. Strong electrolytes are dealt with too summarily to be quite satisfactory, and the chapter devoted to them could with advantage have been twice the present length, some rather speculative material from other sections being sacrificed. The last chapter, on acid-base catalysis, gives an adequate review of the subject.

Within the limits of about 500 pages, the author has managed to give a survey of a few selected parts of modern physical chemistry, which is perhaps as satisfactory as is possible. No one will consider that every section is adequate and most teachers will wish that other subjects in which they are interested could have been included. This would, however, have defeated the object of the author in giving a concise yet adequate survey of a few topics, and would have caused the book to grow to at least double its present size. The references to the literature will enable the teacher to equip himself for lectures and the keen student to extend the knowledge of subjects in which he has been interested by the author.

Dr. Glasstone's book fills a well-defined place in the literature and there is little doubt that it will remain popular for some time, especially if the author takes such pains to keep the material up to date as he has in the present revised edition. The book is well printed on a rather heavy paper and is somewhat expensive for its size.

J. R. Partington.

Short Reviews

Anthropology

Valenge Women: the Social and Economic Life of the Valenge Women of Portuguese East Africa. An Ethnographic Study by E. Dora Earthy. (Published for the International Institute of African Languages and Cultures.) Pp. xi+251+24 plates. (London: Oxford University Press, 1933.) 25*s.* net.

Although the entry of women into the anthropological field has begun to fill what was for long a serious gap in ethnographical investigation, much has still to be done. The value of observation from the woman's special point of view is well illustrated by Miss Earthy's study of Valenga women. The Valenga were described to a certain extent by M. Junod in his book on the Bathonga; but Miss Earthy has carried his observations further; and writing with the place and function of women in the community more particularly as the subject of investigation, she has given a fresh orientation to subjects usually regarded too exclusively from the point of view of the male members of the tribe. This is especially to be noted in the account of such a topic as marriage, and appears very clearly in her account of the details of the observances which precede, accompany and follow the rite. It also has an important influence on the account of family relations.

The most valuable contribution to our knowledge, however, will be found in the account of female initiation, where the author has been able to add to her generalised account of the rite, the recollections, reported in detail, of individual initiates who had undergone the ceremony at varying periods in the past. It has thus been possible to note changes which have taken place in the rite, and to draw inferences as to its original character from observances which have vanished in recent years.

La race, les races: mise au point d'ethnologie somatique. Par Prof. George Montandon. (Bibliothèque scientifique.) Pp. 299+24 plates. (Paris: Payot et Cie, 1933.) 25 francs.

Prof. G. Montandon, now professor of ethnology at the École d'Anthropologie, Paris, has given us in this book an introduction to the study of the races of man which is intended for both the beginner and the layman. He opens with the study of 'race', defining it, and then dealing with the various methods of study and the characters by which race is differentiated in man. Particular attention is paid to the latest developments of the study of heredity as applied to human races, and the evidence which may be afforded by the blood groups is demonstrated. He then deals with racial origins and distribution, electing the hologenetic in preference to the monogenetic point of view. Next he passes on to the description of the significant physical characters in each of the principal races of mankind, classifying them under the main headings of pygmies, negroids, Ved-Australoids, Mongoloids and Europoids. M. Montandon's concept of racial filiation leads to an original plotting of racial migrations, which would bring the earliest immigrants into America by way of the south instead of the more generally accepted north. Here he accords with the theories of M. Rivet and others. M. Montandon expounds difficult material with great clarity.

Biology

La paléontologie et les grands problèmes de la biologie générale. 1: *L'Évolution, adaptations et mutations; berceaux et migrations.* Par Prof. Charles Fraipont et Dr. Suzanne Leclerq. (Actualités scientifiques et industrielles, 47.) Pp. 38. 9 francs. 2: *Adaptations et mutations; position du problème.* Par Prof. C. Fraipont. (Actualités scientifiques et industrielles, 48.) Pp. 26. 6 francs. (Paris: Hermann et Cie, 1932.)

These two pamphlets discuss certain evolutionary problems from the palæontological point of view. Part 1 considers the question of 'cradles' or points of origin of species, and their subsequent migrations. Maps are given showing the geological as compared with the present distribution of various plant and animal groups. The plants considered include certain Marattiales, the tropical genus *Engelhardtia* of the Juglandaceæ, *Juglans*, the Ginkgoales, Araucarians, *Taxodium*, *Sequoia* and *Eucalyptus*. The animals include the Athyridæ (Brachiopods), the Rhynchocephalians, the mastodons, elephants and horses. It is, of course, well known that these groups show marked contraction in the areas occupied by them during successive geological periods. This the authors call "centripetal concentration", and they draw the much more debatable conclusion that each species or group began with a maximum distribution—often world-wide—which has since undergone progressive reduction.

The theory of centres of origin is thus denied, the alternative being that a species is derived simultaneously over the whole of its area from a previous species—a view which many will find unacceptable.

Part 2 is a short review of theories of transformism, in which the Lamarckian principle is upheld, but without any new evidence in its favour. The conclusion is expressed that adaptation is the basis of the formation not only of species but also of genera, orders and all important systematic groupings. Many modern biologists would consider this extreme view to be gainsaid by a mass of evidence, particularly from systematic botany.

R. R. G.

Life and Living: a Story for Children. By Dr. E. P. Phillips. Pp. xiv+152. (Ashford: L. Reeve and Co., Ltd., 1933.) 5*s.* net.

Dr. Phillips has aimed at presenting the facts underlying problems of life which are usually taboo in the curriculum of the adolescent boy or girl. The delicate, yet straightforward, manner in which he tells the story of sex, evolution and heredity is striking. In fact, we may say that it is the best exposition of the subject of this standard we have read.

The subject matter is one complete whole. The story opens with reflections on life in general. Then follow several chapters devoted to various forms of reproduction in the plant and animal kingdoms, leading up to man. The structure, evolution, and psychology of man is then dealt with in more detail. Civilisation and culture receive treatment in the last several chapters, where marriage, morals and religion are discussed.

It is a pity that Dr. Phillips has not given less space to sex and devoted more to certain other aspects of the biology of life. Much of the material on religion and morals, too, we think, should have been curtailed in a book meant for readers of such tender years.

Unfortunately, people are seldom prepared to buy such books for their children; few schools will be able to afford the price. But, though the aim of the author is rather narrow, and not a general survey of biology, it is an excellent book, and, in schools, would form a splendid supplement to a more formal treatise. As a home reader it is most desirable. The author has a compelling style, and many of the diagrams are well executed and refreshingly original in style.

Invertebrate Zoology. By Prof. Robert W. Hegner. Pp. xiii+570+8 plates. (New York: The Macmillan Co., 1933.) 20*s.* net.

This work has grown out of the revision of the author's "Introduction to Zoology" (1912) and is intended for students who have already taken their first course of zoology and desire to obtain a more comprehensive knowledge of the invertebrates. While prepared primarily for American students, and citing wherever possible American examples, it will be found useful by students elsewhere, as it is written in an interesting manner and deals adequately with the principal features of structure and biology of representative members of the respective groups.

The first 118 pages are devoted to the Protozoa and, as would be expected from the author's expert knowledge of this phylum, contain a trustworthy and clear account in which the parasitic forms receive their due, but not an undue, share of attention. Praiseworthy features of the book are its attention to the biology of the groups and the inclusion at the end of each of the more important groups of a brief history of our knowledge of the group. A short bibliography is appended to each chapter. A few of the smaller groups are rather summarily dealt with; for example, the Brachiopoda, Chætognatha and *Phoronis* are all contained in four pages. The statement that the larva of *Phoronis* resembles a trochosphere may lead to misapprehension, and the body cavity of Nematoda should not be called a cœlom. The author has been, as he states, at considerable pains to bring his book up to date and he deserves commendation for his success in dealing with a great body of material so skilfully.

Birds of the Falkland Islands: a Record of Observation with the Camera. By Arthur F. Cobb. Pp. 88. (London: H. F. and G. Witherby, 1933.) 7*s.* 6*d.* net.

The contents of the volume are practically all, if not entirely all, the written result of the author's own seven years' residence on Bleaker Island and other islands of the group. It is not, perhaps, intended to be a scientific treatise on the birds of the Falklands, nor to be an exhaustive list of the birds which occur there; on the other hand, nobody who reads the book can fail to find much in it that is both novel and interesting. No descriptions are given of the various birds referred to. The letter-press deals entirely with notes on the range, habits and nidification of each species. Altogether it gives notes on thirty-one species of birds found on the islands, including geese and ducks, penguins, albatrosses and gulls, waders and birds of prey.

The photographs which accompany the letter-press are very good and are of especial interest; for the author has taken pains to include many which show the type of country the birds inhabit, while there are many excellent plates of breeding haunts, nests and eggs.

This is a little book which can be recommended with confidence to anyone with an hour to spare who would like to learn something hitherto unrecorded about the birds of the far-off Falkland Islands. It is well got up, the printing good and the misprints rare.

Chemistry

Qualitative Chemical Analysis: certain Principles and Methods used in Identifying Inorganic Substances together with a Systematic Survey of the Chemistry of these Materials. By Dr. Roy K. McAlpine and Dr. Byron A. Soule. (Based upon the text by A. B. Prescott and O. C. Johnson.) Pp. xii+696. (London: Chapman and Hall, Ltd., 1933.) 21*s.* net.

This manual is much more than a treatise on qualitative analysis, since it contains a mass of general information on the elements and compounds which are likely to be met with in the analysis of inorganic materials, including the less common elements. It is provided with full references to the literature. The group separations are the usual ones, but the tables for each group are arranged in an unusual symbolic form which

is far from clear. On account of the large amount of detail, the work is not suitable for the elementary student, who requires a clear set of tables, but the advanced student, the teacher and the practising analyst will find it of interest and value. With so much detail, some mistakes are almost inevitable, as when dithionic acid is said to be obtained (p. 511) by the action of carbon dioxide on barium dithionate, and the product of the action of stannite on bismuth salts is given as bismuth oxide (BiO) on p. 244 and (correctly) as bismuth on p. 224. The long section on balancing equations (pp. 629–656) is of doubtful value, and that on solubility product (pp. 44–137) is, as the authors recognise at the end, too far removed from practice to serve as a safe guide in the laboratory. The book is one which every chemical laboratory could usefully have available for reference.

A Short Organic Chemistry. By Dr. F. Sherwood Taylor. Pp. viii+378. (London : William Heinemann, Ltd., 1933.) 5*s*.

THE present book is an abridged form of the larger work by the same author and contains those parts of the subject required by the first year student. The theoretical parts are almost as full as in the longer book and the treatment of the simplest and most important compounds remains almost unaltered. Experiments are described, so that the book gives a complete course in elementary organic chemistry. There are also questions and numerical and other problems, with answers. The text is clear and accurate and the brief descriptions of large-scale operations are much more up-to-date than is usual in such books. The modern formulæ of the carbohydrates are given. The discussions of theoretical matters, such as stereoisomerism and the structure of benzene deserve special commendation. Dr. Taylor's book is a very satisfactory course of elementary organic chemistry and can be recommended both for schools and for junior students in universities.

Laboratory Tables for Qualitative Analysis. Drawn up by the Demonstrators in Chemistry, University of Manchester. Fourth edition, revised and rewritten by Dr. Colin Campbell and J. B. M. Herbert. 17 cards. (Manchester : Manchester University Press, 1933.) 3*s*. 6*d*. net.

THESE tables have been familiar to several generations of students passing through the Chemistry Department at Manchester and their excellence has been amply demonstrated over a long period of time. In their new form an alternative scheme for the separation of phosphoric acid in Groups III–IV is given, and two sheets on the less common metals, Be, Mo, Ti, V and W, provided. The explanatory notes, a very valuable feature of the tables, remain, but have been revised when necessary in the light of modern theory. These tables provide a scheme of qualitative analysis which has been thoroughly tested and their use can be recommended in all chemical laboratories.

Chemical Calculations : their Theory and Practice. By A. King and Dr. J. S. Anderson. Pp. x+181. (London : Thomas Murby and Co. ; New York : D. Van Nostrand Co., Inc., 1933.) 4*s*. 6*d*. net.

THE present collection of examples is accompanied by explanatory matter which is found in all the usual textbooks and could quite well have been omitted. Whilst brief summaries of the theory are desirable in the case of books of calculations on physical chemistry, they take up space and add to expense in elementary works. The examples given are very suitable for students taking the Intermediate Science and Higher School Certificate examinations. Answers are provided to alternate problems only. The calculations in volumetric analysis are all based on the use of normalities, and an insistence on this will remove the habit acquired by some students of working out such results by unnecessarily long and unscientific methods. The book is a good and straightforward collection of problems which should fulfil the purpose for which it was written.

Mathematics

(1) *Logarithmetica Britannica : being a Standard Table of Logarithms to Twenty Decimal Places.* Part 6 : *Numbers 60,000 to 70,000.* By Dr. Alexander John Thompson. Issued by the Biometric Laboratory, University of London, to commemorate the Tercentenary of Henry Briggs' publication of the *Arithmetica Logarithmica, 1624.* (Tracts for Computers, No. 18.) Pp. v+100. (Cambridge : At the University Press, 1933.) 15*s*. net.

(2) *Tables for the Development of the Disturbing Function : with Schedules for Harmonic Analysis.* By Ernest W. Brown and Dirk Brouwer. Pp. v+73–157. (Cambridge : At the University Press, 1933.) 10*s*. 6*d*. net.

(3) *Vierstellige Tafeln der Kreis- und Hyperbelfunktionen, sowie ihrer Umkehrfunktionen im Komplexen.* Berechnet und erläutert von Robert Hawelka. Im Auftrag des Elektrotechnischen Vereins E.V. in Berlin, herausgegeben von Prof. Dr. Fritz Emde. Pp. v+109. (Braunschweig : Friedr. Vieweg und Sohn A.-G., 1931.) 10 gold marks.

(1) THIS, the fifth part published, contains a frontispiece photographic reproduction of a letter from Henry Briggs to John Pell. Dr. Thompson hopes to produce another part containing the logarithms of numbers from 10,000 to 20,000 some time this year.

(2) These tables give coefficients designed to facilitate the numerical development of the disturbing function in planetary perturbations. Writing

$$(1-\alpha^2)^s(1+\alpha^2-2\alpha\cos S)^{-s}=\tfrac{1}{2}G_s^{(0)}+\sum_{i=1}^{\infty}G_s^{(i)}\alpha^i\cos iS,$$

Tables I–IV give eight place logarithms of the G's for $s=\frac{1}{2},\frac{3}{2},\frac{5}{2},\frac{7}{2}$, $i=0,1,2,\ldots,11$, with the argument $p=\alpha^2\div(1-\alpha^2)$ in the interval $0\cdot00-2\cdot50$. Table V gives coefficients of the expansion of $G_{\frac{1}{2}}^{(i)}$ in powers

of $(p-3)$ and $(p-4)$. Tables VI and VII give $(1-\alpha^2)^{\frac{1}{2}} G_s^{(i)}$ for $i=0-4$, $s=\frac{1}{2}, \frac{3}{2}$, with the argument α in the interval $0{\cdot}900-0{\cdot}950$. The remaining tables give certain special data. Schedules for harmonic analysis are appended with fully worked examples.

(3) These useful tables give, to four decimal places, circular and hyperbolic sines, cosines, tangents and cotangents of the complex argument $\frac{1}{2}\pi x+iy$, and the corresponding inverse functions. The unit of the real part of the angle being a right angle, the whole complex plane is covered by taking x from 0 to 1, y from 0 to 1 and then y^{-1} from 1 to 0, all at interval 0·02. A similar device is adopted for the inverse functions. Printed first differences are given both down and across the tables. Where linear interpolation is insufficient, exponential interpolation is used by means of an auxiliary table. The auxiliary tables, nomograms, and reliefs of the functions are in a separate removable part, which makes their use very convenient. L. M. M.-T.

Theory of Functions: as Applied to Engineering Problems. Edited by R. Rothe, F. Ollendorff and K. Pohlhausen. Authorized translation by Alfred Herzenberg. Pp. x+189. (Cambridge, Mass.: Technology Press; Mass. Institute of Technology, 1933.) 3.50 dollars.

THE well-known German book, "Funktionentheorie und ihre Anwendung in der Technik", published in 1931, is now available in an English translation. The first section, written by R. Rothe of Berlin, is devoted to a mathematical discussion of the functions required in the solution of many advanced engineering problems. It deals with the complex variable, line integrals and their relationship to potential theory, complex integration, power series and Laurent's series, residue theorems and singularities.

The second section is concerned with the applications, and each problem is dealt with by an expert. Electric and magnetic fields are discussed by W. Schottky, two-dimensional fields of flow by K. Pohlhausen, field distribution in the neighbourhood of edges by E. Weber, the complex treatment of electric and thermal transient phenomena by F. Ollendorff, and the spreading of electric waves along the earth by F. Noether.

The text is well written though essentially brief, and it is claimed that the book is the first authoritative work on its subject in English. It should certainly be of great value to all who are interested in the study of those new practical problems to which the advance of science continually gives rise.

Cours de mécanique rationnelle. Par Jean Chazy. (Cours de la Faculté des Sciences de Paris.) Tome 1: *Dynamique du point matériel.* Pp. v+392. (Paris: Gauthier-Villars et Cie, 1933.) 70 francs.

THE book before us is the first volume of a course in mechanics given by the author at the Faculty of Science at Paris. In accord with its sub-title, it deals with vectors, the fundamental principles of dynamics, general theorems, the motion of a particle—rectilinear, curvilinear and upon a surface—and finally, with motion relative to the earth.

In characteristic French style, there are no exercises for the reader, whilst the text is mainly devoted to a discussion of general theorems, very few particular cases being deduced. The simple pendulum, for example, is first worked out as an ellpitic integral, whilst the simple case of replacing $\sin\theta$ by θ is disposed of in a short note at the end. The whole course is nevertheless very useful and interesting, but the price is somewhat high for the average British student.

Miscellany

(1) *Goethe als Chemiker und Techniker.* Von Paul Walden. Pp. 87. (Berlin: Verlag Chemie G.m.b.H., 1932.) 2 gold marks.

(2) *Gothes naturwissenschaftliches Denken und Wirken: drei Aufsätze herausgegeben von der Schriftleitung der Zeitschrift "Die Naturwissenschaften".* Pp. iii+99. (Berlin: Julius Springer, 1932.) 3.60 gold marks.

GOETHE'S interest in natural science is an outstanding characteristic of his all-embracing genius. His writings often display a detailed knowledge of the processes of Nature; and his intuitions in many instances are almost prophetic. When he was twenty years of age, he made experiments with the "Liquor Silicium" (1769) which led him to the view that a great deal can be discovered about the nature of the elements by paying attention to the geometrical arrangement of their particles. In 1795 he wrote to Humboldt, "you enquire into the mysteries of nature through its elements, whereas I do by watching their configuration". Indeed, this is the fundamental principle of the colloidal theory which developed later with such remarkable results. Already in 1786, Goethe had noticed that the crystals of common salt take various forms—an indication, he wrote, that they are not pure. So great was his faith in natural configuration that he proclaimed, in the same year, that mineralogy without chemistry cannot progress one inch. His interest in the science of matter remained with him throughout his life. In 1819, he was much puzzled by the constitution of coffee; and when he made the acquaintance of young Runge, who was later to discover aniline, Goethe gave him some coffee beans suggesting that their analysis might interest him. One year later, in 1820, Runge communicated to Goethe his discovery of cafein.

A score of interesting details about Goethe's scientific views and the state of science during his lifetime, will be found in the two pamphlets under review. Thus we are told how Goethe came to study chemistry and its technique, and what are his most original views on the subject. A supplement of thirty pages in the second pamphlet gives a short analysis of his main achievements in the various branches of physical science. T. G.

(1) *Basic German for Science Students. With Vocabulary and English translations of the German Passages.* By Dr. M. L. Barker. Pp. xi+164. (Cambridge : W. Heffer and Sons, Ltd. ; London : Simpkin Marshall, Ltd., 1933.) 6*s.* net.

(2) *The Basis and Essentials of German : containing all that must be known of Grammar and Vocabulary in order to express the most frequently recurring Ideas.* By Charles Duff and Richard Freund. Pp. xix+113. (London : Desmond Harmsworth, Ltd., 1933.) 3*s.* 6*d.* net.

(3) *A German Reader for Biology Students : Passages from Recent German Scientific Publications.* Selected and arranged by Prof. H. G. Fiedler and Dr. G. R. de Beer. With a Vocabulary by Herma E. Fiedler. Pp. vi+92. (London : Oxford University Press, 1933.) 5*s.*

(1) In twenty-four pages, Dr. Barker crowds in the essentials of German grammar in tabloid form and as footnotes to selected passages from the Bible. The rest of the book gives general passages from scientific works in German with English translations, and more technical selections referring to chemistry, zoology, botany, physics, mathematics and medicine. Unfortunately, only one English rendering is generally given to a German word, although it often has other equally important significations.

(2) Equally useful for the general reader is the book by Messrs. Duff and Freund. Though they give the minimum of grammar, however, they stress the importance of the vocabulary, which is selected and presented in such a way as to cause the least difficulty to an English reader. The authors have compiled a large number of German books, noting down the words which occur more often and drawing statistical lists of them. They selected for their book those with the highest coefficient, and divided them between those which are similar to their English equivalent, and those which are different. Some sound guiding principles here and there help the reader to understand the use and memorise whole lists of words.

(3) The work compiled by Prof. Fiedler and Dr. de Beer is simply a selected series of passages from recent German scientific literature, supplemented by an appropriate vocabulary. This reader is intended to be used by students of biology as a supplement to a "First German Course" by Prof. Fiedler and F. F. Sandbach.

The Laboratory Workshop : a Simple Course in Apparatus Making and the Use of Tools. By E. H. Duckworth and R. Harries. Pp. xi+246. (London : G. Bell and Sons, Ltd., 1933.) 10*s.* net.

This book contains information necessary to the man who has what Dewar called "the use of his hands", but who has not had workshop training, and is thus penalised in much loss of time and endeavour when setting himself to make and mend models, instruments and apparatus. Here also can one learn what materials are most serviceable, and how they are described, and where obtained ; what are the most useful tools ; and many suggestions, by the way, about the value of second-hand oddments and out-of-the-way uses for common things ; also valuable sections on glass-working and electrical wiring, with much more of the lore of an experienced laboratory assistant. All this is made plain by a large number of clear drawings, over which much labour must have been spent. On the other hand, of the two photographs comparing an attic workshop with one for a laboratory, uncertainty may be felt whether to admire the attic or be uneasy about the laboratory ; partly no doubt because the detail available is insufficiently informing. Many examples have been included of actual constructions of demonstration apparatus and models.

One lack that will almost certainly be felt, however, is the determined omission of even simple lathe work : it is not easy to understand how anybody in a position fully to utilise the help of this book will be satisfied without the service of at least a simple form of lathe. No doubt a later edition will include this extension, since a knowledge of the proper use of the ordinary cutters is not easy to obtain. W. J. G.

A Retired Habitation : a History of the Retreat, York (Mental Hospital). By H. C. Hunt. With a Foreword by Dr. B. Pierce and a Chapter by Dr. N. Macleod. Pp. xvi+144+12 plates. (London : H. K. Lewis and Co., Ltd., 1932.) 7*s.* 6*d.* net.

The man in the street and the educated layman are extraordinarily uninformed on the subject of the care and treatment of the mentally afflicted, so that it is very interesting to read the history of "The Retreat, York", a title which is very familiar to many. The title "A Retired Habitation" is, we think, a great mistake, for it does not convey any indication of the contents of the book, especially when those contents consist of the history of a very great and humane undertaking.

Mr. Capper Hunt, the steward at "The Retreat", has given us a very simple and readable account of the development of this registered hospital for the treatment of mental disorder, but we could have wished that he had made it much fuller and given greater detail.

Nevertheless, it is a fascinating story and very well presented. The extraordinary kindness and consideration shown to the mental patients in the far off days of the early nineteenth century by the nursing staff appointed by the Friends are an object lesson to many of the twentieth century. The same spirit has always prevailed, and to-day the standard of nursing at "The Retreat" is second to none, and to the late Dr. Bedford Pierce the modern mental nurse may well be very grateful for all he did to secure the "one portal" entry by examination to the State Nursing Service. The book is very well presented and the illustrations excellent.

Nowe Drogi Nauki: Kwanty i Materja. Napisał Dr. Leopold Infeld. (Z Dziedziny Nauki i Techniki, Tom 2.) Pp. x+284+6 plates. (Warszawa: *Mathesis Polskiej*, 1933.)

Dr. Infeld's "New Developments in Science" presents to Polish readers an account of the most recent advances in physics and chemistry, particularly in the domain of sub-atomic phenomena and the structure of matter. The author opens with a reference to Pascal's views (1647) on the aims of physical inquiry and, after a brief historical sketch, proceeds to describe current ideas concerning matter and energy, X-rays, the quantum theory and the new wave mechanics. Attention is directed to the important discoveries of the last few years, including the Compton and Raman effects.

The book, which is well-printed and well-bound in cloth, is illustrated with some good photographs and should serve to acquaint Polish students with the latest developments and discoveries in the borderland of physics and chemistry.

Physics

Introduction to Theoretical Physics. By Prof. John C. Slater and Prof. Nathaniel H. Frank. (International Series in Physics.) Pp. xx+576. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1933.) 30*s.* net.

This is, in some ways, a remarkable book. The authors are convinced that the teaching of physics by way of a series of separated and more or less watertight courses prevents a student from understanding the unity of physics. Moreover, many problems concerning the structure of matter are necessarily discussed in terms of wave mechanics, and a knowledge of wave mechanics again demands a thorough grounding in classical physics. The authors, therefore, with amazing courage, have endeavoured to build up, in the compass of less than six hundred pages, a consistent and comprehensive picture of modern theoretical physics which shall be something more than a collection of disjointed chapters on unrelated topics.

This task requires some forty-two chapters and the authors are not afraid to begin with such elementary notions as are needed for a brief (and possibly to the pure mathematician inadequate) discussion of power series and Taylor's theorem, exponential methods for the solution of differential equations illustrated by simple physical applications, damped and forced oscillations, vector forces and potentials. Fifty-eight pages of this work bring us to Lagrange's and Hamilton's equations, phase space, precessional motion, vibrating strings and membranes, elasticity, fluid and heat flow. Thence we are led to potential theory, Maxwell's equations, electromagnetic waves, and electron theory. Huygen's principle and Fresnel and Fraunhofer diffraction phenomena are disposed of in twenty-six pages, and the way is now clear for discussions of wave mechanics, Schrödinger's equation, the correspondence principle, matrices and perturbation theory. Then within the limits of about a hundred and fifty pages the authors find space to discuss compactly but very clearly some of the details of atomic and molecular structure, equations of state, nuclear vibrations, collisions, electronic interactions and electronic energy of atoms and molecules, Fermi statistics, and dispersion, dielectrics and magnetism. The book is a remarkable example of unhurried and unostentatious compression, and the authors are to be congratulated on the result of their endeavour "not to teach a great collection of facts, but to teach mastery of the tools by which the facts have been discovered and by which future discoveries will be made".

The book is admirably produced. Each chapter is followed by a set of problems, and judiciously selected references will aid the student in his future reading. A. F.

The Electromagnetic Field. By H. F. Biggs. Pp. viii+158. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 10*s.* 6*d.* net.

At its lowest, the mathematical instrument of vector algebra is a labour-saving device, and in dealing with electromagnetic theory time spent in learning how to use the instrument is amply repaid. In many general textbooks on electricity and magnetism the introduction of a mathematical technique which may be unfamiliar to probable readers is avoided; and students of physics often find considerable difficulty in bridging the gap between the Cartesian treatment and the vector treatment usually adopted in more advanced treatises. It is to such students that this book of Biggs is addressed.

The use of vector notation in the representation of static fields is first described, and the circuital relations are developed. Div, curl and related vectorial operators are discussed in connexion with Maxwell's equations, and the relations involving the general scalar and vector potentials are then considered. Many applications are given, and there are neat proofs of a number of well-known theorems. In little more than a hundred pages the author develops practically all of the more important mathematical relations of classical electromagnetic theory. A useful table shows the connexion between the relations discussed, and indicates clearly those which are derived directly from experiment.

The last chapter, which is concerned with the Lorentz transformation, gives an admirable introduction to tensor methods, and to the relativistic four-dimensional formulation of the theory.

The book as a whole should be most useful to all those physicists who can appreciate mathematical methods most readily when they are presented in close connexion with physical applications. E. C. S.

Physics for Medical Students: a Supplementary Text Book. By J. S. Rogers. Edited by Prof. T. H. Laby. Pp. x+205. (Melbourne: Melbourne University Press; London: Oxford University Press, 1933.) 11*s.* 6*d.* net.

It is very desirable that the attention of teachers of physics and medical students, including qualified medical men, should be directed to this book, for it represents the first attempt, so far as the reviewer is aware, to supplement the ordinary textbooks of physics which are given to medical students. It is a very successful attempt to show that physics is a science which really does have an intimate connexion with the theory and practise of the art of healing, as well as with the necessities of everyday life. Such a book has long been wanted and the author well deserves our congratulations on his achievement.

The opening chapters give a brief but very good outline of the history of physics. Incidentally, the author follows tradition in ascribing to Davy an experiment with blocks of ice which he never performed, for Davy did not rub pieces of ice together *in vacuo*; he rubbed them together in air, and he recorded an impossible result. Later chapters give excellent accounts of osmosis, the colloidal state of matter, ultra-violet light, the microscope, hydrogen ion concentration, high frequency currents and X-rays. In all these chapters the importance of physical facts and theories to medicine is stressed, whilst the chapters on blood pressure and its measurement, body temperature, gains and losses of energy in the human body, the resonance theory of hearing, the human eye and the therapeutic uses of radiations also testify to the industry and diligence which the author has so successfully employed in showing that physics can be made interesting to medical students.

The book is well printed and illustrated. It is very pleasant to read and the manner in which the author has everywhere tabulated and arranged the most striking and important points in each section makes it a handy book of reference. There are obvious ways in which the author may expand this work in future editions, and it is to be hoped that it will find an extensive sale in Great Britain.

L. F. B.

Bulletin of the National Research Council. No. 90: *Physics of the Earth.* 6: *Seismology.* Pp. viii+223. (Washington, D.C.: National Academy of Sciences, 1933.) Paper, 2 dollars; cloth, 2.50 dollars.

This new "Bulletin" is comprehensive and inexpensive. The authors are J. B. Macelwane, H. O. Wood, H. F. Reid, J. A. Anderson and P. Byerly, all of whom have made distinguished contributions to seismology. They discuss the various theories of the origin of earthquakes, field data, the design of seismographs, the theory of wave propagation, and the interpretation of the results. References are abundant up to 1931, and there are a few for 1932; and the authors have evidently read and understood what they quote. Two omissions are perhaps worthy of notice. The work of Stoneley and Tillotson on surface waves is mentioned without statement of the results they derive for the thicknesses of the layers; and attention might have been paid to the theoretical solution for a sudden disturbance spreading in three dimensions from a small region.

The book is not made needlessly long by the inclusion of out-of-date material; but the reviewer is left in doubt as to whether Uller's theory of wave propagation needed exposition. Is this very complicated work really able to give any results that cannot be obtained quite easily otherwise? So far as the reviewer can see, it has all the defects of the method of normal modes and none of its virtues. But on the whole the book is the most convenient guide to seismology that has yet appeared.

H. J.

Physical Constants: Selected for Students. By Dr. W. H. J. Childs. (Methuen's Monographs on Physical Subjects.) Pp. viii+77. (London: Methuen and Co., Ltd., 1934.) 2*s.* 6*d.* net.

This little volume of physical constants is well designed in many ways to suit the student's pocket. It is most convenient in form and size, and its price is so modest that few students will be unable to purchase the book. It is sufficiently complete to satisfy practically all the requirements of the ordinary teaching laboratory and most of the normal requirements of a research laboratory.

Psychology

Mental Defect. By Dr. Lionel S. Penrose. (Text-Books of Social Biology.) Pp. xi+183+4 plates. (London: Sidgwick and Jackson, Ltd., 1933.) 8*s.* 6*d.* net.

Mental defect or, more technically, oligophrenia, is such a serious problem that no apology need be made for stressing the extreme importance of educating public opinion. So much inaccurate and prejudiced opinion finds its way into print, particularly in the more sensational daily Press, that an effort should be made to combat it. Dr. Penrose's book is meant for medical or educated lay readers and is therefore not suitable for "the man in the street". He gives an interesting and accurate account of the physical conditions met with in defectives of all classes, and discusses the psychological examination, the taking of family and personal histories, and the classification. In discussing mongolism, the writer expresses the opinion that Crookshank's view that the condition is a regression to earlier ancestral types cannot be upheld. He does not express an opinion on Clark's view that the condition represents a condition of fœtal hyperthyroidism.

It is very gratifying to read a sane account of

sterilisation. The author points out that only one defective out of twenty is born of defective parents, that many defectives are unlikely to produce children and that it is mostly the high grade ones who are difficult in this way. This of course is exactly the group that are difficult to deal with from a legal point of view. In the author's opinion, adequate segregation is a much more rational procedure; sterilisation is no solution of the problem of the mental defective.

Psychoanalysis and Medicine: a Study of the Wish to Fall Ill. By Karin Stephen. Pp. vi+238. (Cambridge: At the University Press, 1933.) 8*s.* 6*d.* net.

Dr. Karin Stephen bases her book upon a series of eight lectures which she delivered mostly to medical students at Cambridge. She has an exceptionally good grasp of her subject, and adopts as the basic idea of her book the hypothesis that neurotic symptoms are defences designed to prevent anxiety from developing when repression threatens to give way. Dr. Stephen is an out-and-out Freudian, but there are many who will find fault with her statement ". . . if we can argue by analogy from the neuroses to the other group of psychogenic illnesses, the psychoses (insanity) . . ." It is surely doubtful if any psychosis can be looked on as purely psychogenic in origin. The causation of the psychoses is a very complicated and debatable subject, and although psychoanalysis can offer explanations of mechanisms its theories of causation are not so easily applied or accepted by those best qualified to assess their value in an impartial manner.

The Human Personality. By Dr. Louis Berg. Pp. xv+321. (London: Williams and Norgate, Ltd., 1933.) 8*s.* 6*d.* net.

Dr. L. Berg looks on the human personality from the *Gestalt* point of view, a conception which has been gradually developing during recent years amongst those best qualified to judge. There is a number of unusually sensible statements in this book—perhaps the most sensible is: "We speak of 'problem children' but we should really say problem *parents*." So many problem children are the results of errors of training in the pre-school years. It is only expressing the view of one school of thought to say that manic-depressive insanity, dementia præcox and paranoia are functional diseases. These disorders are not necessarily due to psychic wounds. Kretschmer's rigid views as to the development of cyclothymia in pyknics and dementia præcox in asthenic types have recently had considerable doubt cast upon them and we should adopt an attitude towards them of 'not proven'. To say that "schizoids become insane because of psychic wounds such as sorrow, unhappy love affairs or career failures" is using symptoms to explain causation.

The Way of all Women: a Psychological Interpretation. By Dr. M. Esther Harding. Pp. xv+335. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 15*s.* net.

It is an arguable question whether the roots of disorders of conduct and life difficulties are not deeper than can be reached by reading a book, however good it may be. Dr. Harding has attempted to explain many difficulties of life, but whether her explanation would be accepted or not by the neurotic and those in difficulties is another matter. The unconscious has an unfortunate habit of erecting barriers against the very explanations given, and a prolonged analysis is often necessary to get behind these barriers and adjust the mind in difficulties to its difficulties. Apart from this, however, the book contains a wealth of sound advice, and there can be few who, having read it, will not derive benefit if they apply the theory to their practice.

Forthcoming Books of Science

Agriculture, Forestry and Horticulture

Edward Arnold and Co.—Hooton Pagnell: The Agricultural Evolution of a Yorkshire Village, Dr. A. G. Ruston and Denis Witney.

Ernest Benn, Ltd.—Modern Flower Growing for Profit, W. E. Shewell-Cooper.

Cassell and Co., Ltd.—Outlines of a Small Garden, C. H. Middleton; The Garden Frame, J. S. Dakers; Tomatoes and Cucumbers, J. S. Dakers.

Thomas Murby and Co.—Soil Analysis: a Handbook of Physical and Chemical Methods, C. H. Wright.

Thomas Nelson and Sons, Ltd.—Colour in the Garden, M. E. Stebbing; Plants and Shrubs, M. W. Anson.

Oxford University Press.—A Text-Book of West African Agriculture, F. R. Irvine.

Rich and Cowan, Ltd.—Gardening Do's and Do Not's, T. G. W. Henslow.

Anthropology and Archæology

Jonathan Cape, Ltd.—We Europeans, Prof. Julian Huxley.

Christophers.—Law and Order in Polynesia, Dr. I. Hobgin.

Faber and Faber, Ltd.—Black Paradise: a Description of the Saramacca Tribe of Bush-Negroes on the Suriname River of Dutch Guiana, M. and F. Herskovits.

W. Heffer and Sons, Ltd.—Links with Past Ages, E. F. Orton.

Jarrolds, Ltd.—Voodoo Fire in Haiti, R. A. Loederer.

Luzac and Co.—The India that is India, Sharpe; Hindu Conception of the Deity, Kumarappa (Bharatan).

Oxford University Press.—The African To-day, D. Westermann; The Early Iconography of the Tree of Jesse, Arthur Watson; Ancient Synagogues in Palestine and Greece, E. L. Sukenik; A Study of Charles Wycliffe Goodwin, W. R. Dawson; Culture below the Potomac, edited by W. T. Couch.

Kegan Paul, Trench, Trubner and Co., Ltd.—Children of the Yellow Earth, Prof. J. Gunnar Andersson; New Light on the most Ancient East, Prof. V. Gordon Childe; The Script of Harappa and Mohenjodaro; Egypt and Negro Africa, Prof. C. G. Seligman.

Williams and Norgate, Ltd.—Out with the Cambrians, Evelyn Lewes.

Biology

George Allen and Unwin, Ltd.—Experimental Bacteriology, W. Kolle and H. Hetsch, edited by Dr. John Eyre.

J. and A. Churchill.—Recent Advances in Sex and Reproductive Physiology, J. M. Robson.

J. M. Dent and Sons, Ltd.—Name this Bird, E. F. Daglish; How to see Insects, E. F. Daglish; How to see Pond-Life, E. F. Daglish.

Faber and Faber, Ltd.—Secrets of Nature, Mary Field and P. Smith.

Victor Gollancz, Ltd.—The World of Nature: a Junior Survey, H. C. Knapp-Fisher.

George Harrap and Co., Ltd.—All about Birds, W. S. Berridge.

Hodder and Stoughton, Ltd.—Old Man Gorilla, Comm. Attilio Gatti.

Jarrolds, Ltd.—Life in the Making: the Story of Human Procreation, Dr. A. F. Guttmacher.

McGraw-Hill Publishing Co., Ltd.—Introduction to Cytology, L. W. Sharp.

Macmillan and Co., Ltd.—Everyday Botany, L. J. F. Brimble; A Classbook of Biology, E. Stenhouse; Introductory Biology, E. Stenhouse; The Families of Flowering Plants, vol. 2, Monocotyledons, J. Hutchinson.

Methuen and Co., Ltd.—A General Textbook of Entomology, third edition, Dr. A. D. Imms; Plant Chimæras and Graft Hybrids, Prof. W. Neilson Jones; Cellular Respiration, N. U. Meldrum.

Thomas Nelson and Sons, Ltd.—At Whipsnade Zoo, Gladys Davidson; On the Seashore, L. R. Brightwell.

Oxford University Press.—The Anatomy of the Salamander, E. T. B. Francis; The Life Forms of Plants and Statistical Plant Geography; The Trees of the South-Eastern United States, W. C. Coker and H. R. Tatten.

Kegan Paul, Trench, Trubner and Co., Ltd.—The A B C of Biology, Prof. C. M. Yonge.

G. P. Putnam's Sons, Ltd.—The Peregrine's Saga, H. Williamson.

George Routledge and Sons, Ltd.—Fishes and their Ways of Life, Prof. Louis Roule.

University Tutorial Press, Ltd.—Textbook of Biology, Dr. E. R. Spratt and A. V. Spratt; Elementary Biology, Dr. E. R. Spratt and A. V. Spratt.

Chemistry

Baillière, Tindall and Cox.—Aids to Qualitative Inorganic Chemistry, R. G. Austin.

J. and A. Churchill.—The Natural Organic Tannins, Dr. M. Nierenstein.

Charles Griffin and Co., Ltd.—Phosphorus, E. B. R. Prideaux, being vol. 6, part 2, of a Textbook of Inorganic Chemistry edited by Dr. J. Newton Friend.

William Heinemann, Ltd.—Physical Chemistry, A. J. Mee.

Leonard Hill, Ltd.—Varnish Making, T. Hedley Barry and G. W. Dunster.

Methuen and Co., Ltd.—Physico-Chemical Practical Exercises, Prof. W. N. Rae and Prof. J. Reilly; The Adsorption of Gases by Solids, Dr. S. J. Gregg; The Galvanic Cell and Electrolysis, Dr. J. A. V. Butler; Flame, O. C. de C. Ellis and Dr. W. A. Kirby.

Thomas Nelson and Sons, Ltd.—The Young Chemist, Dr. F. Sherwood Taylor.

Kegan Paul, Trench, Trubner and Co., Ltd.—Richter's Organic Chemistry, vol. 1, Aliphatic Series.

Engineering

G. Bell and Sons, Ltd.—Modern Acoustics, Dr. A. H. Davis; Engineering Radiography, V. E. Pullin.

Ernest Benn, Ltd.—Haulage and Winding, Prof. Granville Poole.

A. and C. Black, Ltd.—British Aeroplanes Illustrated, C. A. Sims.

Constable and Co., Ltd.—Plane and Geodetic Surveying for Engineers, vol. 2, Higher Surveying, D. Clark, revised by Dr. L. J. Comrie and Lieut.-Col. J. E. E. Craster.

The Draughtsman Publishing Co., Ltd.—Marine Engine Pipe Arrangements, J. M. Baxter; Mechanical Design of Salient Pole A.C. Rotors, W. R. Needham.

Faber and Faber, Ltd.—Aviation: its Past, Present and Future, E. Colston Shepherd.

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Letters to the Editor

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Inner Conversion in X-Ray Spectra

MORE than ten years ago, Coster[1] reported that he had carried out experiments with heavy elements for tracing X-ray characteristic lines due to the transition $L_1(2s) \leftarrow L_{2,3}$ $(2P_{1/2}, {}^2P_{3/2})$, but got no positive results. During the last ten years, a number of other investigators[2] have also reported negative results.

These failures have remained rather mysterious for the transition $L_1 \leftarrow L_{2,3}$ $(\Delta n = 0)$ is not forbidden by quantum mechanics and actual calculation based on wave mechanics shows that the expected line should be quite intense. A recent search by one of us (J. B. M.) for the expected line of W $(L_1 - L_3$; $\nu/R = 139{\cdot}5$; $\lambda = 6{\cdot}4$ A.) also yielded no positive result though both the excitation and exposure were more than sufficient. A search into the current literature shows that though these lines $(L_1 \leftarrow L_3)$ have not been obtained, a number of lines of heavy elements (73 Ta to 81 Tl) due to the transitions between N-levels $(N_{4,5} \leftarrow N_{6,7})$ have been obtained by Thibaud[3], del Rosario[4], Magnusson[5], Prins and Takens[6], while the last two workers report lines due to the transitions $(M_{2,3} \leftarrow M_{4,5})$ of a number of elements. Since in all these lines, $\Delta n = 0$, the failure to obtain the lines due to the transition $(L_1 \leftarrow L_3)$ was remarkable.

It appears to us that the failure to obtain the $(L_1 \leftarrow L_3)$ line is to be completely ascribed to the inner conversion of such lines in the M-levels of the elements. A scrutiny of the L-level values of the elements shows that from 92 U to 68 Er the $(L_1 - L_3)$ values are greater and very close to the M-level values; for example, in W, the ν/R value for $(L_1 - L_3)$ is equal to $139{\cdot}5$ while $M_4 = 137{\cdot}5$, $M_5 = 132{\cdot}9$.

An application of a modified form of the formula for inner conversion given by Miss Swirles, Taylor and Mott, and Hulme[7] shows that the $(L_1 - L_3)$ lines should be completely converted in such cases. It is only in 68 Er that the $(L_1 - L_3)$ ν/R value is just less than any of the M-level values and much larger than N-level values. But this situation persists only up to 55 Cs; from iodine again, $L_1 - L_3$ becomes just larger than some M-values, so that it is expected that only elements from Er to Cs are capable of showing lines due to $(L_1 \leftarrow L_3)$ transitions. This conclusion has not yet been tested.

It appears that the phenomenon of inner conversion is responsible for many of the intensity anomalies which are observed in the line spectra of X-rays, as was suggested some years ago by Wentzel.

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[1] Coster, *Phil. Mag.*, **44**, 945; 1922.
[2] Idei, NATURE, **123**, 643; 1929.
[3] Thibaud, *Phys. Z.*, **29**, 241; 1928.
[4] del Rosario, *Phys. Rev.*, **41**, 136; 1932.
[5] Magnusson, *Z. Phys.*, **79**, 161; 1932.
[6] Prins and Takens, *Z. Phys.*, **75**, 743; 1932. *Z. Phys.*, **77**, 795; 1932.
[7] Swirles, *Proc. Roy. Soc.*, **116**, 491; 1927. Hulme, *Proc. Roy. Soc.*, **138**; 1933. Taylor and Mott, *Proc. Roy. Soc.*, **138**; 1933; and **142**; 1933.

Disintegration of the Separated Isotopes of Lithium by Protons and by Heavy Hydrogen

THE two known isotopes, Li^6 and Li^7, have been separated in quantities of the order of one microgram by two separate methods depending on the passage of several microamperes of lithium ions through electric and magnetic fields. The separate isotopes were collected on metal discs cooled with liquid nitrogen, and after fixation by exposure to hydrochloric acid gas, were bombarded by protons and by diplons in an apparatus already described[1]. It was possible to observe several hundred disintegration particles each minute from the Li^7 targets and about half that number from the Li^6 targets arranged to contain about the same number of atoms. The results are summarised in the accompanying table.

Bombarding Particles	Lithium 6	Lithium 7
Protons	α-particles of 11·5 mm. range	α-particles of 8·4 cm. range
Diplons	α-particles of 13·2 cm. range Protons of 30 cm. range	α-particles up to 8 cm. range Neutrons

The purity of the separate samples was apparent from the very small number (less than 1 per cent) of the 8·4 cm. particles obtained from the Li^6 target, and the total absence of 13·2 cm. particles from the Li^7 target.

It may be seen from the table that observations have been made not only on the α-particles but also on the protons and neutrons liberated from lithium by heavy hydrogen. Owing to the absence of the much more abundant Li^7, the Li^6 targets show very clearly the presence of the very definite range of doubly charged particles previously reported[1] at 11·5 mm. The mica window through which the particles escaped into the detecting chamber had an absorption equivalent to 6 mm. of air, so that the origin of the shorter 7·5 mm. range group also found previously could not be determined.

These observations are in complete accord with the assumptions made in previous papers[1]. Details of the isotope separation will be published elsewhere.

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[1] *Roy. Soc. Proc.*, A, **141**, 722; 1933; and references given there.

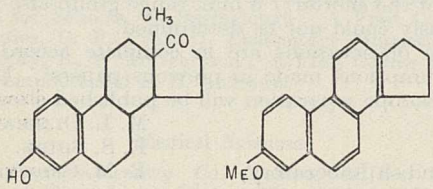
Dehydrogenation of Œstrin

THE chemical constitutions of ketohydroxyœstrin and trihydroxyœstrin are now largely established, mainly by the investigations of Butenandt, Marrian, and their collaborators. There remain, however, certain features of the molecular structure which have not yet been experimentally proved, but depend upon the assumption that the hormones are biological degradation products of cholesterol. The experiment now recorded was undertaken as a preliminary step in an attempt to obtain confirmation of some of the structural details which are still in doubt.

Although Butenandt[1] has shown that trihydroxyœstrin may be transformed into 1 : 2-dimethylphenanthrene by selenium dehydrogenation of the dicarboxylic acid arising by fission of the five-membered ring IV, the dehydrogenation of the hormone itself, with the tetracyclic system still intact, has given very unsatisfactory results. The only pure

substance which has been obtained hitherto is chrysene (0·0049 gm. from 5·4 gm. of crude crystalline hormone), which was isolated by Butenandt and Thompson[2] from the products of zinc dust distillation of ketohydroxyœstrin. Nevertheless, it is clear from recent work on the selenium dehydrogenation of polycyclic compounds of known structure containing five-membered rings (for example, Cook and Hewett[3]) that suitable œstrin derivatives ought to be capable of smooth conversion into derivatives of a *cyclo*pentenophenanthrene by this method.

This is, in fact, the case. In order to avoid complications due to substituents in the five-membered ring, the carbonyl group of ketohydroxyœstrin was first reduced to a methylene group (Kishner-Wolff method). Dehydrogenation of the 'desoxo' compound so formed led to a non-acidic substance by some secondary change involving the hydroxyl group. In the remainder of the material (0·75 gm.) the hydroxyl group was therefore methylated before dehydrogenation. The resulting methoxy compound (m.p. 76°–77°; Butenandt[4] gives 72°) was heated with selenium at 300°–320° for 24 hours, the product was distilled over sodium in a high vacuum, and the distillate was finally recrystallised from alcohol. There was obtained 0·125 gm. of colourless needles or plates (depending on the conditions of crystallisation), which gave analytical figures in good agreement with those required for a methoxy-*cyclo*pentenophenanthrene (Found : C, 86·9, 86·95 ; H, 6·2, 6·4 ; OMe, 12·1 per cent. Mol. wt., 264, 268. $C_{18}H_{16}O$ requires C, 87·05 ; H, 6·5 ; OMe, 12·5 per cent. Mol. wt., 248). This substance gave an orange-red picrate, m.p. 135°–136·5° (Found : C, 60·8 ; H, 4·0. $C_{24}H_{19}O_8N_3$ requires C, 60·4 ; H, 4·0 per cent), and a golden-orange trinitrobenzene complex, m.p. 160°–161° (Found : C, 62·5 ; H, 4·2. $C_{24}H_{19}O_7N_3$ requires C, 62·4 ; H, 4·15 per cent). The melting point (134·5°–136°) of the methoxy compound was unaltered by purification through the trinitrobenzene complex.



(I) (II)

If the phenolic hydroxyl group and the five-membered ring are correctly placed in the current formula for ketohydroxyœstrin (I), then this product of dehydrogenation must be 7-methoxy-1 : 2-*cyclo*pentenophenanthrene (II). The synthesis of (II) is in progress (in collaboration with Dr. A. Cohen and Mr. C. L. Hewett) by a modification of the method used for the synthesis of the parent hydrocarbon, 1 : 2-*cyclo*pentenophenanthrene[3].

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[1] Butenandt, Weidlich and Thompson, *Ber. Chem. Ges.*, **66**, 601; 1933.
[2] Butenandt and Thompson, *Ber. Chem. Ges.*, **67**, 140; 1934.
[3] Cook and Hewett, *J. Chem. Soc.*, 1098; 1933; and in the press.
[4] Butenandt, Störmer and Westphal, *Z. physiol. Chem.*, **208**, 170; 1932.

Influence of Sensitisers on Chemical Reactions produced by Gamma Radiation

Attention was first directed to the above subject during the course of an investigation on the decomposition of chloroform by radiation from radon. Chloroform is decomposed with liberation of chlorine which slowly disappears with formation of hydrochloric acid as a secondary product. The decomposition was measured by estimating the chlorine set free. Certain discrepancies were obtained in the results which were largely explained when it was found that the apparent rate of decomposition was greatly influenced by the presence of the products formed. This was shown by irradiating for a second time the chloroform containing small quantities of products from the first irradiation. It has been demonstrated by others that traces of moisture considerably increase the decomposition of chloroform by X-radiation.

Gamma radiation oxidises solutions of ferrous salts. Berthelot's solution of ferric chloride and oxalic acid, which is rapidly reduced by ultra-violet light, was found not to be reduced at all by gamma rays. On the contrary, the iron in the reduced solution is oxidised to the ferric state, and the addition of small quantities of various organic and inorganic substances was found to accelerate or retard the rate of oxidation. Striking results have been obtained recently with the photographic salt, potassium metabisulphite. Solutions of this substance oxidise slowly in air, but more rapidly when irradiated. The solutions used were of such strength that 5 c.c. required approximately 18 c.c. $N/1000$ iodine solution for titration. The radon seed (150–250 millicuries in strength) was enclosed in a lead case with walls 1 mm. thick, and was held centrally in a glass tube, surrounded by 15 c.c. of solution contained in a larger glass tube. Two tubes of solution without radon served as controls. Overnight the controls showed an amount of oxidation in 5 c.c. equivalent to approximately 1 c.c. $N/1000$ iodine. The excess oxidation with radiation varied from about 2·5 to 6 c.c. $N/1000$ iodine.

Addition of small quantities of iodine solution to the bisulphite had a negligible effect on the oxidation of the non-irradiated controls, but a very great effect on the solutions irradiated, so much so that 0·04 c.c. of $N/1000$ iodine added to 100 c.c. of the bisulphite solution was sufficient under the prescribed conditions to bring about the complete oxidation of the irradiated solution. Potassium iodide and potassium bisulphate, added in equivalent amounts, produced the same effect. Light and X-rays also bring about the oxidation of bisulphite, but in the case of these radiations the sensitising action of irradiation is less marked than with gamma radiation. Glutathione, an organic compound of great importance in tissue metabolism, was prepared by Hopkins' method and tested. Although its rate of oxidation in solution was quite definitely accelerated by gamma radiation especially in the unneutralised state, the rate was not further increased by iodine, potassium iodide or potassium iodate.

Crabtree and Cramer, in recent communications dealing with the action of radium on cancer cells[1], have shown that the susceptibility of cells to radium is not a fixed property of a given type of cancer cell, but changes with the environment. The effect of certain well-known inhibitors of metabolism was shown to produce varying sensibility to radium

in tumour cells. Prussic acid and low temperature greatly increased the susceptibility of tumour tissue to radium, anaerobiosis produced the opposite effect. The glycolytic inhibitors iodoacetic acid and sodium fluoride had little or no effect on the action of radium. As a result of their experiments they suggest that it may be possible to increase the radiosensitivity of cells by introducing suitable chemical substances. The results obtained in our laboratory appear to lend force to this suggestion by showing that reactions fostered by gamma-, and X-, radiations can be sensitised by small additions of chemical bodies in an analogous manner to the action of sensitisers in many well-known photochemical reactions.

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Dec. 7.

[1] *Proc. Roy. Soc.*, B, **113**, 226, 238.

Ethane from Acetic Acid

I SUGGEST that Messrs. Glasstone and Hickling (NATURE, Feb. 3, p. 177) may spare themselves from any "comprehensive investigation of the Kolbe synthesis". This was made clear nigh on fifty years ago.

Chemists were rational in the distant past. Having proved experimentally, by their joint labours, in 1847–48, the truth of the conception first propounded by Berzelius, that acetic acid was "a compound of oxalic acid with the conjunct methyl", our view to-day, Frankland and Kolbe both started out as Japheths in search of Radicles. Frankland went gaily off with the alcoholic iodides and metals, to bag zinc methyl and various paraffins. Kolbe resorted to electrolysis but also bagged paraffins. His results are recorded in the *Quarterly Journal of the Chemical Society*, vol. 2; the account was given to the Society on March 29, 1849, before anything had been heard of Kekulé.

From previous experience, regarding "electrolysed oxygen (as) one of the most valuable oxidising agents at the chemist's disposal"; thinking that "electricity might effect a separation of its conjugated constituents": Kolbe electrolysed acetic acid (as potassic salt). He obtained the result he expected, expressed in the equation:

$$HO.(C_2H_3)C_2O_3 + O = C_2H_3 + 2CO_2 + HO.$$

Kolbe's use of CO_2 (C = 6, O = 8) is of historical significance. Acids were then thought of as compounds of an acidic with a basic oxide; bearing this in mind, the equation we write to-day is the precise equivalent of Kolbe's:

$$2CH_3.CO_2H + O = (CH_3)_2 + 2CO_2 + OH_2.$$

Came 1865. Schützenberger, following up Sir Benjamin Brodie's discovery of acetic peroxide, simply mixed an excess of barium peroxide with acetic oxide in a small flask; on warming the mixture, ethane, together with twice its volume of carbon dioxide, was regularly evolved. He remarks: "the preparation of ethane in this way is as simple as that of any other gas". The work has been strangely overlooked (*C.R.*, 61, 487; 1865).

Some of us, having regard for patent facts, have long preached the doctrine, that the electrolysis of aqueous solutions is essentially an oxidation (hydroxylation) process. Oxygen is commonly obtained because the peroxide first formed is decomposed at the electrode surface. Any promoter of its breakdown, such as lead peroxide, necessarily prevents the appearance of the peroxide or of its immediate decomposition products. In making acetic acid from aldehyde, on the large scale, during the War, the need of a manganese or other suitable salt to promote decomposition of peracetic compounds was clearly recognised, though not fully until after a serious explosion. Textbooks have little regard for truth. The fiction that hydrogen and oxygen are immediate products of electrolysis is a hardy chestnut we might well transfer to the dustbin: no boy should be taught to use it as a Conqueror.

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Passage of Hydrogen through Steel

I WAS much interested in the communication by T. N. Morris to NATURE of February 10, p. 217, concerning the observations he has made relating to the diffusion of hydrogen through steel. Since he asks whether facts of the kind he mentions have been previously recorded, may I make the following observations?

The diffusion of hydrogen through mild steel under varying conditions of temperature and acid concentration formed the subject of a paper which was published (under my name) in the *Journal of the Iron and Steel Institute*, vol. 2, 1925. This paper dealt with a quantitative study of certain aspects of this interesting problem; but it was by no means the first time that the phenomenon had been observed. So far back as 1874, Osborne Reynolds directed attention to it in a paper he published in the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, vol. 13, p. 93.

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Side-Chain Reactions of Benzene Derivatives

WE have recently examined a number of side-chain reactions in the light of the postulate that the differences in the rates of reaction of a series of similarly constituted compounds under identical conditions are to be ascribed solely to different energies of activation, substituents contributing additively to the total energy[1]. Our results[2] for the reaction of hydrogen ion with various *p*-substituted acetophenones $X{\cdot}C_6H_4{\cdot}CO{\cdot}CH_2R$ (acid-catalysed prototropy) indicate that the energies of activation are given by the expression $E = E_0 - C(\mu - a\mu^2)$, where C and a are constants for the series, E_0 is the value of E for the unsubstituted compound, and μ is the dipole moment of C_6H_5X. The substituents dealt with included three halogens, to which the equation applies accurately, but did not include 'inclined' groups such as $-OAlk$ and $-NAlk_2$. We further suggested[3] that the expression $E = E_0 \pm C(\mu - a\mu^2)$ might be applicable to side-chain reactions in general, the negative and positive signs referring respectively to those of Classes A and B[4]. A review of fourteen reactions led us to the conclusion that, for *m*-substituted compounds, the equation is valid except

when the substituent is a halogen, while, with the substituent in the *p*-position, complications arise, as anticipated, from the operation of electromeric effects, and in a number of Class *B* reactions the term in μ^2 changes sign, an observation for which there was no obvious explanation.

We wish now to suggest that, while the equation $E=E_0-C(\mu-a\mu^2)$ applies to reactions of Class *A*, the correct expression for Class *B* reactions may be $E=E_0+C(\mu+a\mu^2)$. Assuming this expression, the halogens *as a group* behave in accordance with the dipole moments of C_6H_5X, while the 'inclined' groups are exceptional. The new view is based, in fact, on the probability (kindly pointed out to us by Prof. Ingold) that the 'effective polarity' of these groups is represented not by the measured dipole moment but by the component in the plane of the nucleus. The calculation of the angle of inclination for $-OCH_3$, from results where complications appear to be absent[5], gives the value 112° or 104·5°, according as the value of μ for anisole is taken as $-0{\cdot}8$ or $-1{\cdot}2$ Debye units. This may be compared with the angle suggested for singly-linked oxygen[6] and the vertical angle for water[7].

No clear distinction can at present be drawn between the possibility outlined above and that suggested previously, but it is hoped to obtain further information from experiments now proceeding at these laboratories.

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Cardiff.

[1] Compare Bradfield, *Chem. and Ind.*, **51**, 254; 1932.
[2] *J.C.S.*, 217, 890; 1933.
[3] *J.C.S.*, 1248; 1933.
[4] Ingold and Rothstein, *J.C.S.*, 1217; 1928.
[5] Shoppee, *J.C.S.*, 696; 1932.
[6] Wolf, *Z. phys. Chem.*, B, **3**, 128; 1929.
[7] Debye, "Polar Molecules", 1929, chap. iv. Mecke, *Z. Physik.*, **81**, 313; 1933.

The Infinite and Eternal Energy

THE quotation for which Mr. Donald Murray asks in NATURE of February 24 is in Herbert Spencer's "Principles of Sociology", Part 6—Ecclesiastical Institutions, Chap. 16—Religious Retrospect and Prospect. It there reads as follows: "But one truth must grow ever clearer—the truth that there is an Inscrutable Existence everywhere manifested, to which he [the man of science] can neither find nor conceive either beginning or end. Amid the mysteries which become the more mysterious the more they are thought about, there will remain the one absolute certainty, that he is ever in presence of an Infinite and Eternal Energy, from which all things proceed."

It first appeared in January 1884, when this chapter of the "Sociology" was published as the first article in the *Nineteenth Century*. It was, I think, mainly responsible for the attack made upon Spencer by the late Mr. Frederic Harrison, the controversy between him and Spencer lasting almost throughout that year. In the course of the controversy, Mr. Harrison had referred to the Inscrutable Power as "the All-Nothingness", and Spencer replied in July: "So far from regarding that which transcends phenomena as the 'All-Nothingness', I regard it as the All-Being. Everywhere I have spoken of the Unknowable as the Ultimate Reality—the sole existence; all things present to consciousness being but shows of it." The entire controversy was issued in book form in America, at the insistent request of Spencer's American friend Prof. E. L. Yeomans, but an objection raised by Mr. Harrison so incensed Spencer that he wired to his New York publishers ordering the book to be withdrawn and the plates to be destroyed. It was unfortunate, for the whole incident made much clearer the positive aspect of Spencer's doctrine concerning the Ultimate Cause, as opposed to the negative aspect so unduly enlarged upon by his opponents.

GEORGE EASTGATE.

28, Stanley Road,
Woodford, E.18.
Feb. 26.

[Several other correspondents, for whose letters we cannot find space, have also identified the quotation.—Ed. NATURE.]

Uniformity in Bibliographic Particulars

IN the library of the John Innes Institution, and presumably in other scientific libraries, the indexing of 'separates' has become a formidable task. It is made more laborious where the particulars given of the source of the paper are misleading or incomplete. Editors will not, I am sure, be unwilling to consider the needs of the librarian, and I therefore venture on some suggestions.

First, the bibliographical particulars should be readily available on the cover or front page of the separate. (It is not necessarily the business of the person making the index cards to read the papers.) Secondly, no irrelevant matter should appear. The citation should be essentially as follows:

> Name of author; title of paper; year; name of journal; volume; page references. (The pagination should be unaltered.)

Although there are a number of journals which adhere to this standard practice, too many others deviate from it in one way or another. The most usual deviations are the following:—

(1) Separates are sent out in blank covers, or in covers bearing the name of the journal but no other particulars.

(2) The title, etc., is given on the cover, but the page references omitted.

(3) The name of the journal is followed by the day, month and year of publication, and the volume and page references omitted; or the session (in the case of *Proceedings*) is given, and the year omitted.

(4) The paper is re-paginated, and the original page references not only omitted but also unascertainable.

(5) The cover is like that of the parent journal, and the name of the author of the paper either has to compete with that of the editor of the journal, or does not appear on the front page at all.

To take these points in order: (1) may be due to economy, which does not permit of a separately printed cover. It would cost no more and would suit most of us better to have such a paper without a cover, but with full particulars at the head of the first page. (2) is due to lack of foresight, as it is scarcely any more trouble for the printer to add the page references when printing the title; but in their absence *every* recipient of the separate who keeps a card-index has to waste time looking inside. (3) shows a lack of foresight that is even more depressing, as one cannot cite the complete reference without undertaking

bibliographical research on one's own account. As the reprints are meant to reach those who do not see the journal, it seems indeed thoughtless to give on them a citation which cannot be completed except by reference to a file of the journal. The same applies to (4). In (5), which is due to excess of zeal, the author's name if it appears at all is coyly hidden between those of the editor and publisher (as in the case of the railway station which was called Bovril). This at the best is distracting to the eye; at the worst, in the hands of an assistant who is not very strong in foreign languages, it can lead to quite remarkable results in the filing.

Thirdly, on the more general question of bibliography, apart from the immediate one of separates, journals have various idiosyncrasies. There are for example some which begin over again at p. 1 for each part within the volume, or have separately paginated appendices. Surely the volume should always be the unit. There is one venerable and distinguished London journal sent out in continuously numbered parts; the volumes are made up of an irregular number of these parts, but there is nothing on the cover to show which part begins or ends a volume. Then there are a great many journals which still use roman numerals, a quaint but eye-straining practice. There is the confusing trick of numbering the plates, including their versos which are always blank, along with the text; and finally there is the practice of putting last year's date on an overdue part. Such falsification of a document is scarcely an example of scientific integrity.

To conclude, it is evident that many journals which are scientific in content are traditional in form. It may be that there are certain advantages, of which I am unaware, in the practices which I deprecate, but it seems more likely that they have persisted, not on account of any essential virtue, but simply because it has been no one's business to have them altered. The eminent men of science who conduct the journals may consider such small matters unworthy of their attention; but convenience and consistency underlie all scientific method and might well be applied in this case as in others.

BRENHILDA SCHAFER
(Librarian).

John Innes Horticultural Institution,
London, S.W.19.
Jan. 1.

Graphical Determination of Contemporaries

THE illustration which Mr. Lucas gives of his graphical determination of contemporaries[1] is perhaps an unfortunate one, for even with the help of this example his letter affords no clue as to what he is trying to do or why he has chosen an oblique method of doing it.

The duration of a life is very simply represented by the length of a line or, better still perhaps, by the interval between two points and it would seem that the interesting chronologies[2] of Prof. Thomas Young are admirably adapted to the determination of contemporaries.

In referring to the Chronology of Mathematicians and Mechanics, reproduced in Fig. 1, I was interested to read, on the facing page, Young's counsel of perfection to everyone who is desirous of enlarging the sphere of our knowledge with respect to any

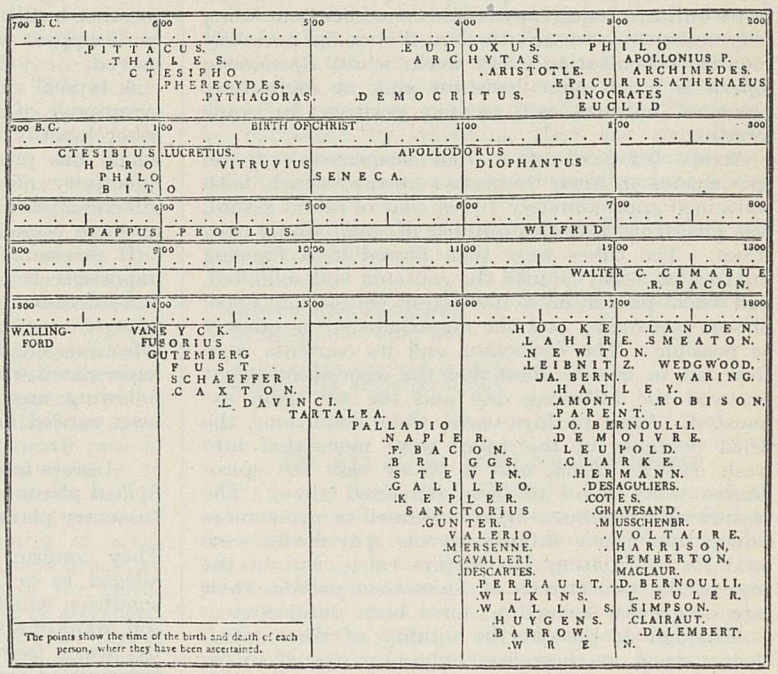

FIG. 1.

branch of science: "to collect that previous knowledge of all that has been already done with the same view, which, in justice to himself, he ought to acquire before he enters on the pursuit, or at any rate, in justice to the public, before he calls on the world at large to participate in his improvements and discoveries".

A. F. DUFTON.

Greenbank, Garston,
Hertfordshire.
Jan. 30.

[1] NATURE, **133**, 141, Jan. 27, 1934.
[2] Young, T., "A Course of Lectures on Natural Philosophy and the Mechanical Arts", London, 1807.

The Viability of Spirochætes dried *in Vacuo*

IT is well known that all kinds of spirochætes, both pathogenic and non-pathogenic, are unable to withstand ordinary desiccation, for repeated experiments have shown that they very soon lose their vitality after ordinary drying. Hitherto, however, no attempts seem to have been recorded on the results of drying these organisms by the special methods used with success for the preservation of certain filterable viruses and some bacteria. In view of the difficulty and expense of maintaining strains of spirochætes in the laboratory, it seemed of interest to see whether they could be preserved in the same way, and the results show that under special

conditions it is possible to dry them without destroying their vitality.

Five strains of spirochætes have been used in these preliminary experiments; two culture strains of *Spirochæta pallida* obtained respectively from Kroo and Vasarhelyi, and three strains of *Spirochæta biflexa*, the common water leptospira, two Leyden strains obtained from Schüffner and van Theil, and a strain which I have recently isolated from London sewage. Extremes types of spirochætes were thus included, for *Spirochæta pallida* is somewhat exacting in its cultural requirements and in addition to being very susceptible to variations in the media, normally requires subculturing every week, whilst *Spirochæta biflexa* is much more resistant and, at room temperature, cultures will remain positive for some months.

About 0·5 c.c. of a rich suspension of the spirochætes in their respective media, which both contained approximately 10 per cent of rabbit serum, was placed in each of a number of small sterile test-tubes. The tubes were then placed in a freezing mixture at −10° C. until the contents had solidified, and then placed in a desiccator containing phosphorus pentoxide, and the air exhausted as quickly as possible. The desiccator and its contents were then left in the ice chest and the desiccating agent renewed the following day and the air again exhausted. After 15 days under these conditions, the dried contents of the tubes were inoculated into fresh culture media, and in every case the spirochætes were found to have remained alive. The strains of *Spirochæta biflexa* seemed to grow more slowly than when ordinary motile spirochætes were used for inoculating the culture tubes, but in the case of the two strains of *Spirochæta pallida*, their rate of growth seemed to have been unaffected.

Although at present the vitality of these spirochætes dried *in vacuo* has only been tested up to 15 days, there is no reason to doubt that they will remain alive for very much longer periods. This method, therefore, should be of value for the maintenance of strains of spirochætes in the laboratory, as it reduces the necessity for repeated subculturing.

EDWARD HINDLE.

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Insect Transmission of Spike Disease

IT has been recently announced[1] that transmission experiments with the Jassid, *Moonia albimaculata*, have yielded three positive results; that the symptoms so produced are inseparable from typically spiked plants on morphological, biochemical and cytological grounds.

This important result was the subject of a discussion at one of the meetings of the Working Committee on Spike-Disease Investigation (July 28, 1933) when Dr. V. Subrahmanyan, in view of the fundamental nature of the finding, suggested that the result should be critically examined in all its aspects. As a result of the discussion, it was felt that the evidence, based on symptomatic and other grounds, was by itself not sufficiently conclusive to justify the incrimination of *Moonia* as the vector of spike disease. It was therefore suggested that the matter should be regarded as *sub judice* pending the results of infectivity experiments by grafting, which was considered to be the decisive test in doubtful cases of disease.

It is well known that the sandal plant assumes a variety of morphological characteristics, some of which are often mistaken for the condition of spike. Experiments have shown that this condition can be brought on by deprival of host plants, an impoverished soil, drought and other adverse soil and climatic factors. These symptoms can be distinguished from those of a genuinely spiked plant, are not transmitted to other healthy plants by grafting and can be made to disappear when the adverse conditions are removed.

A typical spiked plant, however, is infective, the symptoms of the disease being communicable to other healthy plants through grafting, a technique which has proved most useful in determining the infectivity of doubtful cases of spike. It is the infectious character of the disease that renders the problem economically important and serious.

It is clear from the above discussion that it is important to distinguish between the curable and non-infectious condition of stunting induced by an adverse environment, as against the deadly and infectious condition of spike disease, which, to an experienced worker, is not difficult to diagnose. The following are results of grafting tests which have been carried out:

Leaves from	Number of plants operated	Number of plants spiked
Spiked plants .	12	9
Insectary plants .	14	0

They confirm the suspicion that the three plants alleged to be diseased only represented a stunted condition which was brought on by an impoverished soil, want of a vigorous host and probably aggravated by insect feeding. The symptoms have not been transmitted through grafting, and further, the plants themselves, after a careful nursing with fresh soil and host, have since turned completely healthy.

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Jan. 18.

[1] NATURE, **132**, 592, Oct. 14, 1933.

Bilateral Gynandromorphism in Feathers

MR. PAUL 'ESPINASSE has recently pointed out[1] some difficulties preventing complete acceptance of the growth rate theory of Lillie and Juhn[2] in which bilateral gynandromorphism of individual feathers is supposedly explained. The existence of differences in rates of growth of individual barbs, by which these authors explain different degrees of susceptibility to female hormone, would be proved if, in successive cross sections of a feather, barbs arising near the ventral point fused with the rhachis at a higher level on one side than on the other, but this has never yet been observed.

The concrescence theory of development of a feather, in which the rhachis is regarded as formed from two halves of a collar (the growing basal region) is also due to these authors, but this interpretation, necessary for an explanation of the growth rate theory of Lillie and Juhn, is not in agreement with the results of Davies[3] and Strong[4].

According to the present investigation, the formation of ridges in a feather follows, and is probably due to, the rapid proliferation of intermediate cells causing increased pressure on the pulp, while lateral expansion is prevented by the sheath. These ridges proceed in a curve round the feather germ, so that ultimately the ridge nearest the ventral point lies dorsally. There is no suggestion of a movement of cells from one position to the other—rather a passive cutting up of the intermediate cell layer.

The rhachis has a complex origin, as Davies and Strong agree, but which Lillie and Juhn consider incorrect. Sections through the tip of a feather show a ring of barbs, with little or no difference in size between the ventral and dorsal ones. This is particularly evident in embryonic feathers. Successive cross sections down the feather show the fusion of barbs to form the rhachis.

The hyporhachis is formed in the same way, the ridge nearest to the ventral point fusing with its neighbour as do the ridges near the dorsal point in forming the rhachis. The calamus is merely the cornified collar, as though the process of cornification, having gained speed in passing down the feather (correlated doubtless with the withdrawal of pulp) is here too rapid for the formation of ridges.

In view of this method of development of individual barbs, it is difficult to correlate the appearance of female bars on one side only of an otherwise symmetrical feather, with differences in growth rate of the barbs. Barbs certainly grow more quickly at their apices, where they are smaller in cross section than near the rhachis—hence the upward curve of barbs in a definitive feather. But barbs of equal length at any level must of necessity have arisen at the same time near the ventral side of the germ. Some other explanation, therefore, must be advanced for a correct interpretation of the female bar in the feathers figured (Nos. 51 and 52) by Lillie and Juhn.

A re-examination of feather development is obviously necessary for an accurate explanation of known experimental facts, and it is hoped, during the summer, to publish the results of a study, now nearing completion, of the development of nestling and definitive feathers in the domestic fowl and the duck, and of definitive feathers in the starling.

ANNE HOSKER.

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The University,
Leeds.

[1] NATURE, **133**, 330, March 3, 1934.
[2] "Physiol. Zool.", **5**, 1932.
[3] "Morph. Jahr.", **15**; 1899.
[4] *Bull. Mus. Comp. Zool. Harv.*, **40**; 1902.

Effect of Yeast Extract on the Growth of Plants

WE have read with great interest the communication by Prof. V. Subrahmanyan and G. S. Siddappa in NATURE[1] under this title, in which the authors state that in 1932–33 several Indian papers published results of their experiments, in which yeast extract was injected into plants with a marked effect on the growth and blooming. Unfortunately, we were hitherto completely unacquainted with this interesting work and, consequently, were unable to refer to it in our previous paper on the subject[2].

Our work was carried out in 1932–33, and differs substantially from the observations of Subrahmanyan and Siddappa, as we showed that plants are able to take up the promoting factor (or factors) in the yeast extract, through their roots. In our opinion, this is of great interest, since it tends to show that the micro-organisms in soil are of importance in the formation of different growth-promoting factors. Soil micro-organisms would thus have functions previously unforeseen.

Further to our earlier note, we have found that the factor which stimulates the blooming of the pea is soluble in ether (communication to a meeting of the Society of Finnish Chemists on November 4 last). The extract is equally effective in sterile water cultures and in the usual pot cultures with quartz sand.

Pot cultures with different types of soil showed that in clay soil the effect of yeast extract on the growth of the pea was still distinct, although not so marked as in quartz sand. In rich humus soil the effect was very weak or possibly nil. This could be explained by assuming that the stimulating factor of yeast extract is normally present in soils rich in organic matter and with an abundant microflora.

A detailed report of our work on the subject will appear elsewhere.

A. I. VIRTANEN.
SYNNÖVE v. HAUSEN.

Biochemical Institute,
Helsingfors. Jan. 26.

[1] NATURE, **132**, 713, Nov. 4, 1933.
[2] NATURE, **132**, 408, Sept. 9, 1933.

The Age of the Sub-Crag Implements

I AM glad that Prof. Boswell[1] has expressed an opinion upon the nature of the material attached to the surfaces of a rostrocarinate flint implement exhibited, recently, in the British Museum. There are few people for whose views upon such a matter I entertain more respect, and I intend, if he will allow me, to go further into the question of this particular implement with him, and of that of others I am in process of collecting from beneath the Red Crag. It is evident that we are dealing with a complex matter in which Prof. Boswell's specialised knowledge of Crag deposits will be of great value.

As regards the geological age of the boxstones, I find that Lankester, who made a very close study of these specimens, and, in fact, gave to them their characteristic name, states[2] that they are "The Remains of a Pliocene deposit, anterior to the Coralline Crag, and identified by its fossils with the Black Crag, or Diestian Sands of Belgium", while in Clement Reid's "Pliocene Deposits of Britain", p. 223, the "Sables à *Isocardia Cor*, or Diestian" of Belgium, are placed by him in what he calls the "Older Pliocene". Also, in the Survey Memoir "The Geology of the Country around Woodbridge, Felixstowe and Orford", p. 16, Prof. Boswell himself states: "Although the boxstone fauna has been compared with the Continental Miocene, or even with the Oligocene (Rupelian), it is at present generally regarded as of Lower Pliocene Age." It was for these reasons that, in my recent note in NATURE[3], I stated that the Diestian boxstones are referable to the Lower Pliocene epoch. But, in the note mentioned, I made no claim that the British representatives of the Continental Diestian deposits are the boxstones of Suffolk. I merely, like Lankester, look upon the boxstones as representing, in the Suffolk Bone Bed, the Diestian Sands of Belgium.

J. REID MOIR.

[1] NATURE, **133**, 331, March 3, 1934.
[2] *Phil Trans.*, B, **202**, 291.
[3] NATURE, **133**, 64, Jan. 13, 1934.

Research Items

Indian Iconography. Tours of inspection in Bengal districts by Mr. H. E. Stapleton, Director of Public Instruction, N. Chakravarti and S. K. Saraswati, have produced data of historical and archæological interest which are recorded in three communications (*J. and Proc. Asiat. Soc. Bengal*, New Ser., 28, No. 1; 1932). In the district of Dinājpur along the Chirāmati River, in particular, Mr. Saraswati found interesting sculptures among figures worshipped at local shrines which have furnished details of importance in Hindu iconography. In the village shrine of Dehābandh was found a sandstone *lingam* of very rare iconographic character. It is encircled by four effigies of the Devī, which have matted hair and are seated in the *padmāsana* attitude with clasped hands held up in adoration. The female figures around Siva's symbol evidently stand for his female energies. At Mahendra a previously unknown iconographic specimen was obtained. This is an image, probably of Sūryya, on the pedestal of which are the seven horses and the chariot; above are all the usual attendants, Dandī, Pīngala, his two queens, etc. All the figures are booted as is usual with the image of Sūryya. The interesting feature is that Sūryya has six hands instead of four or the more usual two. The two main hands hold lotuses by the stalks as prescribed, the others show respectively the gestures of 'granting boons' and 'granting security', one holds the rosary and another the pot. Nowhere are six hands mentioned or shown, nor are the rosary and pot known as his attributes. The image seems to correspond to a description of Dhātri, the first Ādītya, except for the two additional hands. This is perhaps the first iconographic treatment of such a deity yet discovered. At Betnā a female figure fighting with a host of pot-bellied Asuras is evidently an aspect of Chandīkā fighting the demons. She holds various weapons in thirty-two hands; but in spite of the large number of additional arms, the figure is masterful in its life and reality.

Prehistoric Goats of Poland. In a neolithic settlement in the commune of Zlota, Poland (dated 2500–2000 B.C.) remains of domestic goats have been found, and M. K. Wodzicki identifies the fragments as belonging to the *Capra prisca* type (*Acad. Polonaise Sci. Lettres*, 1933, p. 89). The skulls and horns show a considerable amount of variation, but there is no indication that any other species was domesticated. Fragments which have been described from fifteenth and sixteenth century settlements in Poland and from early historic sites also belong to *C. prisca*-typus, although in the Middle Ages two races can be distinguished by the compactness or divergence of the horns, and in the early ages the horns are distinctly smaller and their slope markedly divergent.

Hydrography of an Indian Tank. Dr. Hem Singh Pruthi has made a detailed study lasting over three years of the seasonal changes in the physical and chemical conditions of the waters of the tank in the Indian Museum compound ("Studies on the Bionomics of Fresh-waters in India (1)", *Internat. Rev. Hydrobiol. Hydrographie*, 28, Hft. 1–2; 1932). In the tropics, growth is more rapid and decay is more sudden than in temperate regions; also, because of the great amount of evaporation and consequent rainstorms, the condition of tropical waters is altered more in a few hours than in many days in temperate regions. It was found that there was a complete mixing of surface and bottom waters in January, the upper layers after this becoming warmer and a thermal stratification beginning which is complete in April. The *p*H value has two maxima in the year, in spring and in autumn, the latter being higher than the former. The changes in the *p*H value seem to be connected with the photosynthetic activity of the chlorophyll-bearing organisms, which depends on the weather and the amount of necessary salts available. If the weather is fair, the surface water is generally saturated with oxygen after 10 a.m., but the bottom water is always deficient in oxygen. The surface layers are replenished in salt content partly when the thermal stratification is disturbed during the monsoon or when the waters mix in January, but chiefly by the rain-water laden with salts which flows into the tank from the high banks during the rainy season.

Morphology of the Insect Abdomen. The writings of Mr. R. E. Snodgrass on insect morphology are well known to all students of entomology. In his most recent contribution entitled "Morphology of the Insect Abdomen" (*Smithsonian Misc. Coll.*, 89, No. 8; Oct. 1933) he continues his previous memoir on this subject and, in the present instance, deals with the genital ducts and the ovipositor. He concludes that the primitive gonoducts were paired mesodermal tubes each opening to the exterior by a separate pore. These pores were located on the 7th abdominal segment in the female and on the 10th segment in the male. In most insects, as we know them to-day, a median ectodermal passage has developed and become connected with the primitive ducts. This has resulted in the acquisition of a single genital pore which opens between the 9th and 10th segments in the male, while in the female it is more variable in position since it may be located on the 7th, 8th or 9th segments. In dealing with the structure of the ovipositor, Mr. Snodgrass's account is illustrated by a wealth of original figures portraying the structure of the organ and its associated musculature in different groups. While in many Orthoptera the ovipositor is formed by three pairs of valvules, in the Gryllidæ and Acrididæ only two pairs are evident, namely, the 1st and 3rd, the 2nd pair of valvules being vestigial. On the other hand, in the Thysanura, Hemiptera and Homoptera, the ovipositor is likewise formed of two pairs of valvules, but in these cases it is the 1st and 2nd pairs that compose the organ. The memoir is too detailed to allow of more than brief mention and is one of general interest to students of insect morphology.

Protein Metabolism in Wheat in Relation to Nitrogen Supply. In a study of the distribution of nitrogen in wheat plants grown in water culture, A. G. McCalla (*Canadian J. Res.*, 9, 542; 1933) finds that altering the nitrogen supply does not materially affect the amount of protein in the plants, though with low nitrogen supply there is a marked reduction in the

amount and proportion of non-protein nitrogen and, in particular, a much lower proportion of amide nitrogen. These effects are not, however, observable in the seeds, where low nitrogen supply reduces the total nitrogen present, but does not cause any significant variations in the proportions of protein and non-protein nitrogen. The proteins of the seeds, on the other hand, possess lower proportions of amide nitrogen and higher proportions of mono-amino nitrogen when nitrogen supply is low. Finally, the low-nitrogen seeds contain a much smaller proportion of gluten than do those supplied with abundant nitrogen. In both sets of seeds, the physical properties of the glutens and the ratio of alcohol-soluble protein to alkali-soluble protein appear to be identical. The author concludes that differences in nitrogen nutrition do not produce any essential difference in the quality of the kernels except those due to varying amounts of gluten. The variations in quality of grain of any variety of wheat grown under field conditions are, therefore, due to other factors.

North Pennine Ore Deposits. The well-known mineral fields of Alston Moor and Upper Weardale have been studied in detail by Dr. K. C. Dunham (*Abs. Proc. Geol. Soc.*, p. 47 ; 1934). The mineralised area is divided by the faulted monocline of Burtreeford into two crudely circular areas within each of which the minerals are distributed laterally and vertically in well-marked concentric zones. Three zones of gangue minerals are recognised : a central fluorspar region (281 veins) ; a broad peripheral fringe of barytes, with local witherite (208 veins) ; and an inconstant transition belt (17 veins). From each centre the successive sulphide zones are characterised by (1) notable amounts of chalcopyrite ; (2) galena with subordinate zinc blende ; (3) galena and zinc blende in roughly equal amounts ; and (4) galena alone, blende falling off rather abruptly. Sulphides die out beyond the galena zone and the veins become almost entirely barytic. The zonal arrangement is superimposed on the Carboniferous formations and the Whin Sill with complete impartiality. This marked independence of distribution serves to dismiss the old lateral secretion hypothesis, and to prove that the Whin Sill was not directly concerned with the mineralisation. It is suggested that the ores were introduced by hydrothermal solutions derived from certain deep-seated foci of intrusion (each corresponding to a dome of mineralisation), of which the representative igneous rocks have not yet been revealed.

Initial Motion of Earthquakes. Two years ago, Mr. T. Fukutomi noticed a similarity in the direction of the initial motion of earthquakes in certain parts of the Kwanto district, Japan. He has recently studied the distribution of earthquakes with similar initial directions of motion with fuller materials (*Bull. Earthq. Res. Inst.*, 11, 510-528 ; 1933), using earthquakes with distinct initial vertical motion in Tokyo from 1914 until 1932 and originating within 100 miles of the city. The total number of such earthquakes is 337, in 176 of which the initial motion was upward and in 161 downward. The epicentres of earthquakes with the same initial direction are grouped in rather definite areas. Thus, the earthquakes originating beneath the basins of the Rivers Kinu and Ogai, the southern part of the Boso peninsula, in the Idu peninsula, etc., begin with an upward movement at Tokyo ; those in the Kasugaura, along the shores of Tokyo Bay, and in the central part of the Boso peninsula, with a downward movement. The writer concludes that the earthquakes originating in the two main regions are due respectively to similar modes of origin.

Tuning Fork as a Standard of Frequency. A paper by the late Dr. Dye and L. Essen has recently been published on the valve-maintained tuning fork as a primary standard of frequency (*Proc. Roy. Soc.*, A, Feb.). The fork used has a massive base and prongs cut from a bar of elinvar and has been in use since 1922. The effect of changing a number of variable factors on the period of the fork has been investigated. The period is independent of the exact way in which the base is clamped only if the prongs are accurately balanced, and a method for doing this is described. The variation with polarising magnetic field, with amplitude, atmospheric pressure, and with the voltages and loadings applied to the driving circuit were all studied and a design for the fork equipment evolved. The residual instability of this arrangement was mainly due to small changes in the voltages applied to the valve circuits and to changes in pressure within the fork enclosure. With improvement in the conditions, the fork is expected to show a long period constancy of one part in 10^7 and a short period constancy of a few parts in 10^9. It is stated that a small reaction occurs between the fork and another oscillator used for comparison ; this might be avoided by the appropriate use of screen-grid valves.

Polarographic Researches. The phenomena associated with the deposition of metals at the dropping mercury cathode have been the subject of investigations during the last few years by Prof. J. Heyrovský and his co-workers. Recently the method has been extended to micro-analysis. Thus, it has been successfully adapted to the estimation of iodine in Chile saltpetre, the analysis of petroleum distillates for reducing agents and in the electro-reduction of many organic compounds. The way in which the platinum elements lower hydrogen overvoltage has also been demonstrated by the polarographic method. A further illustration of its diverse applications is afforded by its use in biological investigations on the adsorption factor of serum and on the lymph in cutaneous diseases, in which the dermatologist, Dr. Petráček, made good use of the method. Perhaps the most striking results obtained with the polarograph are those of Dr. Brdička, who has studied the catalytic action of cobalt ions upon protein decomposition. It is found that the protein content of a fraction of a milligram of material can be estimated by this means. The amount of cysteine in a millimetre of hair has been determined and, apart from its analytical value, Brdička's work has an important bearing upon the elucidation of the co-ordinating properties of polypeptides and their decomposition products. For Czech readers, Prof. Heyrovský has just compiled a monograph summarising the applications of the polarographic method in practical chemistry under the title, "Použití Polarografické Methody v Practické Chemii" (Pp. 132. Published by the Czechoslovak Society for Research and Testing of Materials, Prague III). The monograph, which deserves to be translated into English, gives a comprehensive account of the researches carried out with the polarograph. The bibliography contains 139 references.

Social and Industrial Development of Rural Communities

THE twenty-third report of the Development Commissioners* for the year ended March 31, 1933, is much more than a mere collection of official statements of the various activities directed by the Commission. The report no longer sets forth the work in progress at research institutes and advisory centres in Great Britain, as this will be dealt with in the publications of the Agricultural Research Council and the departments of agriculture. Brief accounts of the institutes are given, touching on their *raison d'être*, personnel and finances, but the chief emphasis is laid on the progress of various schemes which the general public scarcely realises as coming within the scope of the work of the Commission.

In most rural districts in Great Britain, very slow progress has been made by electrical supply schemes, as the cost has been beyond the reach of most rural dwellers, largely because of the distance that current has to be conducted as compared with urban areas. Special arrangements were made to supply a rural area in Bedfordshire with electricity under special terms, and considerable progress has been made during the three years of the scheme. The majority of rural customers use electricity for domestic purposes only, but its use in farm buildings and dairies is gradually spreading, and about 62 per cent of all the premises within the area are now receiving supplies. The most important factor responsible for the progress made seems to be the adoption of a lower tariff than in most rural areas, together with special facilities offered by the Bedfordshire Corporation for assisted wiring without consumption guarantee. It is anticipated that by the end of 1934 revenue from this source will exceed expenditure and yield surpluses from which the advance from the Development Fund will be repaid.

For the last twelve years, the Rural Industries Bureau has been working largely for the benefit of local craftsmen, in association with the National Council of Social Service, the Rural Community Councils and Women's Institutes. Progress was at first slow, partly because of the difficulty of establishing contact with isolated village craftsmen, and partly because such craftsmen viewed the activities of the Bureau with suspicion and failed to realise that it had any value in putting them into touch with the work they needed so badly. Now that confidence has been established, about two thousand craftsmen are in touch with the Bureau's officers, but it is probable that at least three times as many have not yet been reached. The activities of the Bureau are multifarious; craftsmen are trained to make such things as fine ironwork, good furniture and substantial fruit baskets; local textile industries are reviewed and their products adapted to present-day requirements; exhibitions are staged at county shows and local fairs, and every endeavour is made to bring the craftsman into touch with a market for his productions. In general, both the purpose and policy of the Bureau may be summed up in the words, the "Craftsman's Friend".

For some years the Society of Friends has given special attention to allotment cultivation as a means of alleviating distress. In 1930, Government granted £80,000 to the Ministry of Agriculture towards aiding the provision of allotments for the unemployed, but after the financial crisis in 1931 this grant was not continued. However, the Society of Friends decided to carry on the work itself and to obtain money by public subscription. Its efforts were so successful that the 1933 programme catered for providing 100,000 persons with allotments, and Government assistance was applied for. The application was referred to the Development Commissioners, who recommended a grant of £10,000 on the £1 for £1 basis, and a further sum not exceeding £2,500 on the basis of £1 for each £2 raised by the Society of Friends. Certain conditions were laid down as to the application of the grant, which included Scotland in its scope. In actual practice, the cost of carrying out the scheme for the cropping year 1933 worked out substantially below the estimate, chiefly owing to the low price of seed potatoes.

On the fisheries and harbours side, much progress has been made in the extension and improvement of the breeding of shellfish. A simple and effective method has been evolved of rendering mussels and oysters contaminated by sewage clean and safe for human consumption, by placing them in tanks of sea-water made sterile by the addition of minute quantities of chlorine, which is afterwards removed so as to allow the shellfish to function freely. The investigations on the furunculosis disease of salmon, sea trout and fresh-water fish have advanced considerably, but show that there are formidable difficulties in preventing the spread of the disease.

The diverse instances touched on above indicate the wide range of social problems dealt with by the Development Commissioners and demonstrate very clearly the value of their activities in connexion with many and varied aspects of national life.

* Development Commission. Twenty-third Report of the Development Commissioners, being for the Year ended 31st March, 1933. Pp. 107. (London: H.M. Stationery Office, 1933.) 2*s*. net.

Recent Researches on Fuel Technology

ANYONE casting his mind back for twenty years cannot fail to remark on the greatly increased interest in the problems of manufacture and utilisation of fuels. This is largely, although not entirely, a legacy of the War and its interruption of normal supplies, the rise of economic nationalism and the lesson of what could be achieved by the purposeful application of science. Early efforts were individual, in private concerns or educational institutions, but all over the world, State action has followed; for example, the British Fuel Research Board was established to study the production of liquid fuel for the Navy by the carbonisation of coal at low temperatures. Experience soon showed that no immediate solution lay in that direction, and the Report of the Board for the year ending March 31, 1933 (H.M. Stationery Office, 2*s*. 6*d*. net) shows that this aim is still unattained, although retorts of new design are giving promising service.

A limited quantity of oil and spirit from low-temperature tar has been supplied commercially to

Government departments during the last year. Experience has shown that low-temperature tars are particularly susceptible to a hydrogenation-cracking and some can be converted into motor spirit with a yield of nearly 100 per cent by volume, the tar acids being eliminated. Private concerns have accumulated much experience with the hydrogenation of coal and oils but their experience is not available. This adds to the interest of the Board's experiments on the mechanism of hydrogenation.

It has been shown that minute quantities of certain catalysts, for example, 0·067 per cent of some tin compounds, are effective. This emphasises the importance of the inorganic constituents of coal, and coal ashes are being examined spectroscopically to find whether coals exist containing germanium. Such observations stress the importance of the Physical and Chemical Survey of National Coal Resources, perhaps the most important branch of the Board's work, which now covers all the British coalfields. The rôle of the State in the prosecution of fuel research has its critics, but it must be allowed that private enterprise has failed to accumulate and provide the consumer with reliable information about the properties of its wares. Indeed it is a remarkable fact that the Survey has been established against the hostility of less enlightened coal-owners. Another notable item in the report is the publication of a collection of 365 analyses of commercial grades of coal raised in the South Yorkshire area. Actually this is a most useful publication; but in most industries, private concerns bear the cost of supplying the tests of their own commercial products.

The systematic survey not merely shows what is available underground but also suggests at times how the product can be improved by modifying the methods of working the coal. The Survey has confirmed the assertion that British coal seams are among the finest in the world and that with attention to the preparation for the market the product can meet any competition for quality.

Domestic fuel forms a big item in the national fuel bill, and work of general interest is reported. Many consumers can try for themselves the suggestion of making packets lined with aluminium foil containing coal slack. These, when placed on an open fire, hold together long enough to allow the coal to coke and then burn as a lump fuel.

These are a few items from the many investigations mentioned in the report, which covers practically the whole field of fuel technology. Certain investigations in university and other laboratories are also being supported financially, but on a reduced scale as a measure of national economy. H. J. H.

Cosmic Rays

KOLHÖRSTER has recently published a critical discussion of the nature of the cosmic rays (*Phys. Z.*, Nov. 15). He points out that the cosmic rays may be investigated by the use of the ionisation chamber, the Geiger counter or the cloud chamber. The distribution of the ionisation in latitude shows variations which indicate that some at least of the rays are particles which can be deflected by the earth's magnetic field. A small azimuthal asymmetry has been detected which may indicate that an excess of the incident particles are positively charged.

Magnetic deflection experiments have not led to unambiguous results. The rays appear to be very fairly constant in intensity, though periodic variations of the order 2 per thousand may possibly occur during the sidereal or the solar day. The variation with barometer, due to absorption in the atmosphere, is well marked, and tends to obscure lesser variations. From time to time large bursts of ionisation are observed (*Stösse*) which are presumably of secondary origin. The curve connecting ionisation with height in the atmosphere has been repeatedly obtained up to the tropopause and some data exist at higher altitudes. The absorption of the radiation in water has been investigated. When the rays pass into a heavy absorbing medium, there is an anomalous variation in the absorption coefficient which indicates the production of a secondary radiation, and the production of such radiation is indicated by experiments with multiple coincidences of Geiger counters. The author concludes that the primary radiation is probably of corpuscular type. There is a long and useful, though incomplete, collection of references to the literature.

In the same number of the *Physikalische Zeitschrift*, Regener describes new measurements of cosmic rays in the stratosphere using his beautiful self-registering electroscope, while the *Journal of the Franklin Institute* of December 1933 contains an account of the photography of the *Stösse* by a Wilson chamber method. G. L. Locher arranges the Wilson chamber so that it is fired automatically by the discharge of three non-collinear counter-tubes. The showers observed often appear to originate at two or more points and must apparently be initiated by non-ionising secondary radiation, since their origins are frequently not collinear. There are also short tracks which are similar to those produced by recoil atoms from neutrons.

Index of Business Activity

IN a paper read before the Royal Statistical Society on January 16, Mr. Geoffrey Crowther described the "Index of Business Activity" which has recently been prepared by the *Economist*. Mr. Crowther pointed out that, up to the present, it has not been possible to measure statistically the amplitude of fluctuations in the general activity of the community. Indices of production are familiar in most countries and in the absence of a more suitable index, they are frequently used as indications of business activity, though they have obvious weaknesses for this purpose.

Productive industry is still the foundation for all economic wealth, but the superstructure of distribution and service is yearly growing in size and importance. Moreover, it is a well-known economic phenomenon that the swings in activity in productive industry are considerably greater than the fluctuations of the economic life of the community as a whole.

An index of business activity must therefore cast its net far wider than industrial production. It must take account not only of the rate at which goods are produced but also of the rates at which they are distributed, transported and sold.

The *Economist* Index of Business Activity
(Average for Year)

1920	97·8	1927	107·8
1921	74·5	1928	105·9
1922	88·3	1929	110·0
1923	94·4	1930	105·9
1924	100·0	1931	96·3
1925	101·8	1932	95·8
1926	93·6	1933*	99·5

* Provisional; 11 months average.

The *Economist* "Index of Business Activity" is published monthly and is based on a weighted series of indices relating to employment, the iron and steel and cotton industries, imports of raw materials and non-ferrous metals, exports of manufactures, railway traffic, shipping movements, consumption of coal and electricity, postal receipts, bank clearings, building activity and the registration of motor vehicles.

History of Mathematical Time

TWO articles under the above title by G. Windred have been published in *Isis*, 19 and 20, in 1933. In the first the author traces the development of the concept of mathematical time from its origins with Napier, Barrow and Leibniz up to the theory of pure time of Sir William Rowan Hamilton. Within the short space of some thirty pages, the author gives an excellent account of Barrow's theory of mathematical time, which formed the basis of the time concept in Newtonian mechanics for more than two centuries. He traces the progress of the concept in the writings of Newton, Maclaurin and Kant, and concludes with a brief account of Hamilton's views on algebra as the science of pure time.

The second article is devoted to the history of time in the mathematical physics of the twentieth century. The author gives a brief account of the fundamental papers of H. A. Lorentz, Poincaré, Einstein and Minkowski concerning 'local' time, simultaneity of events and the synthesis of space and time into one whole in the special theory of relativity. He passes on to a relatively full account of Robb's theory of 'conical order' and concludes with brief references to the later work of Einstein, the system of time due to A. N. Whitehead, the views of Eddington, Vasiliev and Synge, and recent ideas on the atomic structure of time, due principally to Robert Lévy and Pokrowski. Here one misses any reference to the writings of H. Reichenbach, more particularly his "Philosophie der Raum-Zeit-Lehre", 1928, where a good deal of space is devoted to a discussion of the nature of time. Apart from this omission this part of the essay gives a clear and relatively full account of the changes brought about by the advent of the theory of relativity in our ideas of time. The last section of the essay gives a summary of the applications of the theory of time to mechanics and mathematical physics and of its implications for philosophy and psychology.

The essay can be highly recommended to anyone, whether mathematician, philosopher or physicist, who needs a brief summary of the history of the concept of time from its origin to its latest developments. It is well supplied with references and so can serve as a guide to anyone desirous of studying the question more completely than is possible in so short an essay.

University and Educational Intelligence

CAMBRIDGE.—The Buildings Syndicate recommends that the vacant site between the Museum of Archæology and Ethnology and the Botany School be assigned for an extension of the Museum, provided that this assignment be reconsidered if no permanent building is erected on the site within ten years.

The Council of the Senate recommends that a pension of £430 a year be granted to Prof. J. T. Wilson on his retirement from the professorship of anatomy.

The Faculty Board of Medicine recommends the establishment of a Marmaduke Shield scholarship in human anatomy of the value of £100 a year.

OXFORD.—In Congregation on March 3, the degree of D.Sc. was conferred on Charles K. Meek (Brasenose College), Government anthropologist in Nigeria, and author of three important works: "A Sudanese Kingdom" (1931); "Tribal Studies in Northern Nigeria" (1931); "The Northern Tribes of Nigeria" (1925).

ADULT education is being exploited in the United States on a vast scale by the Federal Emergency Relief Administration as a means of providing work for unemployed teachers (including many unemployed persons who are potential though not professed teachers) and at the same time raising the standard of employability of the general mass of unemployed. Any person now on relief or urgently in need of a job, who is a college graduate or able to offer other proof of intellectual ability, is to be given an opportunity of employment as teacher. The scheme has six divisions, of which two are outside the field of adult education: teaching of 'illiterates', which is construed to mean education of adults up to sixth-grade level, general adult education, trade schools, training of physically disabled persons, reopening of rural schools closed for want of funds to pay teachers, and nursery schools in mining camps, mill villages and other places where children, especially children of the unemployed, are not being adequately cared for. It is anticipated that where the local organisation is slow in developing a general adult educational project, a competent unemployed scientific worker will work up a class for himself to teach, whereupon he will be enrolled as a paid instructor. The rates of payment have been revised, the former limit of 15 dollars a week having been withdrawn. The trade schools will provide employment for many engineers thrown out of work by industrial depression and the nursery schools will absorb some of the unemployed women trained in child psychology or kindergarten. *School and Society* of December 2 has an authoritative leading article describing the scheme.

Science News a Century Ago

Darwin in the Falkland Islands

Between March 10 and April 7, 1834, H.M.S. *Beagle*, for the second time, was in the Falkland Islands, and on March 16–19 Darwin made an excursion inland with six horses and two Gauchos, "dexterous hands in all the requisites of making the camp life comfortable", who to Darwin's surprise made a fire, nearly as hot as a fire of coals, with the bones of a bullock lately killed but from which all the flesh had been stripped by vultures. Describing the Islands in his "Journal of Researches", the archipelago, he said, "is situated in nearly the same latitude with the mouth of the Strait of Magellan ; it covers a space of one hundred and twenty by sixty geographical miles, and is little more than half the size of Ireland. After the possession of these miserable islands had been contested by France, Spain and England, they were left uninhabited. The Government of Buenos Ayres then sold them to a private individual, but likewise used them, as old Spain had done before, for a penal settlement. England claimed her right, and seized them. The Englishman who was left in charge of the flag was subsequently murdered. A British officer was next sent, unsupported by any power : and when we arrived, we found him in charge of a population, of which rather more than half were runaway rebels and murderers."

"The theatre is worthy of the scenes acted on it. An undulating land, with a desolate and dreary aspect, is everywhere covered by a peaty soil and wiry grass, of one monotonous brown colour. Here and there a peak or ridge of grey quartz rock breaks through the smooth surface. Everyone has heard of the climate of these regions ; it may be compared to that which is experienced at the height of between one and two thousand feet on the mountains of North Wales ; having however less sunshine and less frost, but more wind and rain."

The Fullerian Professorship of Physiology

In 1833 John Fuller, a wealthy and somewhat eccentric member of Parliament and landowner of Rose Hill, near Robertsbridge in Sussex, endowed at the Royal Institution the Fullerian professorship of chemistry which was held by Faraday to the end of his life. Fuller, if the tales about him are to be believed, was distinguished alike for his turbulence in the House of Commons and his somnolence in the lecture theatre of the Royal Institution, but he had an abiding respect for the Institution and the philosophical attainments of its professors. Early in 1834 he expressed to the Managers his wish and intention of founding another professorship. His offer was gratefully accepted, and on March 10, 1834, he executed a deed of endowment creating the Fullerian professorship of physiology. Unlike the chair of chemistry, which in a hundred years has been occupied by only five professors, Faraday, Odling, Gladstone, Dewar and Bragg, that of physiology was to be tenable for a limited period of three years. The first professor was Peter Mark Roget, physician, and secretary of the Royal Society. Roget was the author of that invaluable book of reference, the "Thesaurus of English Words and Phrases", a work which in recent years has extended his fame to the wide and unthought-of circle of those who take their crossword puzzles seriously.

John Fuller, in founding his professorships, added to the benevolent purpose of making some return to society for the benefits he had received during a long life, the patriotic intention of helping to maintain Britain's great and growing reputation in the field of scientific inquiry. His professors have fulfilled his intention. The list of the Fullerian professors of physiology is a much longer one, but it is no less distinguished than that of the professors of chemistry, and includes such names as Huxley, Owen, Michael Foster, Ray Lankester and Sherrington. Only twice in its history has the chair been held for a second period of three years, by Thomas Henry Huxley and, more recently, by Sir Arthur Keith.

Great Western Railway

The Great Western Railway may be said to have had its birth at a public meeting held in Bristol on July 30, 1833. Eight months later, on March 10, 1834, in the House of Commons, petitions for and against the line were presented, and the second reading of the bill for the railway was passed by 182 votes to 92. The petitions in support of the line came mainly from the towns such as Bristol, Bath, Stroud and Cheltenham, while those against the line were mainly from the landowners in Berks and Bucks and "certain individuals residing at Earl's Court, Brompton". The Marquis of Chandos, in opposing the bill, said he did so principally on account of the strong feeling that existed among the landed interest of that part of the country he had the honour to represent. Not only would the line pass through many private grounds and subject the occupiers to all the inconveniences attending it, but in many cases it would entirely destroy valuable farms and other private property, from the deluge that would be occasioned in the lowlands by the embankments that must be necessarily thrown up on each side of the line. Capt. Dundas objected to the railway as "it would turn adrift many hundred seamen in the coasting trade ; and if the bill was carried, the next railway would be to Shields and Sunderland to carry coals, and then the navy would be ruined, and the breed of seamen soon become extinct".

Foundation of the Statistical Society

"A new Society under this title has arisen from last year's meeting [1833] of the British Association for the Advancement of Science. The eminent individuals who formed the committee of the Statistical Section at Cambridge invited a public meeting at the rooms of the Horticultural Society on the 15th of March [1834]. There were about 250 persons present, and the Marquis of Lansdowne took the chair. His lordship informed the meeting that the Government would be glad to avail itself of the labours of such institution ; which, in return, should have the assistance of Government when it was necessary. The Lord Advocate, Mr. Babbage, Mr. Jones, of the London University, Mr. Spring Rice, Mr. Hallam, and Mr. Brunel spoke warmly in favour of the projected institution. The following resolutions were passed unanimously—That accurate knowledge of the actual condition and prospects of Society is an object of great national importance, not to be attained without a careful collection and classification of statistical facts—That a Society be established by the name of the Statistical Society of London ;

and that the Society consist in the first instance of such of the present company as shall subscribe an obligation to that effect—That the Committee be empowered, until the day of the next meeting, to receive the signatures of additional members, and to admit them Fellows of the Society. Messrs. Babbage, Jones, Hallam, and Drinkwater were nominated a Committee. M. Quetelet, of Brussels, to whom the formation of this statistical section of the British Association at Cambridge was mainly due, was elected the first honorary member.

"A statistical society was founded three or four years ago in Paris, and similar societies are now forming in other countries. This disposition of mankind to associate together for common objects will lead, at no distant period (viz., at the time when representative governments shall have become general), to European, American, and Cosmopolitan Societies, composed of members of all the governments of Europe, America, or the world meeting together to devise plans for the good of all mankind. Among these will be, universal education, a universal system of weights, measures, and moneys, one common language, one common law, and universal freedom of commerce. As to the question of peace or war, there will be very little danger of the latter, when it is not the interest of any particular class of men to make it." (*Gentleman's Magazine.*)

Societies and Academies

London

Royal Society, March 1. A. J. Bradley and J. W. Rodgers: The crystal structure of the Heusler alloys. In an investigation of the ferromagnetic alloys of copper, manganese and aluminium, an alloy was found which showed an almost complete change of crystal structure due to heat treatment. Drillings of this alloy, which had been annealed at 500° for several hours and cooled slowly to room temperature, were found to have the δ copper aluminium (Cu_9Al_4) type of structure. The alloy is non-magnetic, but on quenching from 800° C. it becomes strongly ferromagnetic. The structure is now entirely body-centred cubic, with a face-centred superlattice. On comparing X-ray powder photographs of the same specimen made with radiations from iron, copper and zinc anticathodes, it was found that the relative intensities of the weaker reflections varied with the wave-length of the radiation. This made it possible to distinguish the manganese atoms from the copper atoms. C. Sykes and H. Evans: Some peculiarities in the physical properties of iron-aluminium alloys. An account is given of measurements of the resistivity of alloys of iron and aluminium containing 11–16 per cent aluminium by weight. Resistivity at room temperature depends on the rate of cooling of the specimens from a temperature of the order of 600° C. Alloys in this range consist of a single solid solution at all temperatures concerned. It is concluded, therefore, that rearrangement of atoms takes place in the alloys under slow cooling conditions, and the more regular arrangement so produced leads to a decrease in resistance. Experimental results suggest that the rearrangement of atoms in the space-lattice takes place over a considerable range of temperatures even under conditions of very slow cooling.

Dublin

Royal Dublin Society, December 19. J. Reilly, P. P. O'Donovan and Miss H. Murphy: A note on the molecular complexity of amylose in potato starch. Cryoscopic determinations of the molecular weight of dry amylose dissolved in acetamide gave consistent values corresponding to the formula $(C_6H_{10}O_5)_2$. Desiccation experiments showed that drying at 78° C. under 10 mm. pressure completely removed all water and alcohol from the amylose, so that the relative simplicity of the molecules in acetamide solution could not be attributed to the formation of polysaccharide water or alcohol complexes. On the other hand, the ash-content of the amylose could not be reduced much below 0·9 per cent, and it is suggested that the presence of this small quantity of ash may possibly be of importance in the depolymerisation of the amylose. Joseph Doyle and Mary O'Leary: Abnormal cones of *Fitzroya* and their bearing on the nature of the conifer strobilus. The structure of abnormal staminate and hermaphrodite cones of *Fitzroya* is described. On the basis of these structures it is tentatively suggested that:—(*a*) the stamen and the bract of the ovulate cone are homologous. (*b*) There is no auxiliary structure, particularly no reduced branch, in the organisation of the ovulate cone, the ovules being directly related to the bract. (*c*) Neither bract nor stamen is a sporophyll in the sense of a structure in any way similar to a vegetative leaf carrying sporangia. (*d*) Both bract and stamen are the end development of an extreme reduction of a primitive reproductive branching system carrying sporangia, probably terminally, on the ramifications; the main plan of the cone being attained before, or at least independently of, the photosynthetic development which gave rise to the leaf.

Paris

Academy of Sciences, January 15 (*C.R.*, 198, 213–292). The president announced the death of Paul Villard, member of the Section of Physics, Paul Vieille, member of the Section of Mechanics and Jean Cantacuzène, *Correspondant* for the Section of Medicine and Surgery. Hadamard: Observation on a recent note by M. Adamoff. E. Jouguet: Indifferent points and critical points. Ch. Achard and Léon Binet: The effects of sodium thiosulphate on poisoning by potassium cyanide. From experiments with fish it has been shown that sodium thiosulphate exerts a curative action in poisoning by potassium cyanide. J. Favard: A surface with given boundary. Paul Alexandroff: The local properties of closed ensembles. Mandelbrojt: Fourier's series with gaps. F. Leja: A method of construction of Green's function belonging to any plane domain. A. Rauch: The bands of divergence of certain functions of infinite order. Nikola Obrechkoff: The real zeros of polynomials. L. Pontrjagin: Compact topological groups and the fifth problem of Hilbert. V. A. Kostitzin: An integro-differential equation of elasticity. A. Magnan and H. Girerd: The determination in a wind chamber of the polars of butterflies. Armen Asfazadour: The lines of current round a plate in rotation, placed in a fluid current. E. Carvallo: The velocity of the earth measured by purely terrestrial measurements. Calculations based on the experimental data of Esclangon. Bernard Lyot: The

polarisation of the solar protuberances. An account of work carried out at the Meudon Observatory. Of the fourteen protuberances studied, all except one show distinct polarisation. J. P. MATHIEU : A class of tartaric compounds. Discussion of the composition of the tartrates of chromium, manganese, iron, nickel, cobalt and zinc. MME. IRÈNE CURIE and F. JOLIOT : A new type of radioactivity. A description of a new phenomenon. The emission of positive electrons by certain light elements (beryllium, boron, aluminium) when irradiated by the α-rays of polonium continues for some time after removing the source of the α-rays and in the case of boron this time may be as much as half an hour. The intensity of the radiation decreases exponentially with time and the periods differ for each element. These experiments prove the existence of a new type of radioactivity with emission of positive electrons (see also NATURE, Feb. 10, p. 201). MME. P. RUMPF : The kinetic study of the reaction between potassium iodide and hydrogen peroxide in acid solution. The rate of formation of the I_3 ion has been studied with the spectrograph. MLLE. SUZANNE VEIL : The action of the electric field on the stratified diffusion of the alkaline carbonates in gelatine. JOSEPH ZAWADZKI and GEORGES PERLINSKI : The decomposition of nitric oxide by platinum catalysts. The reaction is monomolecular and strongly retarded by oxygen. RENÉ DUBRISAY and GUY EMSCHWILLER : The oxidation of iodoform solutions. A study of the effect of impurities in the solvent. H. HÉRISSEY : Lusitanicoside. MME. RAMART-LUCAS : The colour and structure of the aromatic oximes. P. RUMPF : An electrochemical contribution to the problem of the constitution of the salts of triarylmethyl. G. CARPENISEANU : The determination of pyruvic acid. A modification of the method of Simon and Piaux. P. CARRÉ and D. LIBERMANN : The influence of the phenyl group on the reaction of thionyl chloride with primary fatty alcohols. R. DELABY, S. SABETAY and M. JANOT : The characterisation of double bonds by antimony trichloride. LAMARE : The Permian in the neighbourhood of Bidarray (Basses-Pyrénées). PAUL BOUVIER : A meteor observed in Morocco. N. THÉOBALD : The fossil insects of Célas (Gard). G. A. NADSON and C. A. STERN : New observations on the biological action of metals at a distance. R. BONNET : The neuro-muscular action of the amides and ammoniacal salts. MLADEN PAIĆ : The absorption spectra in the ultra-violet of sera from syphilitic subjects. S. NICOLAU, MME. L. KOPCIOWSKA and M. MATHIS : Intranuclear inclusions in the nervous system of guinea pigs and of mice dead from experimental yellow fever. Genesis, morphology and interpretation.

ROME

Royal National Academy of the Lincei: Communications received during the vacation. E. ALMANSI : Deformations of elastic strips (9). In this final note, various further questions of purely analytical character are considered. T. VIOLA : Baire's functions of the first and second classes. If $y=f(x)$ and $x=\varphi(t)$ are two functions of Baire's first class, the compound function $y=F(t)=f(\varphi(t))$ is, at the most, of the second class. The conditions under which it can be affirmed that this compound function is of the first class are now discussed. A. TERRACINI : Congruences associated with respect to a surface. C. BERTOLINI : Study of an equation to the partial derivatives of the third order. R. CACCIOPPOLI : Non-linear elliptic equations to partial derivatives. B. DE FINETTI : Classes of equivalent aleatory numbers. MARIA CIBRARIO : Bernouilli's and Euler's numbers. C. AGOSTINELLI : Geodetic curvature of dynamic trajectories. Z. PYCHA : Radius for waves associated with phenomena. V. KUPRADZE : Diffraction of elastic waves on an elliptic contour. G. RACAH : Number of isotropic and hemi-isotropic tensors in spaces of several dimensions. The results previously obtained in determining the number of isotropic tensors of a Euclidean S_3 are extended to Euclidean spaces of several dimensions, true isotropic tensors being separated from hemi-isotropic tensors. D. PALERMO : Surface dilatations of elastic solids. G. B. BONINO and G. CENTOLA : Investigations on the theory of concentrated solutions of strong electrolytes ; possibility of extension to the calculation of osmotic coefficients. The theoretical considerations used previously for calculating the activity coefficients of strong electrolytes are now applied to calculation of the osmotic coefficients of such solutions. Good agreement with experimental data is shown. F. GARELLI and G. RACCIU : Ethylacetanilide as a cryoscopic solvent, and the molecular weights of certain cellulose esters dissolved therein. This solvent crystallises better than triphenyl phosphate and freezing points of its solutions are easier to read. For its molecular freezing point depression the mean experimental value is 85·8 and the calculated value 87. At low concentrations, nitro-, acetyl- and ethyl-celluloses form true solutions in ethylacetanilide, their molecular weights corresponding with the dimeric formulæ ($C_6\times 2$). A. ROSSI and A. IANDELLI : Crystalline structure of the compound MgPr. This compound forms monometric crystals of density 4·67. The unit cell, of side 3·88 A., contains one molecule. G. MEZZADROLI and A. AMATI : Action of certain alkaloids on the metabolism of glucides by *Aspergillus niger*. The consumption of glucose or sucrose by this mould in Wehmer's or Raulin's solution is increased by the presence of 0·05–0·3 per cent of strychnine or quinine, but caffeine has the opposite effect. R. NOVELLO : Observations on the activity of chloroplasts in a southern climate. Of 114 plants studied, 91 showed amyliferous chloroplasts, lipids also being present in 55 cases. Chloroplasts with only lipid inclusions were found in 19 plants, whilst with 4 of the plants neither starch nor lipids occurred in the chloroplasts. Lipids included in the cytoplasm were observed in a number of instances. R. SAVELLI : Heleochloroplasts. This name is given to a peculiar form of assimilatory plastid, characterised mainly by carrying a large parastromatic vesicle, and found in various plants. S. GENUSSA : Integration by quadrature of the equation $\delta^3z/\delta x^3 - a\,\delta^2z/\delta y^2 = f(x, y)$.

SYDNEY

Royal Society of New South Wales, November 1. E. C. ANDREWS : Origin of modern mountain ranges. Modern mountain systems comprise cordillera and ordinary plateaux. Both are earth undulations—broad and swelling as plateaux in the more stable earth structures, but crowded together to form cordillera in relatively unstable earth zones, with resultant subparallelism and syntaxis of ranges (with appropriate development of intermontane valleys). They are arranged marginally, in the main, to continents or great continental nuclei ; their growth has been saltatory (punctuated with pauses of still-stand), yet so slow that large streams have main-

tained their ancient courses against the uplift; earth movements have determined the formation of the ranges; while isostasy, through rock flowage, has determined their form, namely, as undulations balancing each other in positions of variable unstable equilibrium. Earthquakes and volcanoes are incidental features. The cordillera and the main continental plateaux are physiographic unities, all being dependent upon a deep underlying and world-wide control operating in late and post-Tertiary time. A. R. PENFOLD and F. R. MORRISON: The essential oils of *Eucalyptus micrantha*, including a form rich in piperitone. The essential oil of *Eucalyptus micrantha* (type) is of no economic value, but that obtained from the new variety, var. *A.*, is of potential value since it contains 40–50 per cent piperitone. M. B. WELCH: Equilibrium moisture content of seasoned timber. Whilst it was found that a number of timbers indoors in Sydney only showed a mean variation of about 2·0 per cent moisture, at Broken Hill and Hay the variation was nearly 8·0 per cent, and whilst individual timbers in country districts during summer contained less than 5 per cent, in winter the figure reached was nearly 19·0 per cent moisture. Of a number of timbers used, Queensland maple showed the greatest fluctuation in moisture content.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, March 12

VICTORIA INSTITUTE, at 4.30.—Dr. W. M. Christie: "The Jewish Immigrant Population of Palestine".

ROYAL GEOGRAPHICAL SOCIETY, at 5.—J. A. Steers: "Scolt Head Island".

Tuesday, March 13

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 5.30.—Annual General Meeting.

PHARMACEUTICAL SOCIETY, at 8.30.—C. E. Carfield: "The British Pharmaceutical Codex—Some Notes on its Revision".*

ROYAL SOCIETY FOR THE PROTECTION OF BIRDS, at 3—(at Church House, Westminster, S.W.1).—Annual Meeting.

Wednesday, March 14

GEOLOGICAL SOCIETY, at 5.30.—Dr. L. Hawkes: "Some Javanese Volcanoes, with notes on the Tectonics of the Island Arcs of the East Indies".

TELEVISION SOCIETY, at 7.—Sixth Annual General Meeting.

Sir Ambrose Fleming: "Invention in Relation to National Prosperity and Legislative Control" (Presidential Address).

Thursday, March 15

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—C. C. Paterson: "The Electrical Engineer and the Free Electron" (Faraday Lecture).

Friday, March 16

ASSOCIATION OF APPLIED BIOLOGISTS, at 11.45—(at the Imperial College of Science and Technology, South Kensington, S.W.7).

At 11.45, Dr. W. Maldwyn Davies: "The Sheep Blowfly Problem".

At 2.30, Dr. I. Thomas: "Some lesser-known Pests of Cereals with Observations on the Source of Infestation".

J. C. F. Fryer: "The Colorado Beetle".*

Official Publications Received

GREAT BRITAIN AND IRELAND

International Agreement, Brussels, 1924. Venereal Diseases: Centres in the Ports at Home and Abroad where Seamen can obtain Treatment. (List 7a, revised.) Pp. 23. (London: Ministry of Health.)

Liverpool Observatory and Tidal Institute. Annual Report, 1933. Pp. 16. (Liverpool: Observatory and Tidal Institute.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 4: A Note on the Molecular Complexity of Amylose in Potato Starch. By Dr. J. Reilly and Miss H. Murphy. Pp. 37–42. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

A List of the more Important Collections in the University Herbarium, Cambridge. By J. S. L. Gilmour and T. G. Tutin. Pp. 40. (Cambridge: Botany School.) 2*s.* 6*d.*

Navy (Health). Statistical Report of the Health of the Navy for the Year 1932. Pp. 144. (London: H.M. Stationery Office.) 2*s.* 6*d.* net.

Imperial Bureau of Plant Genetics: Herbage Plants. Bulletin No. 14: Grassland Research in Australia; Future Programme and Contributions on Pasture Technique. Pp. vi+43. (Aberystwyth: Imperial Bureau of Plant Genetics.) 3*s.*

The Carnegie Trust for the Universities of Scotland. Thirty-second Annual Report (for the Year 1932–33), submitted by the Executive Committee to the Trustees on 7th February, 1934. Pp. iv+202. (Edinburgh: Carnegie Trust for the Universities of Scotland.)

The National Institute of Poultry Husbandry (Harper Adams Agricultural College), Newport, Shropshire. Bulletin No. 9: A Progress Report of Instructional and Experimental Work. Pp. 64. (Newport.)

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution: Report on Observations in the Year ended 31st March 1933. (Nineteenth Report.) Pp. vii+99. (London: H.M. Stationery Office.) 5*s.* net.

OTHER COUNTRIES

U.S. Department of the Interior: Office of Education. Bulletin, 1933, No. 8: A Background Study of Negro College Students. By Ambrose Caliver. Pp. vii+132. 10 cents. Bulletin, 1933, No. 13: High-School Instruction by Mail; a Potential Economy. By Walter H. Gaumnitz. Pp. v+69. 10 cents. Bulletin, 1933, No. 14: The Effects of the Economic Depression on Education in other Countries. By James F. Abel. Pp. v+37. 5 cents. Leaflet No. 44: The Deepening Crisis in Education. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of Agriculture. Technical Bulletin No. 373: Studies of Fluorine Compounds for Controlling the Codling Moth. By E. J. Newcomer and R. H. Carter. Pp. 24. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of the Interior: Geological Survey. Bulletin 846–A: Some Mining Districts of Eastern Oregon. By James Gilluly, J. C. Reed and C. F. Park, Jr. (Contributions to Economic Geology, 1933, Part 1.) Pp. viii+140+8 plates. 25 cents. Bulletin 846–B: Geology and Ore Deposits of the Takilma–Waldo District, Oregon; including the Blue Creek District. By Philip J. Shenon. (Contributions to Economic Geology, 1933, Part 1.) Pp. v+141–194+plates 9–22. 20 cents. Bulletin 849–B: Lode Deposits of the Fairbanks District, Alaska. By James M. Hill. (Investigations in Alaska Railroad Belt, 1931.) Pp. x+29–163+plates 3–10. 35 cents. Bulletin 849–C: The Willow Creek Gold Lode District, Alaska. By James C. Ray. (Investigations in Alaska Railroad Belt, 1931.) Pp. viii+165–229+plates 11–20. 20 cents. (Washington, D.C.: Government Printing Office.)

University Observatory, Oslo. Publication No. 9: On the Interpretation of the Umkehr-Effect in Atmospheric Ozone Measurement. By Chaim L. Pekeris. Pp. 31. Publication No. 10: On the Trajectories of Electric Particles in the Field of a Magnetic Dipole with Applications to the Theory of Cosmic Radiation, First Communication. By Carl Størmer. Pp. 19+9 plates. (Oslo: Jacob Dybwad.)

Colony and Protectorate of Nigeria. Report on the Agricultural Department for the Year 1932. Pp. ii+47. (Lagos: Government Printer.) 4s. net.

U.S. Department of Agriculture. Technical Bulletin No. 399: A Study of Claypan Soils. By Irvin C. Brown, T. D. Rice and Horace G. Byers. Pp. 43. (Washington, D.C.: Government Printing Office.) 5 cents.

Publications of the Observatory of the University of Michigan. Vol. 5, No. 10: A New Method of Driving Equatorial Telescopes. By Robert R. McMath and Walter A. Greig. Pp. 123–131+2 plates. Vol. 5, No. 11: The Elements and Ephemeris of Comet 1933f (Whipple). By Allan D. Maxwell and Helen M. Porter. Pp. 133–135. (Ann Arbor, Mich.)

Library of Congress. Report of the Librarian of Congress for the Fiscal Year ending June 30, 1933. Pp. vi+264+20 plates. (Washington, D.C.: Government Printing Office.) 75 cents.

U.S. Department of Agriculture. Circular No. 295: The Obscure Scale on the Pecan and its Control. By Howard Baker. Pp. 20. 5 cents. Miscellaneous Publication No. 174: The Serphoid and Chalcidoid Parasites of the Hessian Fly. By A. B. Gahan. Pp. 148. 10 cents. (Washington, D.C.: Government Printing Office.)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1932. Pp. 8. (Adelaide: Government Printer.)

Natal's Nature Sanctuaries in Zululand. By E. K. du Plessis. Pp. ii+23. (Pietermaritzburg: The *Natal Witness*, Ltd.)

CATALOGUES

Catalogue de livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 26.) Pp. 307–402. Catalogue des publications suivi d'une liste de grammaires et dictionnaires les plus usités. Pp. 16. (Paris: Librairie Adrien-Maisonneuve.)

B.D.H. Injections for Parenteral Medication. Pp. 54. (London: The British Drug Houses, Ltd.)