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CONTENTS.

Science and Service.

THE universal interest aroused by the Faraday centenary celebrations in spite of the world-wide economic and political unrest well attests the power of scientific biography to arrest public attention when its human aspects are adequately stressed. Beyond question, the contrast between Faraday's humble beginnings as a bookbinder's apprentice and the revolutionary effect of his discoveries on industry and on society has profoundly stirred the public imagination. The immense benefits which society has derived from the researches of this prince of investigators, no less than his unflinching devotion to the pursuit of scientific truth for its own sake, apart from all utilitarian consequences, commanded the homage of the entire world of industry and science, and have manifested to thousands of others the worth and human interest of a scientific career.

There are, of course, innumerable other scientific workers whose lives and achievements, set out so as to reveal their forceful personality and the manner in which the restless, questing spirit of science enabled them to conquer obstacles and obtain, if not always their desired haven, at least some anchorage from which humanity could start its explorations afresh, are no less pregnant with human interest. Moureu, Pasteur, Rayleigh, Ross, Fabre—the brief memoirs we have of these and many others are aglow with inspiration for those who can sense the pulsation of their fateful thought as they wrestled with Nature for her secrets.

Nor is less human interest to be found in the lives of those scientific workers who have devoted their labours to industry. Much has been written in recent years regarding the dyestuffs industry, but the full romantic story of the development of that industry still awaits the chronicler who can weave the fragmentary pictures we have of Perkin wrestling with nitrobenzene at Greenford Green, Dr. Ter-Meer at Uerdingen, or Dr. H. Levinstein's own sketches of the early growth of his father's firm, into some vivid odyssey of industry. Possibly even yet we are too near to the field of action for this task to be attempted. The great combines of chemical industry, of which almost everywhere the dyestuffs industry now forms an integral part, are dynamic and not static, and by no means represent a final phase.

There is, however, a tendency, from which not even Dr. Levinstein appears to be entirely free, to regard the great days as past, and to consider the rationalisation of industry as synonymous with the

departure of initiative and enterprise. To such an assertion, made even of the field of industry represented by the manufacture of dyestuffs, the careers of such leaders as Dr. Duisberg and Dr. Engi, to cite two alone, provide a remarkable answer. Both of these outstanding leaders of chemical industry entered the dyestuffs industry as research chemists, and both were responsible for brilliant discoveries in the dyestuffs field which contributed largely to the rapid development of their respective firms. To Duisberg's discovery of the benzopurpurins and of important intermediates like benzidine sulphone must be added that of numerous other dyestuffs for which the Bayer Company has become famous, as well as the discovery of phenacetin.

Duisberg's talents as investigator, however, were combined with a personality and a vision which not only resulted in his becoming in 1925 the head of the I.G. Farbenindustrie Aktiengesellschaft at Leverkusen, but also an outstanding leader in chemical industry, whose influence was felt in the whole organisation of scientific research in Germany, in the developments which enabled Germany to reconstruct her industries to meet the difficult situations arising in the post-War years, as well as in professional associations and the training of students for industry. Similarly, Dr. Engi's scientific genius, which gave the Society of Chemical Industry in Basle thioindigo and the halogenated indigoid and thioindigoid dyes of the Ciba series, was linked to organising powers and a personality which rapidly brought him to the head of the great Swiss firm.

Other examples might readily be found, but the career of the present chairman of Imperial Chemical Industries, Ltd., Sir Harry McGowan, who entered the service of the Glasgow branch of the Nobel Co. as an office-boy, and, in the United States, Dr. A. D. Little's creation of the largest industrial consulting organisation in the world, are all the further evidence that space permits us to adduce that, even in the present industrial conditions, romance is not dead, and that there is still scope for personality and originality.

The truth is that those who view the rationalisation of industry as involving the suppression of individualism and opportunism commit the ancient blunder of regarding industry and society as static and not dynamic, and are in the company of those who saw in the passing of mail armour, the stage coach, the sailing ship, the windmill, the end of decency and order. Even on its narrowest scientific and technical side, industry is constantly changing, and every technical advance tends to bring other changes which little by little bring new demands and confront industry with fresh problems of supply. So have the growth of the rayon industries and the lacquer industries made fresh demands on the dyestuffs industry, and the relation of these industries, and particularly the lacquer industry, to the development of the automobile industry is sufficient evidence of the rashness of attempting to prophesy the demands which will be made upon any industry two or three decades hence.

Apart from this technical aspect, rationalised industry itself offers a challenge to personality which is missed by many superficial observers. These see in the magnitude of the combine a security which they assume was not possessed by the smaller firms of a previous generation, and conclude that individualism and initiative will wither for want of stimulus. The very care with which the progressive rationalised undertakings provide for the welfare of their employees tends to blind these observers to the fact that size does not affect the dependence of the large combine for security upon the same law of service as the individual and smaller firms from which it has grown.

Rationalisation of industry is only a means to render more effective service under modern conditions, and such service will not be continuously rendered unless originality and personality find their full play in the direction of the large combine and ensure that its policy is not stereotyped but develops to meet the changing needs of the world. Service, not security, is the goal, and if prizes are greater in the larger enterprise, the possibilities and consequences attending a blunder in management can equally be more serious. New methods have to be elaborated, forecasting and planning to be attempted on a larger scale, and not even in these days can an adventurous spirit be diverted from the successful conduct of industry. The great prizes of industry as of life are never to the safe and prudent, but to the adventurous who are willing to sail the uncharted seas, who take risks and know that they take them. In the fields of industrial and economic co-operation which open before us to-day, in the planning of industry on a national and an international scale so as to avoid the recurrence of such depressions and economic crises as we are at present experiencing, no less than in the complex reactions of scientific discoveries and their technical applications, there is scope for man's noblest intellectual and moral gifts in securing control of his environment.

Progressive Biology.*

By Sir FREDERICK GOWLAND HOPKINS, Pres. R.S.

IT is not going too far to claim that recent progress in experimental biology, though to a superficial view less impressive, has been not less significant, and indeed not less revolutionary than the progress of modern physics. I might support this claim in many ways. It is, I think, justified in that region of knowledge where cytology and genetical studies meet. The progress and the significance have become the greater since it was recognised that the material units of characters—the chromosomes and subdivisions of chromosomes—are 'determinants' rather than 'carriers' of genetic factors.

This domain of disinterested science is making many practical contacts. To mention but a single recent instance: Prof. R. C. Punnett, one of the original discoverers of the phenomenon of sex-linkage in inheritance, by applying his expert knowledge of that phenomenon, has produced what may be called a synthetic fowl, of which the qualities are such as to make it of extreme value to the now highly important industry of poultry breeding and egg production. The bearing of the same body of knowledge upon human affairs has been recently very ably discussed by Prof. L. T. Hogben.

The phenomena of heredity were long the stronghold of those who cling to the obscurantism of vitalistic doctrines. Infinitely complex as of course they are, we have now abundant proof that they are susceptible to analysis and that to-day they are yielding their secrets to well-controlled experimental studies. The results of these are becoming quantitative and are even yielding material for mathematical treatment, as the interesting writings of Dr. R. A. Fisher and Prof. J. B. S. Haldane have shown.

Another region in which accurate experimentation has removed, and is continuing to remove, inhibitions due to obscurantist assumptions is the physiology of the nervous system of vertebrates. It is, perhaps, too late in the day to refer to the work of Pavlov upon conditioned reflexes, though it is justifiable to emphasise its still growing influence upon thought. The work is a supreme proof of the success of the experimental method in analysing even such apparently transcendental phenomena as those which underlie the higher functions of the brain.

The nature of the transmission of events in the nervous system is receiving much illumination from the work of the Royal Society's Foulerton professors. Prof. E. D. Adrian, having developed a most admirable experimental technique for the purpose, is studying the nerve impulse and its origin with highly profitable results. He and his colleagues are now able, with great gain, to work with single nerve fibres and single isolated end organs.

A striking circumstance, brought to light by Adrian's work and that of his colleagues, is that the nervous structures so far examined exhibit such physical regularity in their behaviour that results can often be predicted within about one per cent. His experiments on animals have shown how the phenomenon of a grading in the contraction of muscles is controlled by the frequency of impulses sent out from the central nervous system, and by the number of nerve and muscle fibres involved. Moreover, he has been able to observe the activity of a single nerve cell in his own spinal cord by needle electrodes placed in his muscles, and finds human voluntary contractions are regulated in exactly the same way.

Further, Adrian has found that slow potential changes occur in nerve cells and that these are connected with their discharge of impulses; so far this work only extends to isolated nerve ganglia from insects and to nerve cells in the brain stems of fish, but the phenomena he has found are extremely significant, and it seems possible that changes of potential may be of fundamental importance in the activity of nerve cells.

Adrian has found that damaged nerve fibres set up impulses at very high frequencies, and these perhaps play an important part in sensations of pain, though his more recent work has made it clear that impulses in the smaller slowly conducting nerve fibres must also be concerned in the physical mechanism responsible for pain. A most striking feature of all this work is the general similarity of behaviour of nervous structures from whatever animal they may be taken.

Prof. A. V. Hill is studying the nerve impulse from the point of view of the thermal phenomena which accompany it. So small, of course, is the heat production in the nerve that its measurement, like that of the potential changes, calls for great refinements. It is becoming clear, though we do not yet know the details of its nature, that the nerve impulse consists of a transmitted physico-chemical event, probably involving changes of ionic concentrations at membranes with consequential changes of electric potential; the whole cycle of events, comprising activity and recovery in the nerve, being supported by the energy derived from metabolic oxidative processes which, very small in scale, are associated with the cycle.

When we hope for an increase in our knowledge of the nervous system we are always accustomed to look to researches from the laboratory of Sir Charles Sherrington. An extended study of reflexes has shown that the centripetal impulses do not pass straight through the spinal cord, but at central stations in the cord they are transformed into an enduring excitatory state, which may in turn set up fresh nerve impulses yielding the reflex discharges. The nature of this central excitatory state is being studied and will link up, I think, with some of Adrian's observations upon cell potentials.

It has long been suspected that when a sympathetic nerve is stimulated, adrenalin is liberated at the nerve ending, and that the observed

* Excerpts from the presidential address at the anniversary meeting of the Royal Society on Nov. 30.

effects are immediately due to the action of that substance. Now Dr. H. H. Dale, in conjunction with a member of his staff, Dr. Gaddum, has investigated the case of the para-sympathetic nerves, the influence of which in general opposes that of the sympathetic group, and has obtained good evidence that when one of these is stimulated, the substance acetyl-choline, previously existing in some inactive form, is liberated at the nerve ending. The action of acetyl-choline when injected into the circulation resembles in general the effect of stimulating para-sympathetic nerves, and there is every reason to believe that the physiological activity of the substance, rather than the transmitted physical impulse itself, is immediately responsible for the observed effects of stimulation. I may say that Otto Loewi, of Graz, has shown that when the heart beat is inhibited by vagus stimulation, acetyl-choline is actually formed in the organ, and the same substance, when artificially injected, is known to produce effects like those of the vagus.

In rather unexpected circumstances we have thus brought before us an example of specific physiological effects due to the influence of the specific structure of an organic molecule. Such effects and such relations are being demonstrated in increasing diversity as fundamental factors of organisation in the animal body. This is illustrated most strikingly, of course, in the domain of the control of its activities by a group of hormones. We find in the cases of adrenalin and thyroxin, the constitution of each of which is accurately known, widely different influences depending on differences of molecular structure.

I may logically pass from hormones to devote a few words to vitamins. We now possess proof that vitamin A is closely related to the carotenes, and this knowledge may well lead, without long delay, to the artificial synthesis of the vitamin itself. With respect to vitamin D, it seems probable, if not yet quite certain, that its artificial production is already accomplished. Some four years ago the constituent of animal and vegetable substances, which is converted into the antirachitic vitamin D by ultra-violet radiation, was identified as ergosterol by Rosenheim and Webster at the National Institute for Medical Research, and concurrently by Windaus in Göttingen. A team of workers at the National Institute, led by Dr. R. B. Bourdillon, appear now to have arrived at the next stage, of isolating the vitamin itself, in crystalline form, from the mixed products of irradiation; and Prof. Windaus, following with his co-workers a different route, has again arrived simultaneously at the same goal.

There is no doubt that the substance which the British group now term 'calciferol', and which they have isolated as a dinitrobenzoate from the mixed product, is identical with the 'vitamin D_2' which Windaus and Linsert obtained by a different method; and there is little doubt that this substance, as obtained in either laboratory, is the essential vitamin D in a state of practical purity. One milligramme of calciferol has an antirachitic activity corresponding to 40,000 of the newly accepted international units.

Before I close I would like to refer to a certain aspect of the chemical dynamics of living cells, concerning which progressive studies have been made during the last few years. The cell is, of course, a seat of catalysed chemical reactions and would seem to possess a multitude of catalysts each highly specific in the influence it exerts. In the case of reductions and oxidations, however, there are other agencies of less specific activity which promote the final stages of oxidation. Of great interest among these are certain combinations of metallic iron with pyrrol groupings. One such compound is concerned, possibly with the intervention of yet another, in bringing molecular oxygen into the field of activity. What, however, is specially interesting about these associations of pyrrol groupings with a metal is the wide extent of their biological functions.

We have long known, of course, of the presence of one such association in the chlorophyll molecule, where it functions as part of the trap for solar energy, and we have been long familiar with the presence of another in hæmoglobin, where its function is to hold oxygen during its transference from the lungs of vertebrates to their tissues. Further, we now know that, within the tissues, two others promote oxidation, and yet a third prevents by its presence any deleterious accumulations of hydrogen peroxide. For adjustment to each separate function there is some slight modification of a fundamental structure. Compounds of the type in question are found in many of the lower organisms. Just as Nature seems to have hit upon sound principles for nerve structure early in evolution, so she seems to have satisfactorily chosen, very early, the chemical materials for life. This same suggestion is carried by all the more important constituents of living stuff; fundamentally the same throughout, yet always with minor differences underlying specific morphological differences.

To return to cell dynamics. Knowledge of enzymic catalysts which, with highly specific relations, activate in a certain sense the molecules which are to suffer oxidation, is almost daily accumulating. It is because this specific activation must precede oxidation that the indiscriminate action of oxygen on the living cell is prevented. Although an understanding of the complex organisation of chemical events in the living unit is far beyond our present powers, we are, I think, beginning to see what kind of organisation it may be.

One last word, however. We have assumed that the living cells we have best known are the ultimate units in biology. But of late years the viruses have forced themselves into our thoughts. What are viruses? Do they merely simulate some of the properties of the living? Can we conceive of them as something between the non-living and the living? Are they alive? We do not yet know. Research upon them is at any rate intensely active at the moment. Its results may make it necessary to modify some fundamental biological concepts, and indeed be as revolutionary in their effects as the breaking up of the atom.

A Century of Meteorology.*

By Sir NAPIER SHAW, F.R.S.

THE progress of the science of meteorology to the evolution of the weather-map and beyond that to the introduction of broadcasting, which makes its treatment a matter of universal interest, can be traced from the unco-ordinated efforts of private observers, which were criticised in a report to the British Association in 1832 by J. D. Forbes, professor of natural philosophy in the University of Edinburgh, as the feeble expression of an infant science. It passes through the unfulfilled ambition of a Meteorological Society of London expressed in its transactions published in 1839 by John Ruskin, who defended the science as of universal interest and as necessarily dependent on universal co-operation, and then through the co-operative investigation of weather at sea, by which the tropical hurricane earned the name of 'cyclone' from Henry Piddington and riveted the idea of a travelling vortex on the science.

Co-operation in the study of weather at sea found further expression in the International Conference at Brussels in 1853, suggested by Lieut. M. F. Maury of the U.S. Navy, and the consequent formation of the Meteorological Department of the Board of Trade under Admiral FitzRoy in 1854.

About the same time, co-operation was extended to the collection of simultaneous observations from different stations by the aid of the electric telegraph. It began with some spasmodic efforts in 1851, and gradually developed until the weather-map in its present form, with the aid of wireless, is the most striking example of successful international co-operation.

Within each twenty-four hours the British Meteorological Office collects some seven thousand facts about the weather based on simultaneous observations at some hundred stations in Europe, Africa, Asia, the eastern Atlantic, its ships and its islands, in Greenland, Iceland and Spitsbergen, and the islands of the far north. The observations at the surface are supplemented by incidental observations of clouds and winds in the upper air, and occasional observations of pressure and temperature there too. Four hours of observation are chosen, and between the observing hours of 7 h. and 13 h. the observations for the twenty-four hours are transcribed, charted, printed, and posted with the inferences drawn from them about the weather to come.

For land-stations co-operation took the form of compiling observations of the meteorological elements as an expression of climate under the guidance of the British Meteorological Society from 1850, the Scottish Society from 1856, and the British Rainfall Organization from 1858. From the very beginning of regular observations the chronological sequence was used to identify the rhythm of the sequence of weather at individual stations as diurnal and seasonal. The temptation to seek for evidence of other rhythmic periods, especially those of the moon, was irresistible. It was ultimately guided into the righteous paths of harmonic analysis and the periodogram, which form an interesting chapter in the scientific history of the century.

Correlation came later when Galton had become disappointed with the behaviour of the cyclone and anticyclone. Francis Galton, who was one of the general secretaries of the British Association, had a great share in the development of the science of meteorology. He was actively interested in the establishment of a weather-map and also in the Kew Observatory in the Old Deer Park at Richmond, which was maintained by the British Association, and among other things he developed methods of recording automatically the variation of the meteorological elements.

When FitzRoy used his weather-maps to make public forecasts of weather and issue storm-warnings some prominent scientific authorities thought it premature, and on FitzRoy's death, at the request of the Government, a Meteorological Committee was appointed by the Royal Society to take on the work of the Meteorological Department of the Board of Trade and bring it into co-operation with the meteorological work of the British Association's Observatory at Richmond.

During twelve years a strenuous effort was made, chiefly under Galton's guidance, to use the records of the instruments at seven observatories like Kew to interpret the sequence of weather shown on the daily maps. Meanwhile forecasts were suspended. For twelve years every curve drawn by the instruments was reproduced with the associated maps for public information. The systems of closed isobars, now known as the cyclonic depression and the anticyclone, were the most striking features of the sea-level maps. The track and behaviour of every one of them during the twelve years was "set in a note-book learned and conned by rote". They were enthroned as Nature's proctors for the guidance of weather, and under their guidance forecasting was restored in 1879 by direction of those who had been critical in 1865.

The method of forecasting on the basis of cyclones and anticyclones was set out effectively by the Hon. Ralph Abercromby. The problem of the sequence of weather seemed to be solved. It was supposed that the progress of storms across the Atlantic could certainly be anticipated. Further investigation of the upper air by shell-bursts, by balloons, by the study of clouds under a new directing council, would clear up all the outstanding difficulties.

Somehow the effort failed. The maps used were bounded on the west by the Irish coast. Cyclones and anticyclones suggested rules of behaviour but did not keep to them, and a magnificent effort was made to find out the how and why of the irregularities by maps of the Atlantic and adjacent continents for the days of the year of

* Substance of a paper entitled "Meteorology after the Century" read before Section A (Mathematical and Physical Sciences) of the British Association on Sept. 25 during the centenary meeting in London.

polar exploration 1882–83; but no one has ever been able to make out a rational account of the behaviour of cyclonic depressions. The Norwegian school has traced with marked success the influence of the movement of the different kinds of air of which they are composed, but the origin of the currents of which they are composed is not yet understood. Disappointed, the council turned its attention to harmonic analysis of hourly values as a method of discovering the latent causes of weather, and Galton transferred his interest to eugenics.

All this while, Buys Ballot's law that wind is along the isobars with a deviation towards the low pressure and dependent for its strength upon the closeness of the isobars was recognised, and when the phenomena of turbulent motion were explained, it became apparent that the surface-layer was so much affected by turbulence that regularity in the relation of pressure to the surface-wind was not to be expected. But observation showed that in the upper air it might be assumed that the effect of turbulence is negligible, and the geostrophic relation between pressure-gradient and horizontal wind under the influence of the earth's rotation might be regarded as a definite meteorological law, most definite where isobars are straight and parallel. Moreover, it accounts for the development of high pressure, a matter which has been neglected in the study of weather. Wherever the horizontal wind in an air-current is not in agreement with the formula the rotation of the earth will push it sideways, from high to low if the horizontal component is too slow, from low to high if it is too fast. The adjustment will always be operative over the whole mass of the moving air so that the air may be regarded as adjusting the gradient to its motion as a bicyclist adjusts his inclination to the vertical.

In the concentration of attention on the closed isobars of cyclones and anticyclones the study of the straight isobars between them has been overlooked; and it may fairly be asserted that if the origin of the currents with straight isobars can be traced, they may be relied upon to adjust the pressure-gradient to meet the exigencies of the wind in the upper air, which is an indubitable expression of actual energy of vast amount.

Meanwhile, the air is everywhere stratified according to its entropy, and any change in the entropy by gain or loss of heat, by conduction to or from the ground, by radiation to or from the air, or by the condensation or evaporation of water within its mass, will have its effect on the stratification, and the readjustment of the stratification will transform the thermal energy of the air into the actual energy of wind. The currents of straight isobars have, therefore, an obvious claim upon the students of the dynamics of the atmosphere. The extension of the area of the daily map to include the whole hemisphere makes productive investigation possible.

To summarise, our survey leads to the conclusion that meteorology has been mistaken in regarding the cyclonic depression and the anticyclone of a hypothetical sea-level map as the principal agents in control of the energy of weather, and asks for the consideration of the currents in the free air indicated by straight isobars as expressing the real estate of energy in the atmosphere, while the differences in the distribution of entropy and water-vapour associated therewith represent its potential estate.

Recent Developments in Optical Glass Manufacture.*

By W. M. HAMPTON and W. N. WHEAT.

THE demand for particular types of optical glass has changed considerably during the post-War period, largely under the influence of the remarkable development of the modern photographic lens, which has been based on the production of the more extreme types of glass, notably the barium crowns.

This change is shown by the following table of the percentage of the various broad types manufactured by Messrs. Chance Brothers and Co., Ltd., of Birmingham, in the years 1914, 1918, 1929.

	1914.	1918.	1929.
Hard Crown and Zinc Crown	24	29	7
Borosilicate Crown	23	14	18
Light Flint and Baryta Light Flint	27	14	11
Dense Flint	23	27	13
Extra Dense Flint	2	4	16
Barium Crowns	1	12	35

Recent research has enabled the manufacture of the barium glasses to be put on a routine basis, the variation in optical constants from one melt to another not being appreciably greater than is normally obtained with the simpler types. This is largely due to the utilisation of refractories for the melting-pots of a composition which is sufficiently resistant to the solvent action of these very corrosive glasses, thus minimising the trouble, once serious, of dilution by aluminous material dissolved from the pot wall. Improvements in the knowledge of melting technique and of the volatilisation losses which accompany the process of fusion have enabled a more strict control to be exercised over the types of barium glasses which contain a percentage of boric oxide in place of silica, these glasses being indispensable in the manufacture of the modern wide aperture photographic lens. The most extreme example in this series has a refractive index of 1·6140 and a value of V, or reciprocal dispersive power of 59·8, representing the practical limit to which it has so far been found possible to go.

A knowledge of volatilisation losses is of great importance if exact control of the melting of the flint glasses is to be maintained, and it has been established that, within the limits of composition

* Substance of a paper read at the Science Museum, South Kensington, on Oct. 29, in connexion with the Exhibition of Modern Technical and Artistic Glasses.

obtained in most optical glasses, the losses of any given oxide may be taken as being directly proportional to the concentration of that oxide, this proportionality holding in the case of lead oxide up to about 50 per cent concentration of PbO. Working at 1400° C. in a covered pot, it has been found that the loss of lead oxide may be expressed as 0·014 lb. per 100 lb. of glass for every one per cent of the oxide present, the corresponding figure for K_2O being 0·12. These values, of course, presuppose constancy in temperature, shape of pot, and length of melting-time.

It is easily seen from the above considerations that in the case of an extra dense flint glass, approximately represented by SiO_2, 44 per cent, PbO, 50 per cent, and K_2O, 6 per cent, the loss in pounds of K_2O may exceed the total loss of PbO and the glass after melting actually be richer in PbO than is calculated from the batch composition.

With our present methods of manufacture, perfectly isotropic glasses are probably an impossibility. The degree of homogeneity obtained by stirring is the result of a compromise between various opposing factors. Thus the action of stirring, as the pot and the material of the stirrer itself are very slightly soluble in the glass, will tend to produce veins of different refractive index faster than they can be eliminated by the mixing process if the temperature of the melt is too high, this being due to the rapid increase of the rate of chemical attack with rising temperature. If volatile constituents are present a high temperature of stirring may mean that the surface of the glass, slightly poorer than the rest in the volatile oxide, may be stirred in faster than the resulting veins can be eliminated. On the other hand, too low a temperature produces a heavy 'drag', which may draw in aluminous material from the pot wall in sufficient quantity to render the melting useless.

The most noteworthy recent advance in optical glass manufacture is the production of improved refractories for pots. This work was undertaken recently by Messrs. Chance Brothers and Co., Ltd., with the co-operation of Sir Herbert Jackson, and full-scale pots based on the experimental small-scale samples have been in use for some time. It has been found that the more acidic glasses, such as the ordinary crowns and especially the borosilicates, are best melted in pots having a relatively acidic clay composition—$Al_2O_3,5SiO_2$ being typical. The more basic glasses, such as the flints and the barium crowns, need a lower concentration of silica in the pot material; in these cases a reduction up to 10 per cent of SiO_2 may be made. One of the immediate advantages gained from the use of these new pots was an improvement in the transparency to light of the resulting glasses. The task of measuring the small differences in absorption which exist between various meltings of optical glass is a difficult one, and the figures given in the present paper were obtained by the British Scientific Instrument Research Association, using an apparatus similar to that described by W. D. Haigh.[1]

It has been found that if the absorption per inch of glass material at each wave-length is plotted against percentage of iron oxide present in the glass, the points lie on smooth curves which do not pass through the origin but indicate a definite absorption at zero concentration of iron. However, the absorption in optical glass is largely proportional to the amount of iron oxide present, and the new refractories, coupled with the use of only the purest raw materials, have enabled this to be reduced to a minimum.

The extent of the improvement is shown by the following figures, which are published by permission of Sir Herbert Jackson:

Melt.	Iron per 10^6.	Percentage of Light extinguished per Inch of Glass.						
		3650.	4078.	4358.	4916.	5460.	5790.	6500.
B.S.C. 5358	180	12·50	3·70	4·62	3·10	2·76	2·88	4·10
B.S.C. 6029	50	2·94	0·82	1·50	1·10	0·76	0·91	1·73

A similar improvement has been made in most of the optical glass types, particularly the dense flints, the barium crowns, and very heavy lead glasses of ^nD up to 1·8; and it is now safely claimed that the optical glasses of the new high transparency type made in Great Britain have a lower absorption of light than any glass of foreign manufacture.

In the efforts to eliminate iron oxide from the glass, work has been done on the purification of sand, and a process has been worked out and patented,[2] using a reducing gas such as sulphur dioxide and chlorine, which has on an experimental scale enabled the iron oxide concentration to be reduced from 0·008 to 0·0025 per cent. The use of purified sands may enable further improvements in transparency to be made in the near future, the present values being considered the maximum possible with existing raw materials.

Although from time to time it has been suggested that the chilling which takes place in moulding may cause heterogeneity in optical glass which is not removed by the subsequent annealing, no direct evidence in support of this has yet been advanced, and it is still considered that the laws approximately represented by Twyman's equation are the only considerations which govern the degree of freedom

Type.	Refractive Index and Value of V.	Autoclave Test (4 Atmospheres).	Test using Steam. Steam under Atmospheric Pressure.
B.S.C. .	1·5090 64·3	Unattacked	Unattacked.
H.C. .	1·5159 60·3	Practically unaffected	Unattacked.
L.F. .	1·5475 45·3	Slightly affected	Slightly affected (wipes clean).
Soft Crown	1·5143 56·8	Marked filming	Unaffected.
E.L.F. .	1·5337 49·1	Badly attacked	Surface dulled but wipes clean.
D.B.C. .	1·6140 56·2	Slightly affected	Severe iridescent tarnish.
D.B.C. .	1·6140 59·4	Slightly affected	Completely dulled.

from strain of a block after a certain heat treatment. The essential condition is the accurate measurement of the upper temperature at which strain in the glass block is released in a reasonably short space of time.

Research on methods of testing the resistance of polished glass surfaces to atmospheric attack has led to the abandonment of the old autoclave test of superheated steam at four atmospheres pressure. The abnormality of the conditions of this test must make the results open to doubt, and it has been found that the modified method of testing in water-vapour at atmospheric pressure and a temperature of 80° C. gives results more in accordance with general experience, although the period of the test has to be increased from two hours to two weeks. The revised method of testing puts the various types of optical glass in a different order as regards resistance to surface attack, some of the types previously thought unstable from the results of the autoclave test now being shown to be perfectly reliable, while certain other types previously thought of fair durability are now shown to be very unstable, confirming the experience of the lens manufacturer.

The table on p. 927 shows the classification of representative types of optical glass according to the autoclave and atmospheric durability tests.

Among the new types which have been successfully produced in recent years is a dense barium flint made of ${}^{n}D$ 1·6437, ${}^{n}C - {}^{n}F$ 0·01332, V 48·3, which is as extreme a member of the flint series as the barium crowns are in the crown series. The very heavy lead glasses of ${}^{n}D$ up to 1·8 are now produced in large blocks of a degree of homogeneity and freedom from colour never previously attained, this being largely due to the use of the new refractories and correct temperature control in melting.

[1] "Proceedings of the Optical Convention", 1926.
[2] Brit. Pat. 325,386 (1929), Chance Brothers and Co., Ltd., and J. English.

Obituary.

DR. S. W. STRATTON.

SAMUEL WESLEY STRATTON was born at Litchfield, Illinois, in 1861. He graduated in 1884 from the University of Illinois, where he remained for the next eight years, at first as an instructor, then as professor of mathematics, and finally as professor of physics and electrical engineering. In 1892 he became assistant professor of physics and later professor in the University of Chicago. Nine years afterwards he was invited by the Assistant Secretary of the Treasury to formulate a project for the development of work on weights and measures, and in 1901 was mainly responsible for the Act which established the Bureau of Standards at Washington. Of this he became the first director, retaining the position until 1923, when he was appointed president of the Massachusetts Institute of Technology. He had a lifelong connexion with the American Navy, and in 1898 served during the Spanish American War. This brief summary of his activities shows that the most important part of his work was connected with the Bureau of Standards, which is indebted to him for its existence and for many of its most striking developments.

Stratton was a welcome visitor to the National Physical Laboratory, and spent some time at Bushy House in early years; from this time on the connexion between the two institutions has been a close one. Visitors to the National Physical Laboratory will remember an old chestnut tree near the door of Bushy House, said on good authority to have been planted by Charles II. Round the Bureau of Standards, when founded, was a wood of chestnuts; the site was part of Washington's estate, and tradition says that, after one of his visits to England, Washington took back the chestnuts which formed the nucleus of this wood.

An Electrical Congress, in connexion with an International Exhibition, took place at St. Louis in 1904 and proved to be Stratton's introduction to that international work which for the rest of his life occupied much of his time. This Congress passed two important resolutions: one in favour of a formal International Conference to deal with electrical units, the other inviting the leading technical societies of the world to co-operate in the standardisation of electrical machinery; the first led to the International Conference on Electrical Units in London in 1908, the second to the establishment of the International Electrotechnical Commission.

After the St. Louis Conference, at which I represented the British Government, I spent some time with Stratton at Washington discussing with him, much to my own profit, questions of laboratory organisation suitable for any institute such as those we directed respectively. In 1905 he became a member of the International Committee of Weights and Measures and, as a result, a frequent visitor to this side of the Atlantic

The International Electrical Conference foreshadowed at St. Louis was summoned by the British Government and met in the rooms of the Royal Society in October 1908. Stratton was prominent among the American delegates; he was accompanied by Dr. E. B. Rosa, who had done much valuable work at the Bureau on electrical units.

A distinction had been drawn at the Chicago Electrical Congress, some years previously, between the ohm, the ampere, and the volt, multiples of the C.G.S. units, and the International Ohm, Ampere, and Volt taken to be close approximations to the absolute units, and defined in a manner which it was hoped would permit their realisation with sufficient accuracy for all practical purposes in any fully equipped laboratory. Some of the American delegates would have preferred definitions based only on the C.G.S. units.

The Conference also passed a resolution recommending the various governments interested to establish a permanent International Commission for Electrical Standards and, pending the appointment of this, requested its president, Lord Ray-

leigh, to nominate a committee to advise as to its constitution and to direct such work as might be necessary in connexion with the maintenance of standards. It was suggested that the functions of the International Conference of Weights and Measures might be enlarged with the view of some combination of effort. The Electrical Conference was of opinion, however, that the Permanent Electrical Commission should be a distinct body.

Stratton was closely concerned in the consequences which followed from these two resolutions and took an active part in the development of each. He was a member of Lord Rayleigh's Committee, and in connexion with the maintenance of standards invited representatives of the Reichsanstalt, the Laboratoire Centrale d'Électricité, and the National Physical Laboratory to meet at the Bureau of Standards in 1910 and complete the work, left incomplete in 1908, of preparing specifications for the standards. The representatives (Dr. E. B. Rosa and Dr. Wolff, Dr. W. Jaeger, Prof. F. Laporte, and Mr. F. E. Smith) met at Washington and worked together during a large part of 1910; their report, "On the Concrete Standards of the International Electrical Units", was issued in January 1912 and has formed up to the present the basis of international co-operation. Dr. Stratton undertook the duties of treasurer of Lord Rayleigh's Committee and collected funds to meet the cost of this joint investigation from certain American societies interested in electrical matters.

The establishment of a Permanent International Electrical Commission was a more difficult matter. The International Conference of Weights and Measures was established to give effect to the resolutions adopted in 1875 by the Metric Convention. The Conference dealt solely with standards of length and mass. To these had been added, as a necessary outcome of accurate measurements of length and mass, the standardisation of a limited range of temperature. A committee of the Conference guided the work of the Bureau International des Poids et Mesures at Sèvres, and Stratton had been a member of this committee since 1905. He believed that the enlargement of the functions of the Conference offered the best solution of the problem of establishing an International Electrical Commission.

After his retirement from South Africa, Sir David Gill became the British representative on the Conference of Weights and Measures, and Stratton found in him a congenial colleague and a cordial supporter, but 1914 prevented the immediate realisation of his ideas. This, however, was achieved, not entirely in the manner originally suggested, in 1927, when the Committee of Weights and Measures adopted the following resolution, ratified later by the Conference: "The International Committee of Weights and Measures approves the organisation of a Consultative Committee for Electricity to advise the International Committee of Weights and Measures on questions relating to systems of Measurement and Electrical Standards". That Committee is now in being and has already done valuable work; the International Committee of Weights and Measures has become the central organisation for the issue of electrical standards. For this purpose it works in close co-operation with the national standardising laboratories, and the standards it proposes to issue will be based on the comparison and co-ordination of the results of these laboratories. At the meeting of the Conference held during the current year, at which Dr. Stratton was present, photometric standards were brought within the ambit of the Committee.

International standardisation did not by any means include the whole of Stratton's work. Since the War, standardisation has been much to the fore in the United States as elsewhere, and Stratton has been a leader on many of the committees dealing with engineering matters. He was a member of the National Screw Thread Commission, and all who have had occasion to study the report of that Commission have appreciated the thoroughness with which its work was done and the value of its results. Stratton was himself a very skilful mechanic. He also served on the National Research Council and on the Advisory Committee for Aeronautics, which under the guidance of Dr. Ames has done much to secure to America a leading place in the scientific study of aviation problems.

Stratton's friends in England welcomed him recently as a delegate to the British Association, Faraday, and Clerk Maxwell centenary meetings in London and Cambridge. These he enjoyed greatly. We met at the National Physical Laboratory and discussed old times, and again at Cambridge, by chance in a bookshop where he was collecting literature relating to Maxwell, as well as during the meetings themselves. He was a guest at Caius College, much impressed by the advantages of college life and the kind hospitality of his hosts.

The end came on Oct. 19, soon after his return to Boston—"No warning, not a moment's illness—just fell forward while talking, that's all" are the words of a letter telling me about it.

R. T. GLAZEBROOK.

MR. ELSDON BEST.

ELSDON BEST, doyen of Polynesian ethnology, died at Wellington, New Zealand, last September. He was born in 1856 at Porirua and had little schooling, but was from his earliest years associated with the Maori population. At eighteen years of age he was in the Poverty Bay district, then emerging from the shadow of Te Kooti's massacres, working in the bush on fencing and felling contracts. He joined the armed constabulary for the, as it turned out, bloodless campaign against Te Whiti, the latter part of his service being in control of a party of 'friendlies' in the bush. In 1883 he went to Honolulu, later moving on to California, engaging in timber work among the redwoods of the Sierra Nevada. He then moved east into Arizona, New Mexico, Texas, and Louisiana, working as a cowboy and as foreman in railroad construction. At the end of 1886 he returned to New Zealand and entered on the period of twenty-five years' intimate connexion with the Maoris which furnished him

with the material for his long series of books and bulletins. The latter part of his life was spent in Wellington, on the staff of the Dominion Museum.

Varied experience among men gave Elsdon Best ease of manner, and this, coupled with unusual natural gifts—sound judgment, clarity of thought, and quick decision—left a deep impression on all who met him. He was a master of direct English and had great linguistic abilities, best seen in his mastery of the Maori language, which he spoke in later years more accurately than any living Maori. To this was added the gift of thinking like a Maori. His achievement lay especially in accurately recording difficult data.

In the opinion of the late W. H. R. Rivers, Best was the greatest of all ethnological field workers who have worked in the Pacific. He changed the whole face of Maori ethnology, incorporating in his publications all old data of any value and placing on record a mass of his own data far surpassing, both in quantity and quality, all that had been recorded before him. By his death New Zealand has lost one of the first intellects among her native born.

H. D. SKINNER.

MR. HENRY GARNETT.

MR. HENRY GARNETT, for many years director of Messrs. Flatters and Garnett, Ltd., opticians and scientific instrument makers of Manchester, died on Nov. 3, aged sixty-three years. Henry Garnett was born in Waterford, Ireland, in 1868, where his father was head of Newtown School (of the Society of Friends). There he formed a close friendship with the naturalist J. H. Salter (afterwards professor of botany at Aberystwyth). He was apprenticed to a chemist in Evesham, and during his scant leisure collected a herbarium which was awarded the Bronze Medal of the Pharmaceutical Society. Later he won the Bell Scholarship, and after passing the minor and major (1890) examinations, he secured three silver medals and the Pereira Medal. He worked out, under the direction of Prof. Dunster, the active principles of *Piper ovatum*, and some years later, with Mr. J. Grier, conducted a research into the active principle of ginger, contributing papers to the Pharmaceutical Conference in 1907. Mr. Garnett was keenly interested in birds and plants, and at the time of his death was vice-president of the Manchester Microscopical Society.

WE regret to announce the following deaths :—

Major-General Sir David Bruce, K.C.B., F.R.S., president of the British Association at the meeting at Toronto in 1924, who was a pioneer in the study of tropical medicine, on Nov. 27, aged seventy-six years.

Mr. James H. Dellbridge, who was second engineer in Capt. Scott's first Antarctic Expedition, on Nov. 12, aged fifty-nine years.

Prof. W. A. S. Hewins, first director of the London School of Economics, formerly Tooke professor of economic science and statistics at King's College, London, and formerly Under-Secretary of State for the Colonies, on Nov. 16, aged sixty-six years.

Sir Thomas E. Hill, O.B.E., lately medical officer of health for the County of Durham and formerly professor of public health in the University of Durham, on Nov. 25, aged sixty-six years.

Mr. W. F. Reid, an original member of the Society of Chemical Industry and former president of the Society, known for his work on smokeless powder, on Nov. 18, at an advanced age.

News and Views.

THE Savilian professorship of astronomy at Oxford, to which Prof. H. H. Plaskett, professor of astrophysics at Harvard University, has recently been appointed, is the oldest chair of astronomy in Great Britain, with the exception of that at Gresham College, London. Like the Savilian professorship of geometry, it was founded in 1619 by Sir Henry Savile (1549–1622), the Elizabethan scholar, provost of Eton, and warden of Merton College, Oxford. John Bainbridge became the first occupant of the chair, Henry Briggs being his colleague in the chair of geometry. Briggs died in 1631 and Bainbridge in 1643, and both were buried in the choir of Merton College Chapel close to the memorial to Sir Henry Savile. During the renovation of the chapel, a good many years ago, the tombstone of Briggs and the memorials to Savile and Bainbridge were removed to the west end of the chapel, where they are to be seen to-day. The immediate successor of Bainbridge was John Greaves, who measured the pyramids ; he was deprived of his chair by Parliament in 1648. The chair then passed to Seth Ward, afterwards Bishop of Salisbury, while among his successors have been Wren (1661–1673), David Gregory (1691–1708), Bradley (1721–1762), Thomas Hornsby (1763–1810), Rigaud (1827–1839), W. F. Donkin (1842–1869), Charles Pritchard (1870–1893), and the late Prof. H. H. Turner, who held the chair from 1893 until his death last year.

IT is announced in the *Times* that on Nov. 26, at the University of Coimbra, a room was dedicated to the memory of Sir Isaac Newton. At the invitation of the Rector, Dr. João Duarte de Oliveira, the British Ambassador to Portugal presided over the ceremony, and the opening speech was delivered by Sir Frank Dyson, the Astronomer Royal. Afterwards addresses were delivered on Newton's mathematics, physics, and philosophy, and on the law of gravitation; and the Ambassador then unveiled a bronze name-plate in the Sala de Newton in the observatory. Coimbra, once the capital of Portugal, is picturesquely situated on a hill on the bank of the river Mondego. The earliest certain information of a university in Portugal dates from 1288, but it was three years later that a " Studium Generale " was founded at Lisbon. That city not proving suitable,

the new school was removed to Coimbra in 1308, but in the next two centuries it was twice transferred to Lisbon and back again, its final removal to Coimbra being in 1537, in the reign of John III. One of its professors in the sixteenth century was the famous Scottish reformer George Buchanan (1506–82), who went to Coimbra in 1547 and was imprisoned by the Inquisition. Mathematics and natural philosophy were first taught there in 1770, after the University was reorganised, and to-day there are five faculties, theology, law, medicine, mathematics, and philosophy. Coimbra has a population of about 20,000, and the students number 1400 or more.

THE Council of the Royal Meteorological Society has awarded the Symons Gold Medal for 1932 to Prof. V. F. K. Bjerknes of the Physical Institute of the University of Oslo, Norway. The medal is awarded for distinguished work in connexion with meteorological science and will be presented at the annual general meeting on Jan. 20. Prof. Bjerknes was born at Oslo on March 14, 1862. He received the degree of doctor of philosophy at Oslo in 1892, and from 1907 onwards has been professor of mechanics and mathematical physics at various universities in Norway and at Leipzig. His work deals almost entirely with the mathematical description of the motion of moving fluids, and especial reference must be made to the two volumes and plates of "Dynamic Meteorology and Hydrography", published at Washington in 1910 and 1911 and in German at Braunschweig in 1912. He has devoted much attention to the theory of cyclones, and has written several of the Norwegian series of Geophysical Publications on this subject. His work played a large part in the development of the Norwegian theory of the 'polar front', and in 1920 he read an important paper before the Royal Meteorological Society on "The Structure of the Atmosphere when Rain is Falling".

AS Lord Moynihan remarked in laying the corner-stone of the Wellcome Research Institution on Nov. 25 (see also p. 974), the ceremony might well be regarded as referring to the corner-stone of a long life's work. The various constituent research laboratories of the Wellcome Research Institution are perhaps better known than some of Dr. Henry Wellcome's other scientific activities. Since the time when he paid a visit to the South American cinchona forests in 1879, Dr. Wellcome has given many evidences of his interest in the tropical regions. The results of his archæological excavations in the Anglo-Egyptian Sudan will, when published, throw new light on the racial history of north-east Africa. At the Wellcome Tropical Research Laboratories in Khartoum, Sir Andrew Balfour made war on the malaria-carrying mosquitoes by means of a highly organised system for searching out the mosquito breeding-places and destroying the larvæ. The researches on trypanosomiasis, kala azar, and other tropical diseases were carried out there with most beneficial results. By the establishment of this research centre, Dr. Wellcome has thus contributed materially to the welfare, not only bodily, but also morally, of a large section of the population of the Sudan. In 1914, Dr. Wellcome instituted a special commission to secure improvements in the construction of field ambulances, and equipped and supplied for the Army Medical Service a medical research laboratory which gave valuable service in Palestine and Egypt. In 1905 he founded the Medical Dispensary at Mengo, Uganda; and in 1927 he founded at the same place the Lady Stanley Maternity Centre.

TWO hundred years ago, on Dec. 12, 1731, Dr. Erasmus Darwin, the physician and poet, grandfather of Charles Darwin and Sir Francis Galton, was born at Elston Hall, near Newark, being the youngest son of Robert Darwin, "a person of curiosity" who had married a daughter of Erasmus Earle, a sergeant-at-law and a member of Parliament. Entering St. John's College, Cambridge, at the age of nineteen, he graduated B.A. in 1754 and afterwards studied medicine at Edinburgh. He first practised at Nottingham, but after a short time, removed to Lichfield where he married and became a popular physician and a prominent figure in intellectual circles. His ability, his radical opinions, and his advocacy of temperance in drinking gained for him as much fame as his eight-acre botanical garden, his poetry, and his speculations. A friend of Wedgwood, Boulton, Watt, Priestley, Edgeworth, and others, he was a member of the once famous Lunar Society, which arranged to hold its meetings at the time of full moon, so as to facilitate travelling. Few to-day probably read his "Botanic Garden", his "Zoönomia, or the Laws of Organic Life", or his "Phytologia, or Philosophy of Agriculture"; all of which, however, testify to his originality and enthusiasm. An inventor himself of mechanical contrivances, it was with a knowledge of Watt's work on the steam engine that he wrote the oft-quoted lines:

> "Soon shall thy arm, unconquer'd Steam, afar
> Drag the smooth barge, propel the lumbering car
> Or on wide-waving wings expanded bear
> The flying chariot through the fields of air."

ERASMUS DARWIN'S first wife, Mary Howard, died in 1770, and in 1781 he married the widow of Colonel Chandos Pole. Shortly afterwards he removed to Radbourne Hall, and thence to Derby and finally to Breadsall Priory, where he died suddenly on April 18, 1802, at the age of seventy-one years. By his first wife he had three sons, the third of which, Robert Waring Darwin, who married Susannah Wedgwood, was the father of Charles Darwin, who was born in 1809. By his second wife, he had four sons and three daughters, of which Frances Anne Violetta married Samuel Tertius Galton, and had four daughters and three sons, the youngest member of the family, Francis, who was born in 1822, becoming famous as the founder of eugenics. To him was due the erection of a monument in Lichfield Cathedral to his grandfather, Erasmus Darwin.

THE twenty-ninth annual report of the Imperial Cancer Research Fund, presented at a meeting of the general committee on Nov. 25, records another year of the sound work and steady progress which is

characteristic of that organisation. The investigations which have been in hand deal mostly, in one way or another, with resistance to cancer. For, helpless as the body may seem in the presence of rampant malignant disease, there is no doubt that it does put up some sort of resistance which, in animals at any rate, may be demonstrably successful. On one hand, Dr. R. J. Ludford has analysed the cellular reactions to implanted cancer, using their reactions to various dyestuffs to identify the cells and to indicate their functional capacity. He has in this way shown that the immunity which can be conferred by the inoculation of embryo skin depends on the connective tissue reaction. Dr. W. Cramer, on the other hand, from the study of mortality statistics, shows that an excess of cancer in one organ is often compensated for in the same community by a deficiency of cancer in other parts of the body: the presence of one tumour, that is, makes the body to some extent resistant to the development of another.

SIR ALFRED EWING'S Friday evening discourse on Nov. 27, at the Royal Institution, was a tribute to the life and work of the late Sir Charles Parsons. The genius of Parsons opened up a new era in the production and distribution of power. With Parsons the development of an invention was a patient, laborious advance from experiment to experiment, rejecting the good for the still attainable better. In 1884 Parsons introduced his earliest compound steam turbine; in 1891 he took the further step of continuing the expansion in the turbine down to the low pressure attainable in a condenser. Before long this enabled the turbine to surpass the older engine of Newcomen and Watt in the efficiency with which it converted heat into work. Thanks mainly to further inventions by Parsons, a great modern steam turbine not only develops power in unprecedented quantity, but also with an economy of coal previously unknown. The steam turbine has an almost complete monopoly as a power generator in central stations, except, of course, in countries where hydraulic sources are available. In 1894 Parsons began to apply the turbine to marine propulsion, and in 1897 his little experimental vessel, the *Turbinia*, astonished the Fleet at Spithead. Before long the turbine was adopted in all warships and in many vessels of the mercantile marine. For the largest ships it gives a concentration of effective power that is attainable in no other way.

IN the report of the Newcomen Society for 1930–31, which was read at the annual general meeting held on Nov. 25, at the Chartered Institute of Patent Agents, reference was made to the need of steps being taken for the prevention of the decay of monuments to distinguished engineers and scientific men. The Society itself has done much in this direction and its example might well be followed by other bodies. In one instance a member of the Newcomen Society was able to locate the tombstone of John Blenkinsop, the pioneer of the locomotive, while the Society contributed towards its restoration. In the case of the monument in Row churchyard to Henry Bell, the pioneer of the steam boat, which was falling into neglect, through the Society the Institution of Shipbuilders and Engineers in Scotland was led to inquire into the matter and to arrange for the monument to be cared for. Following its usual custom, the Society, on Aug. 5, 1931, placed a wreath on the memorial at Dartmouth to Thomas Newcomen to mark the anniversary of his death, and early this year took the initiative in arranging for the celebrations of the centenaries of Henry Maudslay and William Symington. The membership of the Society now stands at 321, of which 63 are institutions and libraries at home and abroad which receive the *Transactions*. Up to the present, one of these subscribing institutions has been the Science Museum, and it is with regret that we learn that the call for economy has led to its withdrawal from the Society. In view of the closely related aims of the Science Museum and the Newcomen Society, and the work done by both, it is surely not too much to ask that this decision be reconsidered, especially as the sum at stake is only twenty shillings.

ON Nov. 26, the new Ramsay Memorial Laboratory of Chemical Engineering at University College, London, was opened by His Royal Highness Prince George, in the presence of a large and distinguished assembly representing many branches of science and industry. His Royal Highness, addressing the assembly in the Great Hall of the College, paid a graceful tribute to the life and work of Sir William Ramsay. He went on to say that the new laboratory should do much to bring scientific research in chemistry and engineering into closer contact with the needs of modern industry. The chemical engineer is an earnest student of the mechanism of his processes from all points of view: he deals not only with chemical reactions, but also with questions of suitable materials, heat balances, etc. He also makes full use of every branch of physics and engineering for the production of the perfect manufacturing plant. Such a spirit could well be introduced into all industries; it is not too much to say that a thorough study of these principles would go a long way towards restoring British manufactures. In chemical engineering, as in every other subject, an attempt should be made to maintain a balance, so that pure research, chemical engineering, engineering proper, and economics are linked together and play their part in that scientific harmony which can maintain Great Britain in her position as one of the greatest nations in the world. His Royal Highness then proceeded to open the new laboratory, and afterwards made a full inspection of the building, unveiling the Ramsay Memorial tablet.

IN his address on "Communications" to the Institution of Electrical Engineers on Sept. 22, which has just been published in the Institution's *Journal*, Sir Oliver Lodge points out clearly the essential difference between telegraphic and radio transmission. He says that the theory of wired signalling is not so simple as that of etheric signalling. Historically it came first, but if it had come later it would have been regarded as an improved method, because it enables privacy to be obtained: it is not broadcast, but concentrated. The answer to the

question why a wire acts as a speaking tube is not very simple. Most people think that the wire conveys the impulse; but a metal wire is only a piece of matter, and has no power of transmitting ether waves. Directly the waves enter the wire, which they do laterally, they are dissipated, their energy being converted into heat. But the very fact that some of the energy does enter the wire enables the wire to act as a guide or director. The energy does not travel through the wire: it travels in the ether outside the wire. The laws which it follows are such that the main part of the wave does not leave the wire and spread out in all directions, but travels near it and so can be received at the far end without much diminution of intensity. It has to be remembered, however, that the waves in wired signalling are to some extent distorted. They do not all travel at the same rate, and these different rates cause the shape of the complex wave to be altered in the act of transmission. When pulses travel in the free ether they arrive without distortion. Hence it is possible to telephone freely by wireless across the Atlantic, although it is impossible to telephone through a cable.

THE paper read to the Royal Society of Arts on Nov. 17, by M. Hochstadter, W. Vogel, and E. Bowden, on an improved method of constructing high-voltage cables marks an important departure in cable construction which may have far-reaching consequences. It seems that by this new method, high-voltage cables could be installed at a cost which would render them formidable rivals to overhead cables. Large telephone networks, which were formerly strung overhead, are now placed underground, and if the new cable fulfils the expectations of its designers, overhead power lines may gradually be replaced by underground cables. At the present time, manufacturers and engineers have been using oil-filled cables for high-pressure work fairly successfully, but they are expensive and only compete with overhead lines in very special cases. In the new method the cable is drawn inside a pressure-tight steel pipe. Lengths of cable up to 550 yards can be drawn into the pipe without trouble. The pipe is then filled with nitrogen gas at a pressure of fifteen atmospheres, eight cylinders of nitrogen being required per mile. No stop-joints, pressure tanks, or expansion tanks such as are necessary for oil-filled cables are required. The thermal characteristics of the cable being good, it can carry a forty per cent greater load than the normal cable. In the case of a serious fault, the nitrogen employed as the pressure medium would have a quenching effect. Experimental results given in the paper show that the pressure cable shows technical and economic advantages over the oil-filled cable. The authors have benefited by the experience gained during the last twenty years, and their cable seems to have guarded against the ordinary causes of breakdown most scientifically.

A COMMITTEE of the Department of Scientific and Industrial Research, under the chairmanship of Sir William Bragg, has issued a short Report on "The Application of X-ray Crystal Analysis to Industrial Problems". (H.M.S.O., 9*d*. net.) It is only eighteen years since the discovery was made that X-rays could be employed to determine the internal structure of crystals; and already results of great value to pure science and to industry have been obtained. It was found that the crystalline condition was far more widely extended than had been supposed, and that such substances as cotton, silk, hair, rubber, wood, muscle, and so on were more or less crystalline, and that their behaviour was closely connected with this condition. During the past three years the new method of analysis has been tested at the National Physical Laboratory, and the work, which has been of an exploratory character, is described in the Report. The method can be used to differentiate between mixtures, solid solutions, and pure compounds. In addition, the method yields information as to the size of the crystals in a substance. A material composed of crystals so small that they are well beyond the range of microscopic vision will still yield an excellent diffraction pattern. It is often found that the suitability or otherwise of a substance for a particular purpose depends on the state of subdivision rather than on its chemical composition. Again, it may happen that as a result of treatment the original random distribution of the crystallites is disturbed and the crystals tend to set themselves in some particular direction. This is shown, for example, in a metal subjected to rolling or drawing, and also in such substances as rubber, cellulose, and silk. The Report is illustrated by a number of excellent plates showing typical diffraction patterns for steels, paints, artificial sapphires, and other materials.

ONE of the series of lectures on "Physics in Industry" arranged by the Institute of Physics was delivered on Nov. 26 at the Royal Institution by Mr. A. Whitaker, who took as his subject, "Physics in Sound Recording". The fundamental inventions of the phonograph and gramophone were rendered possible by the general appreciation of many physical principles by the inventors of the last quarter of the nineteenth century, but the application of systematic quantitative investigation was delayed until the beginning of the last decade, when a technique, developed in connexion with telephony and radio, was applied to sound recording. Since this stage, the progress of sound recording and reproduction has been extraordinarily rapid. Knowledge of the limitations of existing systems has also accumulated, and a better appreciation of the extent to which improvement should be attempted. Both the general improvement in quality, which can be confidently anticipated in the light of recent physical research, and the special requirements and applications of sound recording to the gramophone, the sound film, and radio broadcasting, are likely to keep the research laboratories and factories of the industry busy. The sound-recording industries offer a remarkable example of cases where commercial enterprise may be revolutionised almost suddenly by discoveries emanating from their own laboratories or from the research organisations of technically allied industries. These revolutionary changes come, if unexpected, like tornadoes to the ship of commercial enterprise. It is

the duty of the physicist in industry to act as weather prophet, and when the tornado arrives, as pilot.

APPLIANCES for counteracting the rolling of a ship on a seaway have often been devised. In the British Navy gyro-stabilisers have been used for several years, and they have been installed on some large yachts. In the *Westinghouse International* for the last quarter of 1931 a description is given of the forty-ton stabilising device soon to be installed on the new 2000-ton Italian destroyer leader *Pigafetta*, now being constructed in the Royal Naval Yard at Spezia. The big gyroscopic machine, the rotating part of which weighs eighteen tons, was designed by the Sperry Gyroscope Company of Brooklyn. It was recently inspected and seen under test by naval attachés of the great powers. The rotor is ninety-one inches in diameter and twenty-two inches in thickness at the rim. The maximum speed of the great wheel is 1350 revolutions a minute, giving a peripheral speed of 32,000 feet a minute. The rotor is said to have been so carefully constructed that only 7·5 ounces of weight change was made on one side so as to ensure an accurate balance and smooth operation. New records in accuracy of gun-fire are expected as a result of the stabilisation. On a calm sea also the ship can be rolled at will by the gyro-stabiliser so as to increase gun elevations and thus secure a longer range of gun-fire. In rough weather the gyro-stabiliser eliminates heavy rolling and increases the ease with which the ship can be manœuvred. It also saves power; a twenty-degree roll is estimated to produce a ten per cent loss of propelling power. It is stated that the *Pigafetta* when completed will be the most efficient warship of its type in the world.

FOR the past eight years the British School of Archæology in Athens has been engaged in a series of excavations on prehistoric sites in Macedonia, which has established the existence of a uniform metal-using culture distributed throughout central and western Macedonia and Chalcidice during the latter half of the second millennium B.C. The affinities of this culture lie unmistakably with Troy and north-west Asia Minor; but it has at the same time such striking affinities with the early Helladic culture of south and central Greece itself, which is held to be of south and west Anatolian origin, that a common source for both cultures may be inferred. In a survey of the results of the School's work in this field, which Mr. W. A. Heurtley, the Director, contributes to *Man* for October, it is pointed out that while the persistence of the old Anatolian element, despite interruptions, into the iron age and the period of Greek penetration, has been established in central Macedonia and Chalcidice, in western Macedonia there is a gap in the records. Of the three sites excavated there, two, Servia and Amenochori, were occupied after the end of the early bronze age, while the third, Boubousti, is late bronze and early iron age. The north-west corner, around the head-waters of the Crna river, still remains unexplored. Investigation of this area is imperative to complete the School's programme in Macedonia. Two campaigns will be required, for which the goodwill of the Jugo-Slav authorities is assured. Further, Mr. Heurtley points out, such exploration may furnish evidence which will date the first period of Vinča, a result of which the significance was indicated by Prof. Vassitz's communication to the recent meeting of the British Association, in which he dealt with his excavations on that site.

THE famous Roman camp at Housesteads, on the line of the Tyne-Solway Wall, is now the property of the National Trust, so that its vivid story of activity and conquest will be told to the people for all time. The camp is but an incident in a great defensive scheme, and the aspect which arouses the grand impression of the skill and indomitable force of the Romans is the wide view of the Wall itself running for miles up hill and down dale, deviating from the straight path only when some surface feature of the country offers special advantages for defence. Dr. Vaughan Cornish makes the admirable suggestion that this larger aspect of the Roman handiwork should be enshrined in a Housesteads National Park. The area would be about nine miles long by five broad, with Housesteads as its middle point, and would include the course of the Wall from near Carraw on the east to the summit of the ridge between Caw Gap and Halt-whistle Burn on the west. It is an unspoiled country, suitable in its remoteness and non-arable nature, grand in its possession of basaltic cliffs or 'crags', rising to 1230 feet, of which the Wall makes full use, and which afford glimpses of the Cheviot borders and the mountains of Lakeland. It is a park which could be devoted to recreation, education, and research. Dr. Cornish's views are contained in a pamphlet based upon his British Association address and published at the Map House, 67 St. James's St., S.W.1, at the price of one shilling.

WHETHER or no evolution has come to a close in wild Nature, animals under the control of man appear to be continuing to vary as much as ever. At the British Aquarists' Association show held in October, a blue goldfish of a scaleless variety was exhibited, and the present writer has seen an ordinary scaled goldfish of a steel-blue colour. Of late years, golden-yellow goldfish, as opposed to the red, which is usually the actual colour of 'gold' fish, have become quite common; it is tempting to regard these as representing the original variation, which may have been supplanted in public favour by the more richly coloured red variety, when this appeared; but Darwin, in "The Variation of Animals and Plants under Domestication", quotes an ancient Chinese work on the production of fish with vermilion scales. One fact about the colour variations of goldfish is worth noting: though gold-and-black, gold-and-white, and tricolour specimens are familiar, like the self-coloured gold and silver, black-and-white is almost as rare as blue, which seems curious. In canaries, Mr. G. E. Weston recently recorded in *Cage-Birds* the exhibition of a nearly black variety; whites and greys, like the yellow goldfish, have been in evidence for some years, but these are undoubtedly not new, having been mentioned by old authorities.

A NOTE by Mr. C. S. Webb in the *Avicultural Magazine* for November throws light on what has always been a puzzle in the habits of trogons—why the neotropical species of this ancient tropicopolitan group, which, unlike the Old World forms, are mainly frugivorous, should fly at their food and pluck it on the wing instead of settling to gather it. He saw, in Guiana, a trogon alight on a bush about twelve feet away from some berry-bearing branches and, after a pause, fly out at these seven or eight times, each time plucking a berry and returning to its first perch to eat it. The reason for such an apparent waste of energy was revealed as soon as the trogon left, for the next fruit-eating bird to arrive, a tanager, settled among the berries and instantly fell a victim to a tree-snake which had been lying in ambush. It is quite possible that the fruit-eating habit in American trogons is a comparatively new one in the history of the race, and that the habit of darting out even at this stationary food is merely the blind instinctive continuance of the original fly-catching habit; but the above observation shows that it is certainly justified by results, and may perhaps, after all, be attributed to intelligence. To sit on a perch and dart out at any food looks lazy in a bird, but the habit at any rate encourages observation and gives time for reflection.

IN the interests of the progress of forestry in Great Britain, it is pleasing to note that *Forestry*, the journal of the Society of Foresters of Great Britain (founded a few years ago), maintains its level of excellence. Vol. 5, No. 1 (June 1931), commences with the address delivered to the Society at the annual meeting of this year by the president, Dr. J. D. Sutherland. Two departures have been inaugurated in this number. The president had suggested that a series of biographical memoirs on notable men who have contributed to British forestry should be commenced. In the present number Dr. Sutherland contributes an article on Archibald Menzies, the botanical explorer, whose name is well known to the British forester in connexion with the Sitka spruce. The second departure is due to a suggestion of Sir R. L. Robinson that all available knowledge on the subject of the Sitka spruce should be published in a series of articles, and Mr. A. D. Hopkinson begins with a paper entitled "Sitka Spruce and other Conifers on the Queen Charlotte's Islands". Succeeding articles will deal with the species in Great Britain, its establishment, growth and production, and timber. Mr. Frank Scott contributes an article on "The Place of Douglas Fir in Scottish Forestry". The remarkably rapid growth of this fir in youth led to its being planted in many unsuitable localities; damage and destruction from wind, snow, frost, and, later, disease, almost inevitably followed—and the tree went out of favour. Mr. Scott sets himself the task of inquiring, point by point, into the true position and possible future of the Douglas fir in Great Britain, confining his remarks to Scotland, although they will be found to be equally relevant to many parts of England and Wales.

AMONG the recent acquisitions of the Department of Geology of the British Museum (Natural History) is a mammoth tusk from Siberia, nearly fourteen feet long, and probably the largest known, presented by the Rowland Ward Trustees. The Anglo-Persian Oil Company has presented some Cretaceous Mollusca from Persia, including some gigantic Rudists, one of which is eighteen inches high and nine inches across. These bi-valves, like the oyster, become fixed by one valve when young; but in the Rudists the lower valve further becomes extremely thickened and has a lattice-like internal structure, and grows upwards to form a pillar-like mass, which is often curved. The soft parts remain small, lying in the shallow cavity at the top of the pillar-like lower valve, and are covered by the lid-like upper valve. The Department of Botany of the Museum has received a valuable collection of West Indian marine algæ through the work of Mr. G. Tandy, Assistant Keeper in the Department. There are about a thousand mounted specimens, representing about 425 species. The algæ were collected mainly by Mr. Tandy while working at the Marine Biological Laboratory of the Carnegie Institution of Washington at the Dry Tortugas, Florida; others were collected by Mr. John Colman, who was working on zoological problems. This close co-operation in the study of a small area resulted in the discovery of a number of organisms which had not been found by the specialists who had previously worked over the area. The Friends of the National Libraries, with the co-operation of one of their members, Mr. Basil H. Soulsby, have presented to the general library of the Museum four rare Linneana, including a sixth edition (1764) of Linnæus's "Genera Plantarum", with the rare portrait of the author at the age of thirty-three years, engraved by Tanje, only found in a few copies of this edition.

THAT the law protecting the dwindling mammals of Australia lags behind enlightened public opinion is the conviction of the Council of the Royal Zoological Society of New South Wales. The Report presented to the annual meeting at Sydney states that the removal of protection from the opossum during an 'open' season was opposed by the Society and others, but was granted by the State partly on the ground of the strenuous economic period. It was claimed officially that extreme care would be exercised in the issue of permits to kill opossums (showing that the State recognises the difficulties), and strict rules as to the methods to be employed were issued, and yet, according to the Council's Report, the resulting slaughter was carried out in the usual uneconomic manner (*Australian Zoologist*, August 1931, p. 2). Probably 50 per cent of the skins taken represented females carrying young, which were uselessly destroyed. "So long as our so-called protection laws are subject to suspension at a few days' notice by a Minister acting under political pressure, so long will the continued existence of our native fauna be threatened."

ALTHOUGH much has been done of late, as, for example, by the establishment of the Joint Standing Committee on Library Co-operation, and by the pooling

of library resources through the National Central Library, to enable readers in Great Britain to obtain books of which they know the existence, at the present time, at least on the technical side, the majority of people are not aware of a large proportion of the published data available throughout the world. Librarians have long realised that their duty is not merely to store books, or even to produce them on demand, but to put the serious reader into contact with the books on his subject, whether they are in the library or not. In the past they have been unable to fulfil this duty for lack of a comprehensive subject-catalogue of the best books on every subject published in different countries. To meet this need, the forthcoming publication is announced of an "International Bibliographical Guide" in five volumes (The Weardale Press, Ltd., 26 Gordon Street, London, W.C.1. Price £2 in advance, and £4 12*s.* a volume as issued). Its lists of books are being compiled and annotated by experts in every subject, who treat only of the works published in their own country. Although, probably, no librarian would contemplate the purchase of every book described in the Guide, it should be an indispensable tool whereby to ascertain what publications exist, and through available facilities to connect the reader with the literature of his subject. The Guide will also be of benefit to the book trade by indicating books on any subject.

PART I., "Medical Tables", of the Registrar-General's Statistical Review for 1930 has been issued (H.M. Stationery Office. 7*s.* 6*d.* net). The birth-rate per 1000 persons living was 16·3 (the same as that for the preceding year), the death-rate per 1000 total population was 11·4, and the deaths of infants under one year per 1000 live births was 60; all of these rates are the lowest recorded. The death-rate from all forms of tuberculosis was also the lowest recorded, 898 per million living. Puerperal deaths, however, show no improvement, being 4·40 per 1000 live births, compared with 4·33 in the previous year. The crude rate for cancer was 1454 per million living, against 1437 for 1929. Some comfort may be derived from the statement that the comparative mortality from cancer has been almost stationary during the last few years, if allowance is made for differences in the age constitution of the population. The toll of the roads is increasing, deaths resulting from accidental injury by mechanical vehicles being returned at 6404, as against 4492 in 1927, 5251 in 1928, and 5799 in 1929.

THE Marine Biological Association, Plymouth, has issued a second edition of the account of the marine fauna of the Plymouth district. A brief description is given of the principal collecting grounds and their physical conditions, with a note of the more common and characteristic species found in them. Then follows in systematic order the list of species (pp. 25-331) for which the exact locality is known. The initials of one or more observers are appended to the records, and under many of the species particulars are added as to relative abundance, breeding period, and occurrence of larval stages in the plankton. A list of works referred to and an index to genera and synonyms complete this useful volume, which is published at the remarkably low price of 2*s.* 6*d.* Congratulations are due to Dr. E. J. Allen, Dr. M. V. Lebour, and Mrs. Sexton, who have been chiefly responsible for the preparation of the volume.

IN the progress of the City of Leicester Museum and Art Gallery the past year has been remarkable for the extension of the Museum and Art Gallery building. This enlargement, consisting of a three-story block, contains, besides exhibition rooms, a muniment room and a research room, for the safe keeping and study of local records. But almost as great a gain has been the improvement in lighting and general attractiveness, for the dullness of museums has had much to do with their unpopularity; and the introduction of a fish-pool and fountain in the mosaic floor of the well-light of the central court was discovered by visitors to be a refreshing innovation.

ATTENTION may again be directed to the issue of *Building Science Abstracts* by the Department of Scientific and Industrial Research, published monthly by H.M. Stationery Office. Each number costs 9*d.* net, the annual subscription being 10*s.* This periodical contains a number of classified abstracts of papers in British and foreign journals, etc., dealing with all aspects of building, including timber, paints and varnishes, glass, metal, and design of structures, and it will be of great service to architects and others interested in building.

IT is announced in *Science* that honorary doctorates have been conferred by the University of Paris on Prof. Walter B. Cannon, professor of physiology in Harvard University, and Prof. Henry Fairfield Osborn, president of the American Museum of Natural History.

MESSRS. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, have just published another (New Series, No. 26) of their useful classified lists of scientific periodicals and publications of learned societies. It should be of great service to librarians and others desirous of completing sets upon their shelves.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A radium officer at the North of England Radium Institute, Newcastle-upon-Tyne—The House Governor and Secretary, Royal Victoria Infirmary, Newcastle-upon-Tyne (Dec. 7). An assistant lecturer in engineering at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (Dec. 12). A lecturer in mathematics in the department of physics and mathematics of the Birmingham Central Technical College—The Principal, Central Technical College, Birmingham (Dec. 19). A Kirk Duncanson Fellow of the Royal College of Physicians of Edinburgh—The Secretary, Royal College of Physicians of Edinburgh, 9 Queen Street, Edinburgh (Jan. 15). A bacteriologist at the Wellcome Tropical Research Laboratories, Khartoum—The Director, Wellcome Tropical Research Laboratories, Khartoum, Sudan.

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Reviews.

A New Summary of Knowledge.

An Outline of Modern Knowledge. Edited by Dr. William Rose. Pp. xv + 1103. (London: Victor Gollancz, Ltd., 1931.) 8*s*. 6*d*. net.

THE publishers of this new composite book by twenty-two able and well-informed writers are fully justified for part of the large claim they make for it as the "cheapest book of our generation" and the "most remarkable event in publishing history". It contains, in just over a thousand pages, twenty-four essays on different branches of knowledge by acknowledged experts, and it offers the whole in a volume little larger than a new novel and at only a shilling more. Its production is welcome evidence, like so many similar popular series, that there is an increasing appetite abroad for something more than mere amusement or sensation, and we believe that the statistics of public libraries are beginning to tell the same tale. It is evident also that no reviewer, however conscientious, could hope to give an adequate account, much less a judgment, on so varied a menu served up by chefs each of them far more accomplished in his own branch than himself. The most that can be done is to give a general idea, noting outstanding excellences, and then to qualify—as is also necessary—the impression that might be created by the publishers' notice.

In a general way, then, it must be noted that the book is rather a summary of views than of news. The nearest analogy would be the collection in one volume of the general articles in an encyclopædia, though even from this point of view there are many lacunæ. There is practically nothing on aeronautics, education, engineering, law, linguistics, medicine, war, wireless, to name a few of the great modern topics for which one turns to an encyclopædia. In most of the articles the writer's chief attention is given rather to what has been thought about his subject and its general tendency than to the actual achievements of the workers. Thus, we have a chapter on the canons of literary criticism, but nothing on the modern works of literature themselves; an admirable review of the evolution of music since the Middle Ages, but only two casual references to Elgar and Sibelius for contemporary music; a chapter, as well expressed and stimulating as we might expect, from Sir Arthur Thomson on biology and human progress, from which it would be very difficult to find out the exact position of any particular question now in debate.

There are, of course, several articles of a more definite and informational kind, and the unevenness in this respect seems to indicate some weakness in the editing. A quite admirable introduction to mathematics by Prof. James Rice—the best bit of popular exposition in the book—should have had a more leading place. Profs. Seligman and E. A. Gardner both contribute accurate and well-filled summaries of their own subjects, one on the distribution of the different types of the human race, and the other on 'archæology', meaning in the latter case practically the artistic remains of early Greece. Prof. T. E. Gregory gives a sound and well-balanced statement of modern finance, but it is not exactly popular. Like most of the essays, it requires to be read as a whole and with a good deal of concentration. One writer who succeeds best—and this is very well—in covering his subject as a whole, giving both its main principles and their historical development and changes in recent times, with interesting illustrations, is Prof. C. H. Reilly, of Liverpool, whose forty pages on architecture are masterly.

There is much other first-rate material in the book, and it need scarcely be said that the whole is well worth the money; but as a book of reference—the other claim made for it—it cannot be recommended. It is a series of monographs bound up together, and these monographs leave untouched some of the most important domains of modern knowledge. One singular example of this—perhaps the most striking example of want of proportion and planning as a whole—is the almost complete absence of definite historical knowledge and the profusion of the discussion of sex. It must be added, in fairness, that one of the articles dealing with sex, that by Prof. F. A. E. Crew, director of the

Department of Research in Animal Breeding in the University of Edinburgh, is, side by side with Prof. Reilly's, that in which contemporary work is described with most accuracy. It is, of course, a little specialist treatise in itself, differing in that respect *toto cœlo* from Prof. Rice's introduction to mathematics.

Prof. Hearnshaw gives a closely packed article, with his accustomed precision and good arrangement, on historiography and how historians have regarded their work, and whether history could be considered as a science. But, when we ask what happened to anybody or any one thing in particular, we may search the book in vain. Mr. Cole discourses of Marx and capitalism, and shows that the Soviet system is a logical outcome of Marxism; but for how the Russian system came into being, we have to look elsewhere than in this book. Perhaps it will be felt that this is to ask too much of a thousand pages, but is it not a very important part of 'modern knowledge', and is there any reason why one should take down one 'book of reference' for the theories men have had about society and have—without warning—to find others to tell us how they have acted in practice? One reader at least would have gladly spared some of the more revolting absurdities of psycho-analysis for a few solid facts of history. England in the index has just fifteen items to its credit, Russia nineteen, while sex spreads out to seventy-four, being, except psychology and psycho-analysis, far the largest heading. F. S. Marvin.

Topography and Tradition.

Joshua: Judges. By John Garstang. (The Foundations of Bible History.) Pp. xxiv + 423 + 73 plates. (London: Constable and Co., Ltd., 1931.) 20*s.* net.

In the topographical exploration of Palestine, our countrymen have always taken a leading part. The names of Sir Charles Wilson, Sir Charles Warren, Sir Charles Watson, Col. Conder, and Canon Tristram are eminent, and the great survey of western Palestine undertaken for the Palestine Exploration Fund by Conder and Captain H. H. Kitchener (afterwards Lord Kitchener of Khartoum) is fundamental. Under the present regime, the Mandatory Power is responsible for the protection and maintenance of antiquities, and the British School of Archæology in Jerusalem has been training a new generation of excavators and explorers.

In the first years after the War, Prof. Garstang was both Inspector-General of Antiquities and Director of the British School, and rightly devoted much of his time to co-ordinate in the archives of the Department what was already known about rites and monuments, and to supplement this by the work of the School and its students. Seven years of this experience "impressed him deeply", as it must anyone in his position, "with a sense of material reality underlying the historical narrative" of the Israelite conquest of Palestine; and in comparative leisure thereafter he has put together this valuable collation of traditional history with topographical fact.

In the received text of the books of "Joshua" and "Judges" there are discrepancies and contradictions; but literary criticism has, at all events, separated archetype from gloss and commentary, and earlier from later points of view among Hebrew editors and interpreters. By the single expedient of concentrating topographical inquiries on the earliest passages, which are relatively free from discrepancies, not only has the circumstantial veracity of the narrative been established, but a solution has also been discovered for the grave chronological difficulties which have been found in it by some scholars. So long as it was thought necessary to divide the exploits of the 'Judges' of Israel into regional and concurrent sections, the earlier events were inevitably 'brought down' to periods which preceded the establishment of the united kingdom of David and Solomon by only about one-third of the recorded intervals. It was as though a 'higher criticism' of English history had synchronised, on geographical grounds, the doings of the Houses of York and Lancaster, or the Norman and Angevin kings. The consequent difficulties, however, disappear, and Israelite history fits with Palestinian, when the 'longer chronology' is restored, and the 'exodus' and subsequent invasion of Palestine are assigned to the latter part of the fifteenth century B.C., when the recent Egyptian conquest of Palestine had broken up local dynasties and tribal groupings, but had itself in turn failed to maintain control of the political situation. The conquest, as was perhaps inevitable—for it was a war of revenge after the Hyksos oppression of Egypt—had been a reign of terror. "I sent the hornet before you, which drave them out" (Josh. xxiv. 12), and the "hornet" is the well-known symbol of the kingship of Lower Egypt. This 'historical background' and its implications are the subject of Prof. Garstang's first sections (§§ 1-2), in which the stage is set for the Israelite invasion by a general survey of the political and military topography of Palestine.

The military operations themselves (§§ 3-8) are in all respects the most effective part of the story. The sites are known; there has been excavation at Jericho, under Prof. Garstang's own direction; the waters of Jordan obligingly "rose up in one heap a great way off" in 1927, as in 1906, 1267, and in Joshua's day, the cause being the collapse of its steep alluvial bank, so that in 1927 "no water flowed down the river bed for twenty-one and a half hours". That the Israelites' good fortune likewise was due to earthquake seems, as Prof. Garstang notes, to have been in the earliest version of the story; in the Song of Deborah: "when thou marchedst out of the fields of Edom, the earth trembled".

Less spectacular, but no less important, contributions to the subject are the remaining topics, the "Settlement of the Tribes" (§§ 9-13) and "The Tribes under the Judges" (§§ 14-20), and the very full appendix in which the places, great and small, mentioned in the narrative are described and so far as possible identified with actual sites.

The value of the work is greatly increased by a large number of photographs, which give a very clear notion of the present state of the countryside, and of the vast amount of evidence awaiting exploration in its many mounds and other inhabited sites. J. L. Myres.

History of Medicine.

Sixty Centuries of Health and Physick: the Progress of Ideas from Primitive Magic to Modern Medicine. By S. G. Blaxland Stubbs and E. W. Bligh. Pp. xvi + 253 + 55 plates. (London: Sampson Low, Marston and Co., Ltd., n.d.) 15*s*. net.

THE object of this volume, as is set forth by Sir Humphry Rolleston in the introduction and the authors in the preface, is not to be a complete history of medicine, but rather "to seize the prevalent ideas of each age of medicine with some notes on the public health, to present them with due regard to the colour of the age, and ruthlessly to ignore minor names".

The work consists of twenty chapters, the first ten of which, covering the period up to the end of the sixteenth century, and the nineteenth, on the growth of hospitals and the sanitary idea, are the work of Mr. Stubbs, while the remainder are due to Mr. Bligh.

In the first chapter it is shown that prehistoric man is to be credited with a higher level of health than the products of most civilisations, inasmuch as he escaped most if not all of the diseases due to modern diet, although his ideas of medicine or health were but a crude mixture of the animal and the animistic. The Sumerians, Babylonians, and Assyrians, who are next considered, lived a reasonably hygienic life, though their knowledge of medicine and disease was closely intermingled with superstition and magic, as is illustrated by several quotations from Campbell Thompson's "Assyrian Medical Texts". Foolish and disgusting as many of the modes of treatment then were, they were no worse than those ordered 1600 years later, the object in both cases being to disgust the demon who was regarded as the cause of the disease.

Special emphasis is laid on two important contributions of the Semitic peoples to public hygiene, namely, the institution of the seventh day of rest and the prophylactic code of ritual hygiene and cult cleanliness as set forth in Leviticus.

In ancient Egypt, where, as Armand Ruffer and others have shown, atheroma, arthritis, and every form of dental disease were prevalent, advance was restricted by magic and the confinement of hygienic measures to the king, priest, and nobles, with little regard for the mass of the people.

Before dealing with the remarkable contributions made by the Greeks to the progress of medicine, Mr. Stubbs controverts the widespread opinion that prior to their advent there was no science in medicine but only meaningless magic and silly superstition. The beginnings of western science are to be found in the Minoan, Trojan, and Mycenæan civilisations, especially the first, as illustrated in Crete by the discoveries of Sir Arthur Evans, who found in the palace of Knossos a system of sanitation superior to that of any ancient or medieval civilisation.

A special chapter is devoted to Hippocrates, with numerous quotations from his works to show their modern spirit. The inheritors of Hippocrates and the state of medicine at Alexandria and Rome down to A.D. 200 are next considered, special attention being given to the work of Galen. Although Rome had no science, it is to be credited with an excellent system of hygiene, as exemplified by the construction of aqueducts and sewers and the foundation of hospitals.

The decline in medical science which took place during the Middle Ages, though not primarily due to medieval religion, was undoubtedly hastened thereby, and it was only by the intervention of heretics such as the Nestorians, Roger Bacon and Albertus Magnus, the Islamic invasion of Europe, and the newly discovered learning of ancient

Greece and Rome that the destruction was not rendered complete.

The remaining chapters deal with the foundation of the modern period of medicine in the fifteenth and sixteenth centuries; its progress in the seventeenth century, as illustrated by the birth of modern physiology, the foundation of the Royal Society and the work of Sanctorius and Harvey, the introduction of chemistry and mathematics into medicine by Paracelsus, van Helmont, and Borelli, the microscope and the discovery of germs, the clinical supremacy of Sydenham; the progress of medicine in the eighteenth century, which is described as an era of hygiene in which a lull took place in microscopic research; and the epoch of modern medicine.

The text is liberally interspersed with reproductions of contemporary illustrations, and a short bibliography of readily accessible English works supplementary to those mentioned in the text is appended. The volume may be warmly recommended to those in need of a well-written and lively introduction to the study of medical history.

History of Demography.

Theories of Population from Raleigh to Arthur Young: Lectures delivered in the Galtonian Laboratory, University of London, under the Newmarch Foundation, February 11 to March 18, 1929, with two additional Lectures and with References to Authorities. By Dr. J. Bonar. Pp. 253. (London: George Allen and Unwin, Ltd., 1931.) 10*s.* 6*d.* net.

DEMOGRAPHY, or the study of births, marriages, and deaths, is the science at the base of politics and economics, and its prime necessity is an accurate census, repeated at regular intervals. The author traces its rise by a series of examples from the seventeenth and eighteenth centuries, and it adds to our pleasure that he selects these from our own countrymen, for we know the economic conditions they were experiencing, and the constant question between the growth of population in city and country conditions. Raleigh, Hobbes, Bacon, and More were all great, and the incarceration in the Tower of the former gave us the "History of the World". Therein is praise of the dissimilitude of Nature, and the very practical consideration of an Ark, 600 ft. by 100 ft. by 60 ft. deep, leads Raleigh to conclude that Noah probably selected his animals, so that they by breeding gave us all the present species.

Harrington was a visionary, but Graunt, one of the original fellows of the Royal Society, elected in 1663 for his book on "Natural and Political Observations on the Bills of Mortality", was of a different order. It is based on his collected figures, and these were extended also to the country, so that the population of England is estimated at about 6½ millions, with about a fourteenth of the whole in London. He and all are shy in asking for a census, as it was deemed to be against the law of God.

Petty was a greater man, and his consideration of social conditions is almost such as we might hear to-day; his great remedy is migration, Nature's own method for excess of population. Halley, the astronomer, used Graunt's tables to consider life insurance, adding the tables of mortality of Breslau. Derham quotes the providence of God in reducing the longevity of man at first to 120 years and then to 70 years, so that "the peopled world is kept at a convenient stay". Süssmilch used all tables and applied them to the world, calculating percentages of all ages, and he even considered epidemics. Hume was more economist than demographer—and indeed the whole was then mainly an economic question. Price supported a sinking fund, and his remedy for the National Debt was an increase in the population, but Howlet contested most of his basal work.

Arthur Young, lastly, discusses population and agriculture. His life-work was to improve agricultural methods, and he never seems to have quite understood that manufacture and agriculture go hand-in-hand. He corresponded with Malthus, who later had the benefit of the first accurate census.

The subject is an interesting study, especially when as here illuminated by the mind of an author widely read in world history and the problems of economics. We imagine his view to be that population and world conditions present similar curves, the former lagging a little behind the latter, but that the number of censuses behind us is too few to allow the drawing of such at present.

Animal Aggregations.

Animal Aggregations: a Study in General Sociology. By W. C. Allee. Pp. ix+431. (Chicago: University of Chicago Press; London: Cambridge University Press, 1931.) 22*s.* 6*d.* net.

DEEGENER'S great work "Die Formen der Vergesellschaftung im Tierreiche", 1918, was completely spoilt for us by its cumbrous classification of animal aggregations and the impossibility of assigning many cases to any single group. He saw that many animals normally live in communities consisting of a single or a few species, and

was inclined to regard this as a general phenomenon. Earlier, Espinas, in 1878, had developed similar views. "Communal life, therefore, is not an accidental fact in the animal kingdom; it does not arise here and there fortuitously, and, as it were, capriciously . . . but . . . a normal, constant, universal fact." Wheeler, in 1930, classified aggregations into loosely integrated associations and more permanent societies. The extreme cases of the latter are in ants, termites and bees, and in man. These are not comparable, but Wheeler has shown more than thirty cases of prolonged association of young and adults in five orders of insects. In most cases it is an association of mother and offspring, the chief bond being 'trophallaxis' or mutual feeding. This family basis accounts for much of the phenomena of flocks, herds, and human societies, a certain amount of recruiting from outside being allowed.

Family association is easily understood, but Allee reviews much more widespread aggregations in Nature. He gives many examples of such from unicellular organisms, in which chemical and physical conditions often play a markedly forcing part, to higher and more active organisms, the movements of which, before they come together, may be termed 'random'. Sexual phenomena, moisture and drought, sleep, hibernation, etc., are all factors conditioning aggregations, and the individuals in the same keep together by touch, smell, vision, sound, and perhaps more subtle methods. Generally an aggregation consists of a single species, but allied species are frequently found together, and even the association of animals of different phyla is not unusual. The most common cause for most animals is the 'physiological state' of the gut, the need for food, but this certainly fails to explain the immense numbers often found together in the sea.

Space forbids us to attempt to follow our author into the large number of examples he gives of the harmful and beneficial effects of aggregations. He refers, not ultra-critically, to a host of research papers, and, giving the facts and references accurately, he merits the deep gratitude of busy teachers. In particular we are interested in the variety of the phenomena giving protection from toxic reagents and in the mass physiology of spermatozoa. The problems due to crowding cannot be absent from any chapter. As growth and reproduction may be either stimulated or inhibited in different animals by crowding, there is full scope for research here and the cases cited suggest many practical problems. Four cases affecting the sex ratio are cited as having survival value. Crowding produces morphological effects in many insects, such as the locusts, the story of which is so fashionable to-day. Some insects, too, show the highest known states of social organisation. It is clear that we know little or nothing of the less closely knit insect aggregations, and here there is a vast field for research as to how far in such there may be a co-operative effort, which is victorious in the struggle for existence.

The principle of co-operation in animal aggregations has in Prof. Allee an enthusiastic advocate. "Evidently mutual interdependence, or automatic co-operation, is sufficiently widespread among the animal kingdom to warrant the conclusion given above that it ranks as one of the fundamental qualities of animal protoplasm, and probably of protoplasm in general." Later it is claimed that co-operation and the struggle for existence are the two great principles in determining the trend of animal evolution. About 125 examples of aggregations are given, and more than a hundred of these are not connected with breeding. A phylogenetic tree of animals shows the groups to which these animals, supposed to be co-operating automatically, belong. Some might question this co-operation in unicellular organisms, and we must surely eliminate all colonial animals with repetitions of parts physiologically connected. Coming to the higher forms, it is significant that such surviving animals as are supposed to retain characteristics primitive in their evolution show the minimum of such automatic co-operation. We should ourselves regard it as a quality which has arisen many times over in the evolution of animals, and not a fundamental quality of animal protoplasm.

We have enjoyed reading this book and we thank the author for many suggestions, both for laboratory workers and for field naturalists. Both classes should have this book on their shelves for reference. The study of animal aggregation is clearly of great importance, not merely theoretically but also practically applied to man himself, the phenomena in whose social organisation may find useful analogies in such studies on animals.

Problems in Parthenogenesis.

La parthénogenèse. Par Prof. A. Vandel. (Encyclopédie scientifique: Bibliothèque de biologie générale.) Pp. xix + 412. (Paris: Gaston Doin et Cie, 1931.) 32 francs.

THE subject of virgin birth in animals is so interesting that it is curious that, until now, only two books have been devoted specially to it, those of Delage and Goldsmith (1913), and Winkler

(1920). The last decade has seen so much important progress, however, that a new work is a desideratum, and for its preparation no author is better fitted than Prof. Vandel of the University of Toulouse, as is abundantly proved by his researches on the isopod *Trichoniscus provisorius*, his development from them of the theory of geographical parthenogenesis, and his summaries of modern aspects of the general problem. His book is authoritative and is definitely a landmark.

The appeal is primarily to a scientific audience possessing a certain acquaintance with recent developments in biology. Accurate scholarship, as well as sheer hard work, are shown in the text matter and the comprehensive bibliography of some 700 titles. The results and views of other workers are presented fairly and with judgment. Great use is made of the working hypothesis, an excellent teaching device, but one not to be pressed too hardly. The whole is a model of Gallic scientific exposition—lucid and logical.

Of its uniformly excellent contents space allows special mention of the following only: the clear sensible classification; the skilful treatment of the complicated life-cycles in forms showing alternation of sexuality and agamy; the most useful chapters on precocious parthenogenetic reproduction (pædogenesis), the curious nematode conditions, and plant parthenogenesis.

The two important closing chapters discuss major questions, those of sex determination and evolution. Regarding the former, we may only touch upon the arrhenotokous parthenogenesis peculiar mainly to Hymenoptera and rotifers. The prevalent hypothesis is that males are virgin-born and haploid, while females are sexually-born and diploid. Many new facts, however, show that this interpretation cannot be universally applied, even in Hymenoptera, and raise root problems: (1) Are males really haploid? And (2), if so, why should haploidy spell maleness? The first arises because in cases of natural rudimentary parthenogenesis, and in experimental parthenogenesis, virgin-born organisms as a rule die in early life because their haploid condition inhibits development.

Vandel is sympathetic towards Tauson's findings on rotifers, which suggest that the male is really diploid and shows germ cell haploidy at maturation only, chromosome reduction occurring abnormally early in the diploid spermatogonia. Rotifer cytology being extremely difficult, this new interpretation may be wrong, but even if correct its application may be limited. For, since the publication of Vandel's book, saw-fly studies from the reviewer's laboratory show important features, namely, that the haploid-diploid ratio exists between males and females, while chromosome shape and arrangement suggest the existence of polyploidy and of odd chromosomes which may be sex-determining. Thus we may be within reach of answering the question of haploidy and maleness, hitherto a mystery. The somatic cytology of Hymenoptera will still well repay investigation.

Regarding the evolution of parthenogenesis, the author makes the following points: the parthenogenetic mode of reproduction derives from the sexual; it is very widely spread to a greater or less degree among animals and plants; it has arisen independently in different groups, and the course of evolution likewise differs from group to group.

Certain clues to the origin and evolution of parthenogenesis are seen in the facultative or accidental cases noted in species normally bisexual. The majority of cases are found in Lepidoptera, both sexes being produced (deuterotoky), while female-production (thelytoky), for example, in coccids, is rare. The virgin-born offspring are diploid, and this condition is brought about by different methods of auto-regulation of the chromosome equipment. Now Vandel stresses that among the groups which show rudimentary parthenogenesis there belong those very rare species susceptible to experimental parthenogenesis, and it is therefore deduced that the artificial agencies employed are responsible for the restoration of diploidy, the *sine qua non*, usually, of parthenogenetic development. Hence it seems reasonable to suppose that facultative parthenogenesis is induced by some natural agency or agencies supervening in rudimentary parthenogenesis to bring about the diploid (and viable) state. Of these natural agencies we can say very little.

Direct evidence of the possible origination of parthenogenesis only exists in moth hybridisation experiments first made by Harrison, where the hybrid offspring of two bisexual and non-parthenogenetic species were parthenogenetic. Vandel's alternative interpretation is that this is really a case of facultative parthenogenesis. Only further work will clear the matter. The hypothesis of Winge and Ernst of the hybrid origin of plant parthenogenesis is, of course, not new, and although the proofs are not direct, the many features shared in common by hybrid plants and parthenogenetic plants, particularly polyploidy, strongly warrant such a hypothesis. Vandel stresses another suggestive idea: as polyploidy is intimately associated

with geographical parthenogenesis, it may be a cause of parthenogenesis. But of how polyploidy has originated there is no evidence. Parthenogenetic races have been derived by three main mechanisms: (1) a bisexual form has given origin to two types of parthenogenesis, as where thelytoky and arrhenotoky co-exist, for example, saw-flies, or where obligatory thelytoky and facultative parthenogenesis co-exist, for example, coccids; (2) a heterogonous and migratory species, as among aphids, may have become continuously parthenogenetic owing to the absence of one of the hosts; (3) a bisexual species may have produced a parthenogenetic race of different chromosomal (polyploid) constitution, for example, in geographical parthenogenesis. Briefly, new species are in the making, and as further proof there is a physiological *amixie* between daughter and parent species. Thus the evolution of parthenogenesis is bound up with the evolutionary rôle of the phenomenon.

There can be no longer any doubt that reproduction solely by parthenogenesis exists, as among rotifers, crustaceans, Hymenoptera, aphids, and all geographically parthenogenetic species. Hence the faculty is of survival value. Further, that parthenogenesis does not lead to stereotypy is abundantly manifest from the mutations observed.

Its widespread distribution suggests strongly that the parthenogenetic faculty, though it may be latent, is a fundamental vital phenomenon capable of being activated under certain conditions. This leaves us with the query: Do absolutely non-parthenogenetic organisms really occur?

A. D. Peacock.

Agricultural Entomology.

A Textbook of Agricultural Entomology. By Dr. Kenneth M. Smith. Pp. xiii + 285. (Cambridge: At the University Press, 1931.) 12*s.* 6*d.* net.

In this book the author has restricted himself to the treatment of insect pests of the farm, to the exclusion of fruit insects. By way of introduction, Dr. Smith briefly discusses the current methods of insect control and their application to farm practice, namely, insecticidal or chemical, cultural, biological, and legislative. The relationship of insect outbreaks to weather conditions is illustrated by reference to several well-known species. For example, the diamond back moth becomes abundant in hot dry seasons and decreases in wet cold weather. The pale western cutworm (*Porosagrotis orthogonia*) is subject to similar fluctuations, but for an entirely different reason, which the author does not explain on p. 13. The prevalence of heavy rains in the months of May, June, and July constrains this North American species to abandon its subterranean workings and emerge on the surface, when it is then an easy prey to its parasites. The result is a decided diminution of its numbers the following year. So noticeable is the effect that a close study of the meteorological conditions is important in the forecasting of outbreaks of this species.

The systematic discussion of the insect pests themselves occupies ten chapters. They are distributed among eight orders, which, with the families concerned, are briefly defined. Detailed descriptions of the known stages of each species are supplied, followed by an account of the life-history, the list of food-plants and injuries, distribution of the species, modes of control, and the natural enemies that have been recorded in the various countries of the host insect's occurrence.

On the whole, the insect pests of live-stock have received their due share of attention. It is observed, however, that the order Anoplura (not Anopleura) is but scantily noted, and the Mallophaga are not even mentioned. The Siphunculata are classified as sub-order 2, leaving one to imagine what sub-order 1 may be. If *Hæmatopinus suis* is sufficiently important as to receive a whole page to itself, there appears to be no good reason why *H. eurysternus* and *H. macrocephalus* should not have at least been mentioned. Similarly, *Trichodectes* and *Menopon* are of sufficient economic importance as to merit attention. Of other live-stock pests, the warble and bot flies, blow flies, horse-flies, and Hippoboscidæ are adequately treated, and the author is to be commended for bringing his account of the British Œstridæ up to date in conformity with recent researches.

The rôle of insects in the transmission of virus diseases of cultivated crops is a comparatively recent discovery, in the development of which the author has taken an active share. In Great Britain the potato and hop are subject to attack, and the sugar-beet in Germany. The points emphasised are: (1) the vector insect becomes infected when feeding on an infected plant; (2) the virus remains infective in the insect's body for several days, during which it may infect an unlimited number of susceptible plants; (3) certain varieties of both cultivated and wild plants may act as reservoirs of the virus without their being themselves adversely affected; (4) certain plant viruses seem to have an affinity for particular vectors, as for example *Myzus persicæ* (Aphididæ) and the

various forms of potato virus. In this new field of study there is opportunity for extensive research, which should be productive of important results.

At the end of each chapter there is given a list of reference literature for the use of those who may wish to tap the sources of information. In the first of two appendices following the last chapter, the author has tabulated for ready reference the characteristic symptoms of insect attack on cultivated crops; in the second he has listed the common farm weeds that serve as alternate hosts for many insect pests of the farm. In the tracking of any species discussed in the book the reader will find every assistance in the three indices, the first of which is authors, the second parasites and predators, and the third general.

It is evident that Dr. Smith has spared no pains in producing a book which will at once be very useful to student and teacher as well as to farmer. The illustrations, seventy-nine in number, are clearly and attractively reproduced. If one would offer criticism, it would be that they might well have been increased with advantage to the explanation of the textual descriptions of species. One also notes the lack of keys to aid the identification of the species discussed. Although most keys are admittedly arbitrary, nevertheless both teacher and student find them very helpful in taxonomic work. It is to be hoped that these suggestions will receive attention and be incorporated in the next edition, which should soon be required. A. E. CAMERON.

Researches on Fungi.

Researches on Fungi. Vol. 4: *Further Observations on the Coprini together with some Investigations on Social Organisation and Sex in the Hymenomycetes.* By Prof. A. H. Reginald Buller. Pp. xiii + 329 + 4 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 21*s.* net.

PROF. BULLER'S "Researches on Fungi" is well known to mycologists. The first volume appeared in 1909, the second in 1922, the third in 1924. The present volume is divided into two parts. The first of these may be regarded as a continuation of the previous volume, for it is concerned with the further study of the types of fruit-body of the genus *Coprinus*. Eleven subtypes of fruit-body organisation are distinguished by the author, six non-*Coprinus* (Æqui-hymeniferii) and five *Coprinus* (Inæqui-hymeniferii). Nine of these had been described in detail in the two previous volumes, leaving the *curtus* and *plicatilis* types for the present one. Both these types contain only one species. These are set out with precision, though probably most mycologists will be content with reading the summary. *Coprinus plicatilis* is noteworthy in that it does not undergo autodigestion in the manner of the other species, to which they owe the popular name 'inky cap', though the spores ripen and are discharged as in other Coprini. An interesting point about *C. curtus* is that its fruit-bodies may be rendered sterile by fumes from fresh horse-manure.

The relative efficiency of the *Coprinus* and non-*Coprinus* types of fruit-body organisation are discussed. In such comparisons, however, which are based on a comparison of the nicety of the mechanisms which enable the millions of spores produced to be dispersed effectively, it should not be forgotten that this merely means their ability to leave the hymenium. The details of the processes are known chiefly through Prof. Buller's researches, and they are obviously so efficient that the ultimate spore wastage is all the more startling.

Among other points treated in this section are: the well-known *Coprinus* 'ink' used by Bulliard more than a century ago and recommended by Boudier for documents where forgeries might be attempted—the late Prof. G. H. Bryan suggested its use for spotting negatives; the fact that *Coprinus lagopus* is the species which grows on beet and mangel seeds, and that passage of the spores down the alimentary canal of a horse is an essential feature in the life-history of *C. sterquilinus*. The last-named species when growing is able to exert an upward pressure of nearly half a pound—it is the much more robust *C. atramentarius*, however, which so frequently causes surprise by appearing on hard tennis courts and asphalt paths.

The second section of the volume deals with social organisation and sex. A general consideration of social organisation throughout organic beings seems an unnecessary introduction to the well-known fact that the hyphæ of Hymenomycetes fuse on coming into contact and that such a compound mycelium acts as a unit in producing fruit-bodies. The biological advantages of these multiple fusions are stressed, but the experimental evidence that it is mainly nutritional is insufficient.

The problems of sex in the Hymenomycetes have always aroused interest. We seem to be approaching a clearer understanding of the phenomena, but much remains to be done before the facile interpretations of some writers can be accepted. From the time of Sir John Hill until the eighties of last century, sexual organs were discovered by enthusiasts at appropriate stages in the life-history of mushrooms and toadstools; Dangeard's discovery in

1895 of a nuclear fusion in the basidium seemed for some time to alter the focus, and attention was then paid to the origin of the binucleated condition of the mycelium which provided the fusing nuclei. Mlle. Bensaude (to whom the present volume is dedicated) startled the botanical world when she published her account of heterothallism—two different kinds of mycelium necessary for the formation of fruit-bodies—in a species of *Coprinus* in 1918, and showed the significance of clamp-connexions.

Since that time, research has been steadily carried out, and Basidiomycetes, from being more neglected in academic circles than were Fungi Imperfecti, have almost become laboratory pets. Prof. Buller and his pupils have played a prominent part in unravelling the conditions in *Coprinus*. The account he gives here is based on these researches. As, however, these for the most part have already been published, there is not here the stimulus of novelty, though there is a clear account of present facts and theories of heterothallism in Hymenomycetes. The more recent of the author's own researches were summarised in NATURE of Nov. 1, 1930, pp. 686-689.

Prof. Buller regards the phenomena of heterothallism in *Coprinus* and its allies as those of sex. (It is to be noted that heterothallism occurs in all fungal groups and that scarcely a week passes without an addition to the list of species.) The basis for the belief is the fusion of two nuclei in the basidium. It is obvious that this fusion is secondary and that the fusion of different mycelia is not the same as the fusion of sexual organs. Further, four different spores of different sex occur on a single basidium in such a species as *Coprinus lagopus*, and there may be geographical races which are intersterile. It is obvious that the study of these fungi will bring about a change in our ideas of sexuality.

The book is well printed and has a full summary and a good index. The illustrations are almost unnecessarily numerous and the text somewhat prolix, though perhaps this will not be disadvantageous to non-mycological readers. The volume is sure to find a place on the shelves of most mycologists.

General Stratigraphy.

General Stratigraphy. By Prof. J. W. Gregory and B. H. Barrett. (Methuen's Geological Series.) Pp. xii + 285. (London : Methuen and Co., Ltd., 1931.) 10*s.* net.

IN the preface, the authors state that "the international spirit is as necessary in Geology as in Politics". Undoubtedly, geological science cannot afford to be parochial in its outlook, though few geologists can hope to attain the world-wide experience of Prof. Gregory. The study of geology, however, should, like charity, begin at home, and unless a student is in possession of practical knowledge concerning the geology of his own country, he is not likely to profit by reading about the stratigraphical problems in lands beyond the seas.

To meet this need, the general scheme which is followed by Prof. Gregory and Mr. Barrett is to describe British rocks first, and then to give a brief account of their equivalents in other parts of the world. The facts concerning the distribution of land and sea during each geological period are set forth in a number of diagrammatic maps, and an appendix which gives a list of stratigraphical names employed in different countries might help the reader to a clearer understanding.

It must be confessed, however, that the book is disappointing. The compressions and omissions necessary to summarise the main facts concerning the geology of the world within the limits of 239 pages were bound to be unsatisfactory ; the result is geological pemmican of a kind scarcely suitable for the student or general reader. Unfortunately, too, the book is marred by defects arising from the exclusion of important matter. Take, for example, the chapter devoted to the Carboniferous rocks. No mention is made of the occurrence of marine bands in British Coal Measures. These are of the highest practical importance for correlation purposes. Again, no account of the Millstone Grit of England is given, nor is any notice taken of the notable researches of Bisat, Wright, and others who have done so much to solve the stratigraphical problems of this formation which had so long defied the efforts of older geologists. Had the authors of this book appreciated the significance of zonal studies, they would have at once realised the misleading character of their statement that zone *S* [of the Lower Carboniferous] was represented by Millstone Grit in the Forest of Dean and that the formation began earlier in the Clee Hills.

Further, one is told that "as the arid climate which brought coal formation to an end began earlier in Scotland than in England only the lowest of the four divisions [the Lanarkian] of the English Coal Measures is represented in the Midland Valley of Scotland", whereas, as has been clearly demonstrated both by plants and shells, the four divisions (if there are four) have representation in the Scottish coalfields. Indeed, it has been shown that the Lanarkian, as originally defined by Kidston, includes rocks which range in age from the zone of

Carbonicola ovalis up to the zone of *Anthracomya pulchra*, and it has been placed beyond all reasonable doubt that Skipseys Marine Band is the Scottish equivalent of the well-known Mansfield bed. The statement "according to his [Hind's] identifications the fresh-water lamellibranchs in one seam at Shettleston, near Glasgow, include those of the three lowest of the six Coal Measure zones of the English Midlands established by Trueman and Davis" (*sic*) cannot be checked in the absence of a reference; while recent work on the Coal Measures lamellibranchs in the Scottish coalfields confirms the value of the zonal studies initiated by Dr. Trueman and his co-author, and successfully applied by numerous workers in British coalfields. In regard to the Barren Red Measures of Scotland which have been proved to fall within the zones of *Anthracomya phillipsi* and *A. tenuis* in Ayrshire, no mention is made of them, but the passing reference to their equivalents in Lanarkshire in the chapter devoted to Permian rocks is, to say the least, not helpful.

The reference to the succession in the Kent coalfield is also faulty. Neither Lanarkian rocks nor Lower Carboniferous beds of Pendleside facies are present; on the contrary, Coal Measures of Yorkian age rest with marked unconformity on Lower Carboniferous Limestones. Nearly every reference to South Wales in this chapter and throughout the book is definitely erroneous.

It is decidedly unfortunate that the printer's imp has been unusually busy. Some of the errors of spelling are harmless, but others are likely to mislead the reader. To mention one: *Cœnograptus* is quoted as a Cambrian graptolite. It seems a pity that the book, the compilation of which must have entailed an immense amount of labour, should have so many blemishes, but one may hope that in a second edition most of these will have disappeared. J. P.

The New Surveying.

Surveying from Air Photographs. By Capt. M. Hotine. Pp. xi + 250 + 8 plates. (London: Constable and Co., Ltd., 1931.) 30*s.* net.

IT was chiefly due to the War that surveying from air photographs emerged from the state of being an ingenious but not very serious or practical method, into the condition of being in certain cases indispensable and in many cases of genuine value, and, it may be added, in all cases to be reckoned with. The history of the method ante-dates the invention of aeroplanes. It had been used with comparative success from balloons; and, in the British service, it was the late Col. Elsdale who developed the use of small free balloons, which travelled a sufficient distance to allow a series of plates to be exposed, and then upset themselves and came down to the ground. Photographs of this kind were taken so long ago as 1885.

Since then, as we all know, enormous progress has been made, and those who desire to learn the present condition of this up-to-date art cannot do better than study the admirable volume by Capt. Hotine which is here under review. From the author's preface we shall learn that the object of the book is to describe the way of constructing a map, plan, or detailed description of any portion of the earth's surface by the use of photographs taken from the air. The various chapters deal with such branches of the subject as the general characteristics of air photographs, their interpretation, their economic uses, and such matters. But the bulk of the book is, of course, taken up with discussion of perspective problems, surveying cameras, and, above all, with the employment of stereoscopic methods. In fact, it may be said that the chief change that has taken place in recent times has been the increasing use of the stereoscope for the measurement and interpretation of pairs of photographs taken in the air at short intervals of time.

We are early introduced to stereoscopic pairs, air bases, overlaps and time intervals, lateral and forward obliques, strips, and such details, all very clearly explained. The difficulties inherent in the method are not ignored; for example, the author remarks that at present "the problem of obtaining an accurate measurement of level during flight must be considered as definitely unsolved". In the same way, he points out that aeroplanes cannot, for surveying purposes, be flown economically on courses which are generally north and south. He points out, also, that there is a difficulty in interpreting the features of the ground and in identifying objects, because, at a great height, the landscape appears almost monochromatic. This leads to the dictum that much is to be lost by attempting the interpretation of single photographs; "it is a safe rule to use the stereoscope on all occasions".

Valuable information is given as to the scales that can be economically used for maps constructed from air photographs. The conclusions are that the largest scale is about 1 : 2000, that is, about 30 inches to the mile. The smallest scale which

the method can produce is about 1 : 30,000, that is, about 2 inches to the mile. Very large scales and very small are equally unsuitable. The small scale above mentioned involves the use of a 7-inch lens at a height of 18,000 feet.

An interesting section is devoted to the description of the Canadian 'grid' method, in which high, oblique, single photographs are employed; each photograph shows the visible horizon near its top edge; this horizon line, corrected for curvature and refraction, is used as a line to measure from, and a suitable standard, perspective, straight-line grid is superimposed: the plan can then be drawn by simple rectification of the oblong spaces of the grid—an eminently simple and practical device for the mapping of a flat country like much of the territory of that great Dominion. These photographs are taken with a bare minimum of ground control, from a height, as a rule, of 5000 feet.

This case must, however, be looked upon as exceptional. In general, stereoscopic methods would nowadays be employed. In addition to more certain identification than single photographs can give, the method provides a means of fixing relative heights and of contouring. Much space is rightly devoted to an account of stereoscopic methods and instruments. Descriptions of instruments are always difficult to follow without constant reference to the instruments themselves, and it is no slur on this admirable book to say that these sections will be of special value to the student who has the instruments at hand for reference.

Mathematical sections deal with perspective and the theory of mapping from stereoscopic pairs. Some of this is rather difficult reading—from the nature of the case—and it may, perhaps, rather frighten the 'practical' man. It might have been relegated to an appendix. However, as the author remarks in his preface, the reader who mainly desires to learn practical methods can, if he likes, skip all the mathematical chapters, without losing anything of practical application. The book is, indeed, a very thorough piece of work, and is an indispensable textbook of modern practice in the application of air photography to surveying. This application is by no means so simple as might appear at first sight, and if anyone should think that he could conduct an air survey by the light of Nature, without considering past theoretical studies and practical experience, a reference to this book should go far towards undeceiving him.

C. F. C.

Viscometry.

A Monograph of Viscometry. By Dr. Guy Barr. Pp. xiv + 318. (London: Oxford University Press, 1931.) 30*s.* net.

THE author begins his preface by commenting on the striking disproportion between the small number of works devoted to the subject of viscosity and the enormous number of papers which deal with one or the other of its aspects. Such books as there are give a limited space only to methods of measurement, and the author has felt "that there was need of a book devoted entirely to viscometry, in which an investigator would be able to find some account of most of the schemes which have been applied and some indication of the theoretical and practical difficulties that affect each of them".

Such a book has certainly been lacking, and the author has been completely successful in supplying it and in filling a curious lacuna in the literature of physics. After a brief introductory chapter dealing with fundamental concepts and historical development, he proceeds to develop very fully the theory of viscous flow through cylindrical tubes, and of the corrections which have to be applied in deducing viscosity coefficients from measured rates of flow. Three chapters are devoted respectively to tube viscometers for absolute measurements, commercial absolute viscometers, and capillary viscometers for relative measurements. The treatment is extremely complete: all the conditions to be satisfied and corrections to be applied are set forth clearly; the reader will certainly, as the author suggests, get the impression that absolute viscosity measurements in the strict sense present "a problem calculated to tax the resources of the best equipped physical laboratories". His relief at finding that nowadays relative determinations will generally be adequate may be tempered on reading the chapter describing the instruments for this purpose, and on discovering that many precautions and corrections are necessary which have been neglected in the numerous investigations carried out with the—all-too-convenient—Ostwald viscometer.

The commercial viscometers are classed as 'absolute' because "their standardisation depends in the first place on dimension", although, in practice, calibration is generally necessary. They are treated as fully as the laboratory instruments with long tubes, and standard specifications of the Redwood, Engler, and Saybolt instruments, as well as conversion tables, are given in appendices.

A chapter is devoted to the transpiration method

of determining the viscosity of gases; the equations for a compressible liquid, for which the pressure gradient is no longer constant, are deduced, and various types of apparatus described in detail.

Flow between parallel plates, which is rarely mentioned in the literature of viscosity, also receives attention. As the basis of a method of measurement, it shares with the concentric cylinder system the inconvenience that, while the mathematical treatment is simple for infinitely extended pairs of surfaces, the introduction of boundaries, necessary in practice, causes serious complications.

In the discussion of the falling sphere method, the corrections to Stokes's formula introduced by Oseen and the more recent work of Faxen are fully considered. The method is perhaps the most striking instance of the restrictions imposed by purely technical factors on the practical application of a theoretically simple procedure: in this case, the difficulty of obtaining accurate spheres other than the steel balls used for bearings.

"Rotational and Oscillational Viscometers" include many types which have been used occasionally only: for example, the circular disc oscillating in its *own* plane in Maxwell's classical investigation on the viscosity of gases, and in some early work on the variable viscosity of colloidal solutions. The various types of concentric cylinder instruments, which alone have found somewhat extended use, are all described and discussed fully.

The book concludes with a chapter on "The Study of Anomalous Systems", in which the peculiarity of disperse systems, namely, a decrease of the viscosity coefficient with increasing velocity gradient, and the instruments designed specially for studying it, are briefly but adequately described. The author unavoidably touches on the question whether a special name is required for this property and seems to favour "apparent viscosity". He remarks in this connexion: "The early successes of Bingham's hypothesis of plastic flow led many workers to adopt the term plasticity to distinguish the property in question, both of lyotropic sols and of suspensions, from the viscosity of normal liquids". This practice was almost entirely confined to the United States, where many systems were described as 'plastic', the published flow-pressure diagrams of which certainly do not conform to Bingham's fundamental assumption; in a few years the term will presumably go the way of 'colloidal behaviour', which at one time was so widely borrowed from J. Loeb.

The author has made an admirably complete selection from a peculiarly scattered literature and has presented it critically and lucidly. It deserves to be widely read, and while it is too much to hope that everybody who has to make viscosity measurements will study it with due care, it may induce a few workers to carry them out with the necessary care and precautions—or to refrain from publishing them.

The printing and illustrations conform to the general high standard of the publishers, and proof-reading has been done with exceptional care.

EMIL HATSCHEK.

Nature of Chemical Forces.

Radioelements and Isotopes: Chemical Forces and Optical Properties of Substances. By Kasimir Fajans. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vol. 9.) Pp. x+125. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 12*s.* 6*d.* net.

PROF. FAJANS' Cornell lectures form a very small volume in comparison with those provided by former holders of the Baker lectureship, since they cover only 113 pages of text. The reason for this is a wish to avoid republication of material which is already in print. Thus a course of lectures on radioactivity and isotopy has been omitted, because these subjects are dealt with in existing books by the author and others; but one of the most interesting of current problems is discussed fully in a chapter on the origin of actinium. The conclusion is drawn that this element has an atomic weight of 227 and must, therefore, be entirely distinct from the radium and thorium series, where all the atomic weights are *even*, thus giving rise to radium lead, Pb^{206}, and thorium lead, Pb^{208}, which have both been separated in an almost pure state from minerals rich in uranium and thorium respectively. Strong confirmation of this conclusion is supplied by Aston's observation that lead actually contains the third isotope, Pb^{207}, and we may, therefore, now accept also the further deduction that actinium has its origin through protactinium in an odd-numbered isotope of U^{238}.

Apart from the twenty-four pages occupied by his in teresting chapter, the book contains an introductory lecture on "The Development of Views regarding the Nature of Chemical Forces", and seven chapters on "Chemical Forces and Optical Properties". These chapters are naturally devoted in the main to a summary of the author's experimental work on the refractive indices of crystals of the alkali halides and related substances as evidence of the deformability of ions, but they also contain

the arguments which he uses as evidence of the existence of transitional states between the ionic linkage, which is the common type in mineral salts, and the non-ionic linkage of organic compounds.

Arguments based on the feeble electrolytic conductivity of fused halides, such as aluminium chloride, carry little or no weight, since intermediate degrees of conductivity between those of fused sodium chloride and of liquid carbon tetrachloride must be expected in all those cases in which a covalent complex undergoes reversible ionisation. A more plausible argument can be based upon the difficulty of determining the type of linkage in compounds such as zinc sulphide and silver iodide, which crystallise on a diamond lattice, since it is not easy to admit that the reversible ionisation of covalent bonds is a normal state of affairs in a crystal; and at the absolute zero this process appears to be impossible. The argument is weakened, however, by including gaseous hydrogen chloride amongst the transitional compounds, since it is obvious that the proton cannot persist as a free ion, but must be enveloped by the planetary electrons of the halogen, thus giving rise to a definitely covalent compound. It differs from gaseous hydrogen, however, in the readiness with which (by reason of the stability of the octet of the chloride ion) the proton can be transferred to a molecule of water.

A similar condition appears to exist in stannic chloride, which has all the attributes of a covalent compound, until it is dissolved in water, when it is ionised reversibly, perhaps by co-ordination with the solvent as indicated by the equation:

$$SnCl_4 + H_2O \rightleftharpoons [SnCl_3 \cdot OH_2]^+ + Cl^-.$$

Whilst, therefore, the *absence* of intermediate forms of linkage may still be open to question, more evidence appears to be required before their *presence* can be regarded as established.

The two concluding chapters deal with the adsorption of ions on salt-like crystals, with applications to volumetric analysis and to photochemistry. These applications have a direct practical value; but the theories on which they are based and which they serve to illustrate are also of fundamental importance, since the obscure notions of electrical double-layers, which were both puzzling and repulsive to students of a former generation, become both simple and clear when discussed in terms of an unequal distribution of ions of opposite signs. The book will therefore be read with interest, not only by those who had the privilege of hearing the lectures delivered, but also by many others who will be glad to have the most important of their contents set out in so concise a form.

Paper Making.

The Digestion of Grasses and Bamboo for Paper-Making. By W. Raitt. Pp. xi + 116 + 20 plates. (London: Crosby Lockwood and Son, 1931.) 21*s*.

THE rapid expansion in the demand for paper and for newsprint consequent on the spread of education, as well as the habit of wrapping everything up in several coverings of paper or cardboard, is a fact which, besides its special significance as an index of progress, causes concern to those who have to find new raw materials for the paper-maker. Commencing in the period of intellectual revival after the Napoleonic wars, when the consumption of paper per head in Great Britain was only an ounce or so per annum, the demand has continued until to-day it has been estimated at more than 70 lb. a head.

In America the consumption is still greater, and the world's annual requirements are in excess of twenty million tons. The English Education Act of 1870 is said to have multiplied consumption by ten within ten years. Little wonder that the demand has outstripped the supplies of raw materials, at first of rags and then of cereal straws first introduced in 1860. Esparto came to the rescue in 1860, but the economic radius of its collection was reached thirty years ago, and the production since has been very regular. Wood pulp first appeared about 1866–70 and has held the field until now, during a period in which a large part of the world's timber resources has been cut, so that to-day great anxiety is expressed for future supplies. The annual cut in the United States is four times the annual growth; in Canada only some twenty-five per cent of the original forest wealth is left. Obviously, if the expansion in demand continues, as it will, for cellulose has become a raw product of so many other industries, in particular artificial silk, which has almost unlimited potentialities, new sources of supply will have to be found.

It is obvious that trees are too slow growing to maintain supplies; some pulp wood is a forty years' crop; twenty-five to thirty years is required in Canada to bring a spruce tree to pulp wood size, though in the south with the loblolly pine it is now said to be possible to grow pulp wood in ten years.

The future obviously lies with the grasses, particularly the bamboo, if once satisfactory pulp can be obtained from it. In the past, troubles were experienced in the digestion and bleaching of

bamboo cellulose, mostly because the work had been carried out empirically, without the scientific assistance of the chemist, and it is largely owing to the systematic work of Mr. Raitt that these difficulties have been overcome.

For twenty-five years, in part assisted by the Government of India, Mr. Raitt has made an exhaustive and scientific study of the subject, with the result that the problem of the utilisation of the bamboo has been largely solved. Culms of all ages, including the nodes, can be digested, mixed together, with a soda consumption of 16 per cent on the weight of bamboo, and a bleaching powder use of 8 per cent on the pulp at a pressure of 30 lb. of steam, the process only taking 5 hours. A yield of 45 per cent of unbleached and 42 per cent of bleached pulp is obtained by this process.

The book under review is a complete epitome of the subject based on Mr. Raitt's own practical experience; it deals with the analysis, the digestion in the autoclave, and all the practical problems arising out of the treatment in large scale operations, and contains an attractive account of the occurrence and growth of the bamboo. A section devoted to the microscopic features is illustrated with twenty plates.

The world's total standing crop of bamboo is enormous. In Burma alone an annual crop of 150 million tons is talked of, much of which could be easily exploited commercially, so that if suitable pulp really can be made from it, a supply which is inexhaustible can be obtained from materials which have no value for any other purpose.

E. F. Armstrong.

The Teaching of Mathematics.

Craftsmanship in the Teaching of Elementary Mathematics. By F. W. Westaway. Pp. xvi + 665. (London and Glasgow: Blackie and Son, Ltd., 1931.) 15*s*. net.

SOME four hundred pages of this book are given to the elementary parts of mathematics, from the first four rules of arithmetic up to the standard of a school certificate. The treatment is varied, but often takes the form of outlined specimen lessons; it is full of useful hints about the details of teaching, and is sure to be welcomed by a large body of teachers.

Mr. Westaway's attitude is that of a moderate reformer. He is very far from wishing to impose stereotyped methods on teachers: so much so that sometimes a piece of good advice is given with insufficient emphasis—for example, "it is doubtful if the term infinity ought to be used below the Sixth". What he cannot abide is the slavish adoption of doubtful forms of traditional procedure. His standard of what a boy ought to know is very high; we read, for example, that fourth form boys are prone to forget the factors of $a^4+a^2b^2+b^4$. The excursions into logic are not very successful, though there will be general agreement with what is said about its restricted place in elementary teaching.

In spite of such blemishes, the book will undoubtedly be of great value to the inexperienced teacher; and not to him alone, for there is much that will be helpful to the master responsible for organisation. The importance of the teaching of the lowest sets is insisted upon, and there are useful suggestions about the non-specialists in the sixth form. There are interesting chapters on wave motion, map projections, and statistics, and some shorter ones on subjects like astronomy and optics; these will serve to remind the organiser of some topics that are often neglected.

Mr. Westaway's experience of the teaching of mathematical specialists would seem to have been unfortunate. He has sometimes been "almost bored to tears . . . with the petrifying stuff doled out . . . which is virtually the same as forty years ago". The development of calculus teaching with its applications to mechanics, the improvements in analytical methods and the freer use of projective methods in geometry, and the mitigation of 'identity' work in algebra and trigonometry, are a few indications that specialist teaching is not, as Mr. Westaway seems to think, being stabilised at the level of 1890.

Thus it may be expected that the specialist part of the book will be less valuable than the other. There are, it is true, still useful hints to be found, but the material and treatment smack of the nineteenth century rather than of the twentieth. For example, the "principle of continuity" is quoted from a textbook that appeared in 1893, and although we are told that pupils must understand the notion of a limit, we find, elsewhere, the archaism "when Q coalesces with P, the angle becomes a right angle". Again, the Argand treatment of complex numbers is prefaced by the reactionary proposal to "define the symbol $\sqrt{-1}$ as an expression whose square is -1".

Many references to other books are given, and there is an interesting questionnaire for young teachers which will tax the powers of many of their seniors.

Short Reviews.

Anthropology and Archæology.

Early Man: his Origin, Development and Culture. Lectures delivered for the Royal Anthropological Institute. By G. Elliot Smith, Sir Arthur Keith, Dr. F. G. Parsons, M. C. Burkitt, Harold J. E. Peake, Dr. J. L. Myres. Pp. xii + 176 + 12 plates. (London: Ernest Benn, Ltd., 1931.) 8*s*. 6*d*. net.

In 1929 the Royal Anthropological Institute inaugurated courses of open lectures of a popular character, of which the first series dealing with early man, delivered in the winter session 1929–30, is published in this volume. Of six lectures in all, three deal with the origin and descent of man from the point of view of the physical anthropologist, and three with aspects of the beginnings of culture. Of these latter, that by Mr. Miles Burkitt on "Most Primitive Art" is printed in abstract only, but compensation for the lack of a fuller development of his demonstration of the method of study by 'art groups' is forthcoming in the examples from French and Spanish caves and from South Africa, which have not been published previously.

On the physical side; Prof. Elliot Smith deals with the origin of man. Happily for his readers, while the volume was passing through the press, he was able to add to the lecture, as originally delivered, his conclusions on the place of Peking man in relation to other relics of early man, based on discoveries afterwards made at Chou Kou Tien. Sir Arthur Keith deals with the evolution of races in the past and in the present, and Dr. F. G. Parsons summarises the anthropological history of the modern Englishman, analysing the physical characters of different racial types that have gone to the make-up of that remarkable hybrid.

Of the remaining two lectures dealing with early culture, Mr. H. J. E. Peake on the beginnings of agriculture summarises the present position of research on the origin of cultivated grains, with special reference to wheat and barley, and discusses its bearing on the problem of the antiquity of civilisation in Egypt and Mesopotamia. The course of lectures closed with Prof. J. L. Myres's lecture on the discovery and early use of metals, which appears here in much extended form. Of two chapters, one deals with the 'precious' metals and the second with the 'useful' metals, with a wealth of illustration and commentary which ranges widely over the whole field of early culture and belief. The lecture is as delightful to read as it is informative.

Index of Potters' Stamps on Terra Sigillata "Samian Ware". By Dr. Felix Oswald. With a Supplement (to be consulted in conjunction with the Index) of Stamps obtained or recorded during the Period of printing the Index (with Corrections). Pp. xxiii + 428. (East Bridgford, Notts.: The Author, Margidunum, 1931.) 36*s*.

Dr. Felix Oswald's index to the potters' stamps on Terra Sigillata is an achievement in more senses than one. Owing to the difficulty of obtaining a publisher for a work of so highly specialised a character and the expense of private publication, the author has himself set up and printed the whole on a hand press. It has been the work of his leisure over a period of three years. The result is a credit to his knowledge of typography; and students of Roman provincial cultures are doubly indebted to him for carrying to completion this laborious but indispensable task, by which he supplements and completes the study of sigillata ware published by him in collaboration with Dr. T. Davies Pryce eleven years ago.

With the supplementary list of marks which have accrued in the past three years while the main body of the work was being printed, Dr. Oswald has now brought the list of potters' stamps completely up to date; but he has also added to the stamps previously published in the lists in the corpus of inscriptions, which goes up to 1906 only, the place and period of the potter and the form of the vessel on which the stamps occur, particulars essential for the archæologist but omitted from these lists. The index itself is of highly specialised interest, but as Dr. Oswald indicates in his preface, an examination of the stamps yields much information broadly of interest to archæologists, such as the movements of trade from Gaulish and German factories, the origin and place of work of the potters, their partnerships and nationalities, and even, in some cases, their personal characteristics.

An Introduction to the Sociology of Islam. By Reuben Levy. (Published for Herbert Spencer's Trustees.) In 2 Volumes. Vol. 1. Pp. viii + 410. (London: Williams and Norgate, Ltd., 1931.) 21*s*. net.

This volume is the first of a series to be published by the trustees of Herbert Spencer's will in continuation of his "Descriptive Sociology". Up to a point, Islam lends itself to the treatment which Spencer planned. Mohammedan communities have common characteristics based on their religion which make it possible to treat them as a unit. That unity, however, is no more than formal, and unless the treatment of the subject is to be allowed to expand to an almost inordinate length, local differences must be ignored, especially in outlying regions, such as Zanzibar and Malaya for example, where earlier custom and animistic belief have coloured practice. Mr. Levy has not passed over such differences entirely, but has been able to refer to them only in selected instances.

In his first volume now published, Mr. Levy, after an historical introduction which sketches the growth of Islam and its territorial extent at various periods of its history, analyses the effect of its religion on the life and organisation of society. He covers the grades of society, the status of the woman and the child, jurisprudence, and the caliphate and central government. The form of government in the independent Islamic provinces, ethics, philosophy, and science are being dealt with

in a second volume. Students and others interested in Islam will be grateful for this convenient and compendious survey. Very full bibliographies appended to each chapter serve as a guide to closer study.

Biology.

Journals of Gilbert White. Edited by Walter Johnson. (Broadway Diaries, Memoirs and Letters.) Pp. xlviii + 463 + 4 plates. (London: George Routledge and Sons, Ltd., 1931.) 21*s.* net.

Gilbert White's "Natural History of Selborne", 1789, is a book which stands alone as the work of a charming, kindly old bachelor, naturalist, and poet. It is simple and happy, full of the joy of life, and has a fine literary style of its own; it will probably be for all time the premier work on the natural history of any part of England. The "Natural History" was largely culled from White's *Garden Calendar*, published in full by Bowdler Sharpe in his edition of Selborne, 1900, and from the *Naturalist's Journal*, begun in 1768. The latter is now published for the first time, and it is ably edited, so that passages already used by White are eliminated. But why is it published at all? It was not written by White to be published—and we feel that he would have been very averse from doing so. It adds nothing to White's fame, gives no fresh picture of his life and times, and relatively few natural history observations of value to-day. It was proper to preserve it in the British Museum, but we feel that it would have been preferable to allow it to remain in its honoured obscurity.

An Introduction to Zoology. By P. W. Gideon. Pp. vi + 90. (Dharwar: Students' Own Book Depot, 1930.) 5.8 rupees.

The title of the present book gives no indication as to its nature. It is really a laboratory guide, which in size and the arrangement of the plates recalls Howes's "Atlas of Biology", and is intended for use in the intermediate science classes of the Indian universities. There are twenty-one chapters, some general, but most deal with a series of animal types, from Amœba to the frog. Each chapter contains a general introduction, one or more plates of figures, and several pages of notes arranged in a schematic way. By means of these notes a very large amount of information is conveyed in a limited compass. Considering that it was printed in a small centre, it is well done, but it contains a number of typographical errors. The drawings are clear and well reproduced. In addition to the usual information regarding the types, there are also classifications of the phyla and main groups to which the different animals belong.

The book should prove useful to the students for whom it is intended, and has much to commend it. The danger lies in the student allowing its drawings and notes to replace his own, and in 'cramming' from it instead of relying upon fuller texts. The author has obviously spent considerable time and thought in planning the work, and it will not only assist the student in the laboratory but also help him to arrange his information and to revise his work.

Flora of West Tropical Africa: the British West African Colonies, British Cameroons, the French and Portuguese Colonies south of the Tropic of Cancer to Lake Chad, and Fernando Po. By J. Hutchinson and Dr. J. M. Dalziel. Prepared at the Herbarium, Royal Botanic Gardens, Kew, under the supervision of the Director. Published under the authority of the Secretary of State for the Colonies. Vol. 2, Part 1. Pp. iii + 292. (London: The Crown Agents for the Colonies, 1931.) 8*s.* 6*d.*

In part 1 of vol. 2 of this "Flora", thirty-three families of Gamopetaleæ are considered. From the economic point of view none is of very great significance, but botanically speaking there are several of great importance, notably the Rubiaceæ and the Compositæ. These two account for seventy-three and seventy-two genera, and 465 and 192 species respectively. The former has also the most prolific genus in *Psychotria*, which is represented by fifty-two species in this region. Altogether the thirty-three families present 420 genera and nearly 1600 species; of the latter 102 are new, and there are two new varieties and forty-nine new combinations.

The co-operation of Miss M. B. Moss was obtained for the preparation of the Myrsinaceæ and the Loganiaceæ and of Mr. A. Bulloch for the Solanaceæ.

An interesting fact in plant distribution is the considerable number of species common to this tract and to India, especially the south-west of that country. Strangely, however, *Avicennia officinalis* Linn., which is present in the mangrove swamps of India and East Africa, is not found; the genus here being represented by *A. nitida* Jacq.

Plant Physiology: with Reference to the Green Plant. By Prof. Edwin C. Miller. Pp. xxiv + 900. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 35*s.* net.

In the preface of this book, which he describes as an advanced text in plant physiology, the author points out that the various European textbooks usually fail to deal adequately with the work of American and English plant physiologists. In this book American and English work is very adequately covered, whilst continental work is by no means neglected.

The field of plant physiology is very well covered; a beginning is made with the cell, the entry of water and solutes are then considered and the loss of water from the plant, metabolism, translocation, respiration, growth. Directional growth responses (tropisms) receive very scant attention. The treatment of every subject is comprehensive and clear and the citations of literature, especially modern work, very full, but little attempt is made at a critical appraisal of this great mass of material which, to many students, may prove bewildering rather than illuminating.

Manual of Bacterial Plant Pathogens. By Charlotte Elliott. Pp. ix + 349. (London: Baillière, Tindall and Cox, 1930.) 22*s.* 6*d.* net.

THIS volume is the outgrowth of a card-index on bacterial parasites of plants accumulated by the author and is presented in the form of short summaries of the characters of the organisms and of the disease produced, together with remarkably complete bibliographies of each pathogen.

The book is divided into three parts; the first part, which forms three-quarters of the whole volume, consists of a list of all known bacterial pathogens arranged in alphabetical order, the classification adopted being E. F. Smith's modification of Migula's system. The second part comprises a list of organisms described as commonly found in association with pathogens, but not themselves parasitic, while the third part consists of a chart of the chief characters of the organisms arranged in chronological order of discovery. This last would have been of much more use if the arrangement had been alphabetical, as in the body of the text.

As a source of reference, particularly to the literature, the book will prove of great value to all plant pathologists. R. H. S.

Pflanzenmikrochemie: ein Hilfsbuch beim mikrochemischen Studium pflanzlicher Objekte. Von Dr. A. Tunmann. Zweite vermehrte und verbesserte Auflage bearbeitet von Prof. Dr. L. Rosenthaler. Pp. xxiii + 1047. (Berlin: Gebrüder Borntraeger, 1931.) 75 gold marks.

THE new edition of this well-known book on plant micro-chemistry has been considerably enlarged under the editorship of Prof. Rosenthaler of Bern.

To the general section of the work has been added a section upon micro-manipulation in which, as also in the description of methods of counting and measuring under the microscope, Dr. Ehlers of Jena has collaborated. Sections are also added upon urea, compounds of uronic acid, vital staining, membrane pigments in the mosses, pigments of fungi and bacteria, etc. The citations of literature in the footnotes continue to be very extensive, and the account in small type, which accompanies the different substances discussed and analyses their distribution in the plant kingdom, also remains a very satisfactory feature of this comprehensive and valuable laboratory reference book.

Physiology.

(1) *Ultra-violet Radiotherapy.* By Dr. W. Kerr Russell. (Modern Treatment Series.) Pp. 130. (London: Jonathan Cape, Ltd., 1930.) 5*s.* net.

(2) *Therapeutic Uses of Infra-red Rays.* By W. Annandale Troup. Pp. viii + 58 + 16 plates. (London: The Actinic Press, Ltd., 1930.) 5*s.* 6*d.* net.

THE electromagnetic waves which have found a place in therapeutics extend over a considerable portion of the spectrum, from the γ-rays of radium and the X-rays of short wave-length, through the ultra-violet to the infra-red rays, of long wave-length. In 'light' treatment, the ultra-violet rays play an important part, although their sources used in practice usually emit heat waves also; in 'heat' treatment, the action is due to the long infra-red waves, although the source used may emit visible light rays at the same time.

Light and heat treatment have been employed in a great variety of diseases with benefit in many cases, but as with other kinds of treatment, experience is necessary, and overdosage has unpleasant after-effects. The value of the treatment can only be determined by observation of the results obtained, which depend on the technique adopted as well as on the variable responses of different patients. Hence precise descriptions of technique and the results observed in different diseases are of value in enabling physicians to select those cases which are likely to be benefited by the treatment.

In both the little books before us, the authors describe their technique and their results. Dr. Kerr Russell considers that ultra-violet radiotherapy is almost a specific in certain diseases, and a useful adjuvant to other methods of treatment in many others. Dr. Annandale Troup's book is the first published in Great Britain devoted specifically to the therapeutic uses of infra-red rays; he prefers a low temperature generator, which he describes in detail. The rays are of value in chronic rheumatic conditions, and in sprains and other injuries they can be used in conjunction with ultra-violet radiotherapy.

These books should be of value to those employing this treatment and to others who wish to have some knowledge as to the type of case which it may be expected to benefit.

Bread: a Collection of Popular Papers on Wheat, Flour and Bread. By Harry Snyder. With Biographical Sketch by Andrew L. Winton. Pp. x + 293 + 20 plates. (New York: The Macmillan Co., 1930.) 10*s.* 6*d.* net.

HARRY SNYDER, who died at Minneapolis four years ago, had many friends and admirers in Great Britain. In the United States he was known as the champion of pure white flour and the outstanding man of science in the milling industry. This book contains a biographical appreciation of him by Andrew L. Winton and a series of papers on bread and cognate subjects which are considered of such value as to be of wide interest.

Snyder's theme was the rightful place of bread in the human diet: his conclusions are as valid to-day as when they were first written. The papers form a most valuable source of information on all that concerns bread and flour and wheat, and they are worth a place on the shelves of everyone interested in preserving this source of our food in a pure state. It is a matter which will always require watchful care; Snyder himself did not a little in attacking fallacies concerning food values which were being exploited by the aid of generous advertising. E. F. A.

Psychology.

The Mental Defective: a Problem in Social Inefficiency. By Dr. Richard J. A. Berry and Dr. R. G. Gordon. Pp. xi + 196 + 8 plates. (London: Kegan Paul and Co., Ltd., 1931.) 8*s.* 6*d.* net.

It is almost impossible for a lay mind to form any conception of the tremendous financial drain on the country's resources caused by the socially inefficient or higher grade mental or moral defective. Dr. Berry and Dr. Gordon have set out, in their book, to give a plain and straightforward account of the various grades of mental defective, so that the lay mind may understand the most difficult of social problems, the elimination of the defective from our midst.

The authors provide us with three preliminary chapters—the two on the evolution of brain and the making of mind being particularly well set out, although it is very doubtful if the most educated layman will understand what the authors mean when they describe the "synaptic junction between the axon of the connectant or internuncial neurone and the dendrons of the effector neurone". The anatomy is really too complicated for a layman. The photographs of the higher-grade defectives give a false impression. It is notoriously difficult to pick out defectives from photographs, if not actually impossible.

The best chapter in the book is that dealing with policy. This chapter ought to be read by all members of county councils dealing with the defective in their midst. The running of model colonies for defectives and, more important still, for border-line cases who are socially inefficient is a step in the right direction, but one which, we feel, will take a long time to penetrate to the right quarter.

Brain and Mind. By Arthur Lynch. Pp. 36. (London: The Pioneer Press, 1931.) 6*d.*

When philosophical conclusions are categorically expressed in the first person, it shows that their author is in earnest. Yet individual convictions, however strong, can scarcely pretend to carry universal assent. Philosophers, in particular, are hardened people: the very history of their subject compels them to be sceptical as to the decisive value of any particular system. To base a philosophical theory on the assertion that "psychology is the matrix of the sciences" is nothing new in itself. Scores of psychological schools are attempting the same thing from various angles; while in the more abstract domain of thought, the Russellian and the Brouwerian interpretations of mathematics and logic, in spite of their conflicting results, have shown some remarkable specimens of analysis of mental processes. The claims of Col. Lynch need therefore strong justification: the position of their author will be much clearer if he himself confronts his conclusions with those of other schools of thought. Otherwise an unassuming critic is bound to find in them some vague reminiscences of earlier readings. T. G.

The Will to Live: an Outline of Evolutionary Psychology. By J. H. Badley. Pp. 267. (London: George Allen and Unwin, Ltd., 1931.) 10*s.* 6*d.* net.

The author gives us what he considers is a useful dissertation on psychology in general, suitable for boys and girls who have just left, or are about to leave, school. We think a better title might have been chosen; comparatively few children of school-leaving age show any great interest in 'the will to live', but might be very interested in modern points of view in psychology simply told. The book is very well laid out and, generally speaking, presents a very readable account of psychology. We should prefer to see the word 'complex' used in its narrower meaning; in ninety per cent of cases when the word complex is used in modern psychology it refers to what the author would prefer to term a 'buried complex'. We think the author might have given a rather fuller account of Adlerian theories, for they appeal considerably more to the lay mind as a distinctly healthier view than either those of Freud or even Jung.

Agriculture.

Principles of Tropical Agriculture. By Dr. H. A. Tempany and G. E. Mann. Pp. 328 + xxiii. (Kuala Lumpur: The Incorporated Society of Planters, Malaya, 1930.)

Most books published in English on agriculture in the tropics seem to assume that the greater part of the tropical zone has a high and constant rainfall, and that the so-called 'planting crops' form the chief agricultural enterprises in the hotter parts of the world. The result is to give a very unreal picture of tropical agriculture. The present book is no exception to this rule. It has been written as a textbook of general principles to be taught to students in Malaya. For this purpose it is, on the whole, very well suited, for the conditions with which it chiefly deals are those found in this typical wet tropical area. On the other hand, the portions dealing with the far more frequently occurring dry tropical conditions are very perfunctory, and it is doubtful whether the book should be recommended to a student whose future interest is likely to lie in such areas.

One at least of the authors has had very wide experience in the West Indies, Mauritius, Java, and Malaya, and hence, naturally, the chief tropical data cited are from these areas. It is rather a pity, however, that these have not been supplemented to a greater extent from the work done and information obtained in West and East Africa and, particularly, in India—especially as regards soil conditions and manurial methods found useful there, even with the type of crop and condition with which the book chiefly deals.

For the narrow purpose for which it has been chiefly written, the book will probably be found of great use, and an advance on anything hitherto available; but as a general manual of the principles on which tropical agriculture is based it will be found of comparatively little service. H. H. M.

The Culture of the Orange and Allied Fruits. By Prof. H. Clark Powell. (South African Agricultural Series, Vol. 8.) Pp. 355 + 83 plates. (Johannesburg: Central News Agency, Ltd., 1930.) 21*s.* net.

In 1913 the exports of citrus fruit from South Africa amounted to 70,000 cases; by 1929 this had risen to 1,200,000. At the present time only 22 per cent of the citrus trees in the Union of South Africa are more than eight years old. Citrus groves are established from the Zoutpansberg, in the north of the Transvaal, to Uitenhage, in the extreme south, and Clan William, in the extreme west of the Cape of Good Hope. Such are the very varying climatic and soil conditions under which this young industry is established. There is no well-defined citrus area such as exists in Florida and California. So far as possible, the author has drawn on South African experience, and much information has been collected from the successes and failures of the past. Where South African experience does not exist—and a large amount of research and investigation is shown to be still necessary—the author has of necessity to draw on work done elsewhere.

The book deals in a thoroughly practical manner with all aspects of citrus growing, and should prove a great help to the grower and the industry in general, besides being a valuable addition to citrus literature. A short account is given in the concluding chapters of citrus culture in other parts of the world.

Economics.

Youth and Power: the Diversions of an Economist. By C. R. Fay. Pp. ix + 292. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 10*s.* 6*d.* net.

In this book Mr. C. R. Fay discourses on a wide range of subjects, including topics so varied as the outlook of youth, trade unions, Adam Smith and foreign trade, unemployment, immigration, and the psychology of revolt. Its scope is thus better indicated by the sub-title, "Diversions of an Economist", rather than by the main title. A special interest is attached to Mr. Fay's reflections, since he has had exceptional opportunities of studying conditions in Great Britain, Canada, and the United States. In discussing unemployment, for example, he is thus able to contrast conditions in various countries. In France there is a great degree of economic stability, due largely to her agricultural democracy, but in Great Britain technological unemployment, which is distinctively American, has been added to various pre-War causes. These, playing upon Britain's peculiar post-War situation, have produced a position in which one industry after another is depressed. The present problem, in his view, is one of readjustment to a new world balance which calls for an unusual degree of co-operation between employers and employed. The book as a whole is very readable and should interest the general reader as well as the professional economist.

Britain and World Trade: Quo Vadimus and other Economic Essays. By A. Loveday. Pp. xxi + 229. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 10*s.* 6*d.* net.

This volume consists of a series of essays written at various dates and now collected in book form. The subjects discussed are: post-War economic tendencies up to 1925; gold and prices; Britain and world trade; economic progress 1925–29; tariff level indices, and an essay entitled "Quo Vadimus?" in which present-day economic trends are examined. Mr. Loveday is head of the Economic Intelligence Service of the League of Nations Secretariat, Geneva, and is thus well qualified to discuss these problems. He points out that Great Britain's share in world trade has declined and continues to decline. Whereas in 1913 she claimed 13·9 per cent of all exports, in 1928 this had fallen to 11·2 per cent. He considers that the forces determining economic development to-day demand a revision of industrial methods and a modification of industrial technique which have perhaps been less fully accomplished in Great Britain than elsewhere, though mobility of demand and the rapid progress of science render suppleness of industrial mechanism more necessary than ever. The book suffers from the form in which it is composed, and would have been improved if rewritten into a homogeneous whole.

Geography and Travel.

The Groundwork of Modern Geography: an Introduction to the Science of Geography. By Dr. Albert Wilmore. Third edition, revised and enlarged. Pp. xxii + 533 + 27 plates. (London: G. Bell and Sons, Ltd., 1931.) 7*s.* 6*d.*

A book which has now reached its third edition, in addition to five reprints of the earlier editions, requires no technical criticism; it has obviously filled a long-felt want. We have approached it from the point of view of one who from boyhood has wandered about England and later in many other lands, having been taught to use his eyes and understand something of their geography, geology, flora and fauna, etc., and has in turn tried to impart some of this knowledge to the next generation. With such interests one is never alone; indeed, the trouble is to find time to do all the things that tumble over one another in their urgency when in new country. What a treasury of other people's learning and experience is disclosed by Dr. Wilmore; his simple classifications, the succession of chapters on land forms, make all so clear; so that one can without great difficulty puzzle out some of the riddles of our own Lake District, not unassociated in our memories with the genial enthusiasm of Dr. Marr, and even attempt the more complex conundrums set us in the High Alps.

Climate on holiday means fine weather, yet we are able to realise the need for rain and appreciate Charles Kingsley's reasons for declining to pray for the rain to cease. The book should be better known; it can add enjoyment to every holiday spent in the hills, whether we go to the Alps in summer

or to the English Lakes at wet Eastertide, and it need scarcely be said that it should form one of the few books included in the restricted luggage for a cruise, that is, if the voyager wishes to behold with seeing eyes.

The fine illustrations are not the least attractive part of the work. E. F. A.

Der Kilimandjaro : sein Land und seine Menschen. Von Dr. Walter Geilinger. Pp. 182 + 95 Tafeln. (Bern und Berlin : Hans Huber, 1931.) 15 francs ; 12 gold marks.

THE author, a doctor in Zurich, visited East Africa in 1928–29 and ascended Kilima Njaro, the highest of African mountains. His book contains a short, interesting account of the country and its people, and conveys a pleasing impression of the author's ecstatic enjoyment of the beauties and wonders seen during his tour. He combines his own observations with information from general literature, in the list of which British authorities occupy a fair share. Special features are dealt with in a series of useful appendices, including those on the flora, topography, and geological history of Kilima Njaro. The author's main interest was in the flora and forest trees and the contribution of the vegetation to the scenery of the district.

The text is general and popular, and gives a good picture of the present conditions of the country. The most valuable feature of the book is its illustrations, including 156 photographs and 4 coloured plates. Most of the photographs are by the author and are of the trees, more conspicuous plants. the natives, the glaciers and ice formations on Kilima Njaro, the giraffes, antelopes, and other big game. The illustrations form a graphic and useful record of the natural history of the mountain and its surrounding plains. The name of the mountain is spelt Kilimandjaro on the title page and in the text and Kilima Njaro on the cover. The one drawback of the book is the absence of an index, which would have been especially useful in regard to the flora.

Alarms and Excursions in Arabia. By Bertram Thomas. Pp. 296 + 24 plates. (London : George Allen and Unwin, Ltd., 1931.) 15*s.* net.

THE geographical area covered by Mr. Thomas's book is wider than the title indicates. Of the 'adventures' which he records—and no other name would describe them so exactly—two out of the five have Mesopotamia as their setting and the three others southern Arabia, after he had been appointed Vizier of the Sultan of Oman and Muscat. Although the interest of the first two is essentially that of a record of a difficult military and political situation, Mr. Thomas's insight into the character of the tribal Arab gives it an added value for those who appreciate the significance of racial characteristics in their bearing on the task we have undertaken in Mesopotamia. Of his work and travels in Arabia the scientific results have already been published in the *Geographical Journal* and elsewhere. Here Mr. Thomas gives his readers the lighter side—fighting and politics — and here and there intriguing thumb-nail sketches of customs and beliefs. His book throws an interesting sidelight on the conditions in which his valuable additions to our geographical and ethnological knowledge of Arabia have been made. The recent award of the Burton Memorial Medal of the Royal Asiatic Society to the author is a fitting and well-deserved recognition of his work in the Great Sandy Desert.

Geology.

Central Asiatic Expeditions. The Permian of Mongolia : a Report on the Permian Fauna of the Jisu Honguer Limestone of Mongolia and its relations to the Permian of other parts of the World. By Prof. Amadeus W. Grabau. With a Chapter on the Relations of the Jisu Honguer Formation to the General Geology of Mongolia, by Dr. Charles P. Berkey and Frederick K. Morris. (Natural History of Central Asia, Vol. 4.) Pp. xliii + 665 + 35 plates. (New York and London : G. P. Putnam's Sons, 1931.) 42*s.* net.

WITH the exception of a chapter on the general geology of Mongolia by C. P. Berkey and F. K. Morris, this work is devoted to a detailed account of the fauna of the Jisu Honguer limestone of southern Mongolia, with a discussion of its age and relationship to similar faunas of other regions, more particularly to Russia and India. Brachiopods are the predominating group in the fauna ; of these, no less than 99 species and varieties are recognised, belonging principally to the spiriferids, the productids, and the streptorhynchids, with the remarkable form *Richthofenia*. The Mollusca are relatively few in number, there being only 19 species and varieties of gasteropods and 17 of lamellibranchs. Noteworthy features are the rarity of corals and Polyzoa and the absence of Foraminifera, echinoderms, trilobites, and cephalopods. To account for this limitation of the fauna, combined with signs of dwarfing shown by many of the brachiopods, the author suggests that the salinity of the water was below normal, and compares the conditions with those now existing in Pechili Bay, a nearly enclosed area freshened by the waters of the Yellow River, where some groups of organisms usually abundant in the open sea are rare or wholly wanting.

The Jisu Honguer is correlated with the Uralian of Russia and the Productus Limestone of India. By most geologists the Uralian is regarded as of Upper Carboniferous age, but Prof. Grabau gives reasons for assigning it to the Lower Permian.

Lehrbuch der Geologie. Teil 3 : *Geologische Länderkunde.* (*Regionale Geologie.*) Von Prof. Dr. F. X. Schaffer. Lieferung 1. Pp. vii + 96. (Leipzig und Wien : Franz Deuticke, 1930.) 6 gold marks.

THE third volume of the "Textbook of Geology", by Prof. Schaffer, Director of the Geological and Palæontological Department of the Vienna Museum, is devoted to regional geology. The first part includes the general introduction, illustrated by a map of the world showing the author's conclusions

as to the distribution and character of the main earth-forms. He divides them into three main groups; the Epeirogens are the continental areas; the Orogens are the mountain bands, in which he includes all the North Atlantic, the western part of the Southern Ocean, and the south-western part of the Pacific. His third group includes the Pelagogens, or the areas of the Pacific, South Atlantic, and Indian Ocean which he regards as having been permanent. All the eastern Pacific, he considers, has been an ocean since the pre-Cambrian, and he supports this view by the opinion of Holdhaus that the insect faunas of the Polynesian islands are oceanic—a conclusion rejected by other authorities on the entomology of that region.

Most of the present part is occupied by summaries of the geology of the Pacific Ocean and its islands, of the Australonesian Orogen, based largely on Stanley's works on New Guinea, and by accounts of New Zealand, Australia, and the Antarctic continent and islands. The chapter on India is begun. The author has visited Australia, and his chapter on the Australian region shows general recognition of the predominant influence of block-faulting and of the Great Valley of South Australia as a rift valley. Prof. Schaffer briefly considers the artesian basin of east-central Australia and accepts the view that the wells are discharging an accumulation of fossil water or of magmatic water, and he remarks that many of the wells have already shown a great decline in productivity. In the account of New Zealand he tabulates the classifications of Park, Marshall, and Morgan.

Chemistry.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 11: *Te, Cr, Mo, W.* Pp. xii + 909. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 63*s.* net.

The eleventh volume of Dr. Mellor's "Comprehensive Treatise" includes the element tellurium, held over from the previous volume on sulphur and selenium, and the half-brothers of the oxygen family, chromium, molybdenum, and tungsten, but without uranium. All these elements raise interesting problems of valency; but the section on the valency of tellurium is unfortunately already out of date, since the evidence cited on p. 32 for the coplanar configuration of the four radicals in the telluronium salts has been obsolete since the end of 1928, whilst positive evidence of the tetrahedral configuration was provided at the end of 1929. The chromium ammines are catalogued with characteristic thoroughness under ninety subheadings, and stereo-isomerism is suggested as a possible explanation of the existence of multiple forms of certain members of the series, but the index contains no references by which general phenomena, such as co-ordination, isomerism, or stereo-isomerism, can be discovered. On the other hand, the interesting oxy-salts, which are so characteristic of this family of elements, can be traced quite readily by referring to entries under chromyl, molybdenyl, and uranyl compounds.

As his task approaches completion, however, it becomes increasingly clear that Dr. Mellor's principal achievement is to provide a monumental index to the literature of inorganic chemistry during the preparative period of its development, and thus to ensure that nothing of importance is lost or permanently forgotten. This programme calls for page after page of closely packed references and a highly condensed text, with the result that the more modern problems of valency and chemical properties in their relation to the electronic structure of atoms and molecules must necessarily play only a subsidiary part in the scheme. The treatise is therefore, in the main, a record of detailed facts accumulated during a century of arduous work, and the author is to be congratulated on the inclusion of so many recently acquired details, for example, of crystal structure, rather than to be criticised for the fact that these are scattered at such distant intervals amongst the results of earlier work.

Fundamentals of Organic Chemistry. By Prof. Harry F. Lewis. (International Chemical Series.) Pp. viii + 390. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 13*s.* 9*d.* net.

In the preface to this book, the author directs attention to the lack of a recent American textbook of organic chemistry based on what he calls the "Atomic Linking Theory". This somewhat misleading expression is intended to denote a theory based upon the Lewis-Langmuir conception of electronic linkages rather than upon the mere spatial orientation of the molecules as developed from the work of Kekulé, van 't Hoff, and others. But the author soon encounters difficulties, and on page 10 he confesses that "the arrangement of electrons in ethylene and acetylene is not well understood". He is therefore obliged to fall back upon a study of old-fashioned linkages and groupings, and abandons the idea of discussing electronic linkages. Very little stress is laid, however, upon the use of three-dimensional formulæ and the description of optical activity is rather inaccurate. Thus the expression "straight chains of carbon atoms" is used, and an optically active compound is described as one "having the property of bending the plane of polarised light". The chapter on the characteristics and analysis of compounds is a mere outline and would be more useful if it were illustrated with diagrams.

Nevertheless, the book has some good features. Thus, in many of the problems set, reference to original papers is necessary in order to obtain numerical data, which are to be used in plotting graphs, and the student acquires the habit at an early stage of consulting the original records. Emphasis is also laid upon technical developments of recent date, for example, new fermentation processes, new methods of cracking hydrocarbons, the catalytic oxidation of naphthalene, and technical applications of Friedel and Crafft's reaction. Many illustrations of plant are given.

Quantitative Pharmaceutical Chemistry: containing Theory and Practice of Quantitative Analysis applied to Pharmacy. By Prof. Glenn L. Jenkins and Prof. Andrew G. DuMez. (McGraw-Hill Publications in Pharmacy.) Pp. xxiii + 408. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 17*s.* 6*d.* net.

THIS book bases a four years' course of quantitative analysis for students of pharmacy on the various methods of assay described in the United States Pharmacopœia and National Formulary. It may be questioned whether such a course, even for pharmaceutical students, will give the groundwork which is desirable, seeing that the methods are intended only for standardised articles of a high degree of purity. So far as it goes, however, the course is judiciously arranged; the typical processes are, in general, adequately explained and questions and problems are set at the conclusion of the exercises. The details of some of the processes should have been criticised for the edification of the student, who may be left with the impression that it is usual, in the electrolytic assay of mercury, to employ a cathode weighing 700-800 gm. when the expected increase in weight is about 0·3 gm., or that in the determination of nitrogen by the Kjeldahl process there is no likelihood of loss of ammonia by the addition of strong soda solution to the diluted acid solution in an open flask.

The book is well printed and is remarkably free from typographical errors. A few loose statements are apparent; for example, it is explained that a 0·2 per cent solution of sodium chloride just acidified to litmus paper with nitric acid must not be heated since chlorine may be lost thus: $6HCl + 2HNO_3 \rightarrow 3Cl_2 + 4H_2O + 2NO$. A more serious error is that the student is directed to determine colorimetrically the *p*H of alcoholic solutions. The technique of repeated ether extractions should have included the more usual and convenient practice of blowing off the ether layers instead of running off the aqueous layer. J. R. NICHOLLS.

Chemical Composition: an Account of the Methods by which Atomic Weights and Molecular Formulæ have been Determined. By Dr. A. K. Goard. Pp. viii + 304. (London: Sidgwick and Jackson, Ltd., 1931.) 5*s.*

TWENTY-SEVEN years ago, Miss Ida Freund wrote a book on "The Study of Chemical Composition" which at once acquired a permanent value by reason of the fact that it was made up very largely of appropriately selected quotations from original sources. Miss Freund's book (which has long been out of print) was, however, too expensive to be used extensively by students, and was mainly a source of information and inspiration for those who were responsible for the teaching of chemistry in schools or universities.

It appears certain that Dr. Goard must have been amongst their number, since he has set himself the task of handing on, in a more elementary form and at a much lower price, the doctrines which formed the subject of the larger work. He has carried out his task in a way which appears to be entirely satisfactory, since the shortness of many of his chapters must be very encouraging to his readers; but for a real test of success it would be necessary to discover what impression the book has made on the author's own classes at Marlborough, or on other juvenile readers who have been introduced by it to a section of chemical theory which can be made very dull, but can also form the subject of a rather fascinating story.

The reviewer is too hardened a chemist to make this test in his own person, but would commend the book to those who are in a position to use it for this purpose, since he is certain that nothing but good can come from closer contact between the beginner of to-day and the scientific pioneers of yesterday.

Lehrbuch der physikalischen Chemie. Von Prof. Dr. Karl Jellinek. Fünf Bände. Lieferung 10 (Band 4): *Die Lehre von der Statik chemischer Reaktionen (Schlussteil) und die Lehre von der chemischen Kinetik.* Erste und zweite Auflage. Pp. 288. (Stuttgart: Ferdinand Enke, 1931.) 26 gold marks.

PROF. JELLINEK'S detailed treatise provides the worker in physical chemistry with a survey of the theory and experimental investigations which is at the same time exhaustive and comprehensible. Great care is taken not to pass over points of difficulty, and all the equations used are deduced in full, numerical applications in most cases making their significance perfectly clear. Unlike some treatises, it takes full account of work done in Great Britain and the United States, so that it is international in character. The references to the literature are very complete, and it is clear that the author has made extensive use of original papers.

The present volume extends the treatment of liquid solutions begun in the preceding one, and deals with equilibria in weak electrolytes. The activity function is used throughout, and since such matters as neutralisation curves, buffer solutions, and indicators are included, the volume contains much of interest to biochemists as well as to investigators in pure physical chemistry and technical workers. The text is very clearly printed, and numerous curves and diagrams are included.

The book may be strongly recommended as forming a part of what is undoubtedly the most important and authoritative treatise on physical chemistry of the time. Although the detailed treatment makes it suitable for the specialist, the careful explanations given of all the theories are such as could usefully be read by students able to understand German.

Solvents. By Dr. Thos. H. Durrans. (Monographs on Applied Chemistry, Vol. 4.) Second and revised edition. Pp. xv + 180. (London: Chapman and Hall, Ltd., 1931.) 10*s.* 6*d.* net.

THE term 'organic solvent' has acquired an altogether new meaning during the past year or so in connexion with the various sections of the plastic industry, particularly cellulose lacquer and

artificial silk. The older solvents like acetone have been manufactured by new methods in much greater quantities and at much lower prices; newer solvents are being made and applied to industry all the time, so that, as is often said, what were last year's laboratory curiosities are this year sold in tank waggons. Progress in the new field on the manufacturing side has been largely due to the use of processes involving catalysts, which have led to new syntheses from simple raw materials such as alcohol.

The fact that a new edition of this book has been called for within a year is a proof both of the interest taken in the subject and of the clarity and utility of the work. The method again adopted is to deal with the fundamentals in the first section of fifty pages and to devote Part 2 to the individual solvents in considerable detail. The chapter on plasticising solvents has been considerably extended and now contains notes on forty-one substances suggested for this purpose.

The book is readable, commendably crisp, and will be of value to all who use such solvents.

E. F. A.

Practical Physical Chemistry. By Prof. Alexander Findlay. Fifth edition, revised and enlarged. Pp. xii + 312. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 7*s.* 6*d.* net.

THE fifth edition of Prof. Findlay's "Practical Physical Chemistry" may be regarded as celebrating the half-jubilee of the book, which was first issued in 1906. Throughout this period its general character has been maintained, but its usefulness has been increased by the introduction of new experiments from time to time. In the present edition the preface tells us that these new experiments deal with gaseous dissociation, vapour pressure of liquids, viscosity of highly viscous liquids, potentiometric methods, and the use of indicators for the determination of hydrogen ion concentration, whilst attention has been directed to the concept of the activity of strong electrolytes and to the phenomenon of salt effect. The vapour pressure of salt hydrates and the freezing points of binary mixtures have also received brief treatment.

The new edition does not call for any further comment, except for a word of congratulation to the author on his success in inhibiting the physico-chemical phenomenon of 'ageing' from which books on chemistry are liable to suffer severely.

Die Glykoside: Chemische Monographie der Pflanzenglykoside. Von Dr. J. J. L. van Rijn. Zweite ergänzte und neubearbeitete Auflage von Prof. Dr. Hugo Dieterle. Pp. viii + 620. (Berlin: Gebrüder Borntraeger, 1931.) 48 gold marks.

THE first edition of Dr. van Rijn's book was published so long ago as 1900; it has now been revised and rewritten by Dr. Dieterle.

The chemistry of the individual glycosides which have been found in plants is described in the order of plant families, a method of arrangement which in our opinion, as indeed the author confesses, leaves much to be desired, as it makes the book merely a catalogue of individual substances and does not bring out any general group relationship among the glycosides or assist the reader to study their significance. For each substance the method of preparation, the physical properties, and the constitution of the non-sugar section or aglucone is indicated; a reference is also made to the physiological activity. The work is costly, and suitable for reference in the library rather than for the inspiration of the research worker.

E. F. A.

Physics.

Lectures on Theoretical Physics delivered at the University of Leiden. By H. A. Lorentz. Authorised translation by Dr. L. Silberstein and A. P. H. Trivelli. Vol. 3: *Maxwell's Theory*, edited by Dr. H. Bremekamp; *The Principle of Relativity for Uniform Translations*, edited by Dr. A. D. Fokker. Pp. xi + 326. (London: Macmillan and Co., Ltd., 1931.) 21*s.* net.

THIS, the last, volume of Lorentz's "Lectures on Theoretical Physics" contains a translation of two courses, namely, "Maxwell's Theory", edited in the Dutch by H. Bremekamp and published in Leyden in 1925, and "The Principle of Relativity for Uniform Translations", edited by A. D. Fokker and published in 1922.

The first section contains chapters on the electromagnetic field, electrostatics, stationary currents, induction currents, and the electromagnetic theory of light. The second section, on the restricted theory of relativity, contains chapters on the principle of relativity, the various transformation formulæ and their interpretation, the mechanics of a particle, the inertia of energy, and electromagnetic phenomena in moving bodies.

Although the work treats of very familiar and almost old-fashioned material, it treats them in a manner which is both stimulating and refreshing, the simplicity and generality of the style being reminiscent of Lorentz at his best. The various topics are dealt with in sufficient detail to bring out all the underlying physical principles and their bearing on the mathematical formulations, and they are woven together so as to form a complete and comprehensive text on the subject.

As with the first two volumes, the translators have not always been too happy in their choice of words and phrases, but on the whole the book is a worthy companion to its predecessors, and does honour to the great master whose thoughts it expounds. It can be strongly commended to all who are interested in the subjects with which it deals and, in particular, to students and teachers in need of an introductory textbook to this side of modern physics.

G. H. L.

Magnetism and Electricity. By E. Nightingale. Pp. xvi + 294. (London: G. Bell and Sons, Ltd., 1931.) 4*s.* 6*d.*

THE high standard set in the author's "Heat, Light, and Sound" is fully maintained in the present work, which covers roughly the school

certificate or matriculation range. For students following a school course it would be difficult to imagine a more efficient or attractive presentation of a subject which, thanks largely to the universal interest in wireless, may be regarded as the most popular branch of science, but is often handicapped by heavy or unimaginative treatment. The historical development is prominent throughout. This, as is nowadays generally realised, adds greatly to the reality and interest of science. Here, moreover, instead of the great pioneers being left as little more than names, they are made to 'live' by judicious sketches of their life and times, with portraits, numerous extracts from their original papers, and reproductions of their diagrams and apparatus. The lesser known experimenters receive due recognition, in which connexion Bennett's work and original illustrations are notable. Equally with the historical aspect a practical line of study is followed, aided by a wealth of simple diagrams and numerous ingenious and up-to-date modifications or improvements of the usual experiments. Practical applications to everyday life are emphasised.

The quantitative side has been made to appear integral with theory. Each chapter is provided with a summary, simple questions, and an ample number of questions grouped together, drawn from papers of the various school certificate authorities; worked numerical examples are added. A concluding chapter deals briefly with modern ideas and advances, such as conduction through gases, wireless, and photoelectricity. The book is altogether admirable—a maximum is accomplished in a minimum of space. N. M. Bligh.

Electricity for Everybody: Handbook for 1931; an Electrical Compendium incorporating a Gazetteer of Electricity Supplies, a Directory of Electrical Contractors, and a Diary from April 1931 to March 1932. By R. Borlase Matthews. Pp. lxxxvii + 470. (London: Electrical Press, Ltd., 1931.) 5*s*. net.

Now that electricity supply is available to many, a demand has arisen for accurate knowledge about the various uses to which this supply can be applied for domestic and factory purposes. This book will be useful in this connexion. It contains a useful diary, a calendar, and a section dealing with general principles which can be readily understood by anyone with a little technical knowledge. There is a section dealing with electric lighting, heating, cooking, and power in the home, due stress being laid on the economic and æsthetic factors. The costs of electricity in public and private buildings and in factories are discussed, and simple methods of computing them are given.

Mr. Borlase Matthews is a specialist in the many uses to which electricity can be put on a farm or in a garden. It is used to increase the comfort and hence the utility of live-stock. It also increases their productivity. The heating and lighting of apiaries increases the productivity of each hive by from 15 lb. to 17 lb. of honey per annum. Electric heating of greenhouses for forcing is very readily done, and an even temperature is easily obtained by a thermostatic control. The soil heating of frames and hot beds by means of electric cables is extending in Great Britain. It is much better than using the variable heat given out by manure.

Post-Primary Science. By W. F. F. Shearcroft. Book 1: First Year's Course. Pp. 194. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1930.) 2*s*. 6*d*.

This is the first of three books designed to cover the first three years of a five-year course, leaving two years for a more specialised study. The object is to overcome the difficulty, so painfully obvious to every teacher, that science tends to be studied in water-tight compartments, and progress in one branch is hindered by ignorance of another, ending generally in a knowledge of a little heat and a little chemistry.

Here science is generalised in the extreme by a treatment of measurements, heat, light, sound, and magnetism and electricity, with a trace of mechanics, all merging into each other. The presentation is in the simplest possible style, and in a manner likely to interest pupils from the age of eleven years, for whom the book is intended. The scientific method is the keynote throughout, and the course, being primarily experimental, should certainly train the pupil to think. The provision of a table of contents would be an advantage, an index not being a satisfactory alternative. N. M. Bligh.

An Introduction to Quantum Theory. By Dr. G. Temple. Pp. 196. (London: Williams and Norgate, Ltd., 1931.) 12*s*. 6*d*. net.

This book is concerned more with the ideas upon which quantum mechanics is based than with the applications of the theory to physical problems. The book opens with a general discussion of the principle of duality between waves and particles, followed by a chapter on the theory of photons, in which the idea of a wave function for a single light quantum is introduced. A wave theory of matter is then developed along unusual lines. Electric charge is treated as a fluid which obeys hydro-dynamical laws, and by means of certain special assumptions its behaviour is shown to be governed by a wave equation equivalent to that of Schrödinger. Thus, without interpreting any of the symbols in terms of probability, a considerable number of the results of wave mechanics can be deduced, including the energy levels of a hydrogen atom and the splitting in a magnetic field. The treatment is complicated and involves a considerable amount of mathematics, and therefore can scarcely be recommended to a beginner.

The author then shows that it is necessary to introduce the idea of probability in dealing with collision problems, and in dynamical problems involving the interaction of two or more particles. There follow chapters on quantum algebra and matrix mechanics, attention being concentrated on the formal side of the theory, and very few examples being given. As would be expected from the author's own researches, there are interesting chapters on the relativity wave equation and on the spinning electron.

Quartz Resonators and Oscillators. By P. Vigoureux. Pp. 217 + 13 plates. (London: H.M. Stationery Office, 1931.) 7*s.* 6*d.* net.

Written round the practical use of quartz in vibrating systems, this monograph will be of interest to many classes of readers. It describes the preparation of suitable pieces of crystal from the natural material—apparently by no means a difficult operation—the connexions and mathematical theory of circuits involving these, and the physics of quartz. We should like to direct special attention to the illustrations, and particularly to the photographs of the electrical discharges which vibrating crystals can set up in a partial vacuum, and of the interference fringes seen with a crystal oscillator close to optical flat. It would be difficult to devise more beautiful demonstrations of the modes of vibration of rods and plates. Including as it does an extensive bibliography, the book serves a useful purpose in co-ordinating existing results, and can scarcely fail to stimulate further research. K. G. E.

Engineering.

(1) *Cross-Country Flying.* By Major Oliver Stewart. Pp. ix + 116 (12 plates). (London: Constable and Co., Ltd., 1931.) 6*s.* net.

(2) *Flying as a Career: a Popular Guide for all proposing to obtain a Position in the new Industry as a Pilot, Navigator, or Aircraftsman.* By Major Oliver Stewart. Pp. ix + 81 + 12 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1931.) 3*s.* 6*d.* net.

(1) Major Stewart is a writer of the kind that seems to be prevalent in aviation, to its great advantage. He has the ability to explain the most abstruse problem to the non-scientific reader by selecting the essentials, and presenting them simply yet accurately. His book, "Cross-Country Flying", deals with the use of the compass, air speed indicator, turn and drift indicator, bubble inclinometer, etc., in the air, and the general use of maps, course plotters, and calculators on the ground. He avoids the complicated mathematical theory upon which much of it is based, without descending to such a simplicity as to offend the intelligence of the reader.

There are chapters on the regulations laid down by law to be observed when flying, and a sufficient explanation of meteorology and instructions for the use of wireless communication to enable the pilot to make use of the broadcast services in this respect. A chapter on bad weather flying is unfortunately only too appropriate in Great Britain at the present time.

(2) "Flying as a Career" deals in a strictly impartial manner with the various possibilities in aviation to-day. The author is quite rightly severe in his condemnation of the Royal Air Force 'Medium Service' system as a 'blind alley' occupation. Aspiring aviators and their parents can read this book with considerable advantage.

The Light Aeroplane Manual. By F. D. Bradbrooke. Pp. ix + 251. (London: Chapman and Hall, Ltd., 1931.) 10*s.* 6*d.* net.

This is an exceedingly well written book but with an entirely misleading title. The term 'Manual' suggests the practical outlook, and detailed descriptions of light aeroplanes and their engines, together with hints on their use and maintenance, are expected. Actually the book is a simple and remarkably correctly written treatise on the theory of flight, both from the point of view of why an aeroplane flies and, appreciating this, how to fly it properly. The author has skilfully avoided the all too common pitfall of making a statement scientifically incorrect in order to simplify it. He has not dealt with the more complex mathematical and physical outlook, but as the book is obviously intended for the user rather than the producer of an aeroplane, his action is justified.

The chapter headed "Types of Aircraft" is rather a disappointment, in that it is merely a description of some present-day aeroplanes, which will serve to make the book out of date rapidly, remembering the rate at which aircraft design is progressing to-day. A more general discussion upon the broad classification of types, into which modern aircraft is automatically dividing itself, would have been more in keeping with the rest.

The book should certainly be read by all aircraft owners who are ambitious to be something more than mere aerial chauffeurs, and should be useful to elementary students of aeronautics.

The Mechanical Properties of Wood: including a Discussion of the Factors affecting the Mechanical Properties, Working Stresses for Structural Timber, and Methods of Timber Testing. By Prof. George A. Garratt. Pp. ix + 276. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 17*s.* 6*d.* net.

This American publication deals with a subject that is receiving more and more attention from forest utilisation officers, wood technologists, architects, and manufacturers, for all find that it is very necessary that reliable information should be available upon the mechanical properties, not only of a few woods, but also of all the important commercial timbers. Moreover, it is necessary that there should be an international understanding about any research that is being carried out.

The book under notice, whilst primarily a text-book for students, will also be found of value to other people interested in timber and its manufacture. The author has divided his work into four parts. Part 1 treats of the relation of wood to stresses and strains, which are included under the three general headings tensile, compressive, and shearing, each of which is then dealt with separately and subdivided as necessary. Illustrations and tables add materially to the interest of the descriptions. Part 2 deals with factors affecting the mechanical properties of wood, such as knots, checks, shakes, cross grain, decay, etc. Preservative treatment is given full consideration, time of felling

and its effect on timber, and various other pertinent matters.

Part 3 deals with working stresses for structural timbers. This part will be found of great use to architects and engineers, for it goes very carefully into the question of working stresses for joists, planks, beams, stringers, round posts, wooden columns, etc., with tables showing the comparative strengths of various American timbers. Part 4 treats of timber testing, forms of material tested, size of specimens in relation to tests, moisture determination, machine for static tests, speed of testing machine, with numerous descriptions of tests. At the end of each part is a list of references to questions dealt with in the respective part. The work has a good index.

Charts and Data on Marine Boiler Design : a Summary of the Standard Formulæ in Chart Form with Tables and Notes. By H. C. Walker. Pp. xii + 55. (London : Chapman and Hall, Ltd., 1931.) 25*s.* net.

Though to-day in all naval vessels, and in a considerable number of mercantile vessels, water-tube boilers are used, the standard form of boiler for ships, both small and large, has been that with a cylindrical shell and internal cylindrical furnaces, from which the gases pass into vertical combustion chambers and through nests of tubes. Such boilers are sometimes referred to as return-tube boilers, as the smoke returns to smoke-boxes fitted at the same end as the furnace mouths ; but to all marine engineers they are just known as marine boilers. The design of this type of boiler involves the consideration of the strength of cylinders, of flat plates, of corrugated furnaces, and of riveted joints ; and the dimensions of the various parts are governed by rules laid down in an official document, "Standard Conditions for the Design and Construction of Marine Boilers", published by H.M. Stationery Office. From the formulæ given in these rules the calculations are made. To obviate the necessity for these calculations, Mr. Walker has prepared a series of 17 charts and 25 tables, from which, once his methods are grasped, readings are the work of a few moments only, and the possibilities of error are practically eliminated. The size of the volume, 13 in. × 10 in., has enabled the charts to be of a sufficiently large scale ; they are printed on stout paper, and have been rendered easy for reference. The author has thus provided a reference book which should be of much use for all concerned with the design of marine boilers.

Machine Drawing and Design : a Textbook of Intermediate Standard for Engineering Students. By W. Abbott. Pp. 208. (London, Glasgow and Bombay : Blackie and Son, Ltd., 1930.) 7*s.* 6*d.* net.

This volume is divided into two parts. Part 1 contains the more important details of machinery, such as fastenings, shafts and fittings, bearings, gearing, valves, parts of engines and turbines, with simple explanations of the principles of design. It is assumed that the subjects of mechanics and the strength of materials are being studied conjointly. Part 2 is devoted entirely to exercises, and includes some examples taken from university and Whitworth scholarship examination papers. Most of the drawings are presented in pictorial form, thus preventing the mere copying of orthographic projections and enabling the appearance of the object to be readily understood. The designs included are representative of good modern practice.

There is evidence throughout the volume that the author has taken pains to produce an excellent and well-graded course suited to the requirements of intermediate students. Those interested in the teaching of engineering who are acquainted with Mr. Abbott's former work on "Practical Geometry and Engineering Graphics" will welcome the present useful and practical addition to the literature of engineering drawing.

Civil Engineering Design. By Arthur A. Fordham. Pp. xi + 212 (45 plates). (London : Chapman and Hall, Ltd., 1931.) 21*s.* net.

This book is intended to be of service in the drawing office to students taking courses in civil engineering who have acquired a knowledge of strength of materials, theory of structures, etc. The volume contains twelve designs completely worked out with the necessary calculations and drawings. These include a steel frame building with grillage foundations, steel dock gates, two steel roof principals, one of which is a two-hinged braced arch, five bridge designs, including both steel and reinforced concrete, a masonry dam and an earthen dam. These designs have been carefully worked out and will be useful to the student in showing how principles are applied in practice ; also by modifying specified dimensions the illustrated designs may be used as models for his own designs.

There are not too many volumes on this subject published in Great Britain ; most of the great mass of material at our disposal is scattered in periodicals and transactions of engineering institutions. The present volume will therefore be appreciated by many busy teachers who have to provide data for students' designs. It is unfortunate that the size of the book—12½ inches by 10 inches—required to present the drawings properly, and its weight, which is about 4 lb., make it clumsy to handle and lead to a good deal of wasted space in the text. In view of the excellence of the matter, however, this must be regarded as a minor blemish.

Mathematics.

Numerical Mathematical Analysis. By Prof. James B. Scarborough. Pp. xv + 416. (Baltimore, Md. : Johns Hopkins Press ; London : Oxford University Press, 1930.) 25*s.* net.

Most of the ground of Prof. Scarborough's book on numerical analysis is covered adequately for English readers by Whittaker and Robinson's "Calculus of Observations", and the new work interests us chiefly for its revelation of differences between the American material and our own.

The best feature of the book is the attempt

wherever possible to frame estimates of reliability. In one case the author is led to an important conclusion, for he finds that in spite of its complication Simpson's three-eighths rule carries an inherent error more than twice as large as his one-third rule; the comparison is between the actual errors that must occur in individual cases, not between upper limits to these errors in general, and it follows that the more elaborate rule has nothing whatever to recommend it.

Like the account of quadrature, the account of the numerical integration of differential equations is thorough; four distinct methods are compared and illustrated, and the author's commentary is helpful. But the treatment of other topics is scantier. What are we to say, for example, when the last word on interpolation is with Stirling and Bessel and there is no mention of Everett? There is an adequate chapter on the root-squaring method of solving an algebraic equation. For simultaneous equations, since the labour involved in the computation of a numerical determinant is not exposed, the tediousness of the Newton-Raphson process is not made evident, and while the iterative process is explained for sets of equations to which it is obviously applicable, nothing is said of the way in which sets of functional equations in general can be prepared for iterative solution. Although probability and statistics are outside the range of the volume, a discussion of normal and probable errors and of estimates of precision is included, to lead up to a chapter on the construction of empirical formulæ which is one of the most important in the book.

The explanations throughout are clear. The author attracts confidence by the honesty with which he applies the standard methods, sometimes to unfavourable cases, and teaches the computer to learn by experience. E. H. N.

(1) *Les méthodes de solution approchée des problèmes de la physique mathématique.* Par Nicolas Kryloff. (*Mémorial des sciences mathématiques*, Fascicule 49.) Pp. 69. (Paris: Gauthier-Villars et Cie, 1931.) 15 francs.

(2) *Angenäherte und symbolische Lösung der Differentialgleichungen der mathematischen Physik und Technik.* Von Prof. Dr. N. M. Kryloff. Pp. 162. (Kharkov and Kiev: State Technical Publishers, 1931.) 3 Kps.

(1) One of the most valuable methods for the approximate solution of the differential equations of mathematical physics is that due to Lord Rayleigh and W. Ritz. This starts by applying the calculus of variations to a certain quadratic form and finally obtains a solution in terms of a convergent series of functions; a limited number of terms of this series gives an approximation to the exact solution. However, the method as left by its authors was not fully developed, and a great deal of work has been done by Prof. Kryloff, who has written more than thirty papers on the subject. An essential part of his contributions is to show how to estimate the number of terms which must be taken to make the error less than an arbitrary assigned amount. Great variety is possible in the treatment; in fact, it might be said that each type of equation has its own appropriate method. The account given by Prof. Kryloff in this tract shows that the subject is far from exhausted and offers opportunities for further research.

(2) Another side of the subject is dealt with in the second of the above books of Prof. Kryloff. Unfortunately, this is in the Ukraine language, but there is a summary in German. This book makes considerable advances in the use of the Heaviside operational methods. In particular, it combines them with the methods of approximation on which Prof. Kryloff has worked so long. H. T. H. P.

Leçons sur la théorie mathématique de la lutte pour la vie. Par Prof. Vito Volterra. Rédigées par Marcel Brelot. (*Cahiers scientifiques*, Fascicule 7.) Pp. vi+214. (Paris: Gauthier-Villars et Cie, 1931.) 60 francs.

This book deals with one of the newest branches of applied mathematics, namely, the application of differential and integro-differential equations to biological problems of the survival of the fittest, such as the effect of a change in the rate of fishing upon the proportion of the different species of fish, some of which prey upon others.

The first part of the book assumes that the causes have immediate effects. This assumption, though probably far from the truth, has the advantage of allowing a fairly simple and complete mathematical treatment in terms of differential equations. Three fundamental laws are deduced, those of fluctuations, conservation of means, and perturbation of means, which seem of considerable practical importance. The second part of the book endeavours to extend the results of the first to the case where the causes produce delayed effects.

This work is connected with Prof. Volterra's researches on integro-differential equations and their applications to mechanics. In view of the simplifying hypotheses adopted, the results are not likely to be accepted by biologists until they have been confirmed experimentally, but this work has as yet scarcely begun. H. T. H. P.

Miscellany.

Armadas of the Sky: the Problem of Armaments. By Paul Murphy. Pp 120. (London: The Houghton Publishing Co., 1931.) 5*s.* net.

This is a semi-philosophic discussion upon the possible methods of waging war in the future, bearing in mind the uses made of aircraft in the late War, and endeavouring to visualise their probable development by the time the next war breaks out. The reader is left, as it is suspected the author himself is, somewhat breathless, if not entirely drowned, in the sea of argument and counter-argument. The conclusion that appears to emerge from the welter of facts intermixed with visions is that the use of aircraft plus radio communication will so radically alter methods of war that it is impossible

to foresee what will happen. In the absence of this knowledge, it is absurd to prepare for a limited number of possibilities only, and impossible to be ready for every one, because of the magnitude of the task. This is rather hard on the professional fighters, who are apparently preparing for a war to be fought on lines similar to the last one, not so much out of ignorance or lack of vision, as because it is the only concrete thing that they have to work upon.

A long chapter is devoted to a dramatic description of the first twenty-four hours of an imaginary war of the future. The capitals of both of the combatants are immediately crippled by the enemies' air fleets, and we are left with the impression that the continuation of the war is impracticable, because of the destruction of the centres of organisation. This holocaust occurs principally because of the rapidity of the blow, which is made possible, first, by the lack of cumbersome mobilisation of armed forces as in previous wars, and, secondly, by the facilities with which orders can be transmitted by wireless.

The author develops a rather ingenious subdivision of methods of use of gas in aerial warfare, which can either be used for killing, temporarily incapacitating a population, or rendering an area uninhabitable. A good many aircraft designers of to-day would not agree with one of his premises, that civil air transport aeroplanes can be used immediately for war purposes; also, that the airship is inferior to heavier-than-air craft in every respect, both in its war and peace applications.

Equality. (Halley Stewart Lectures, 1929.) By R. H. Tawney. Pp. 303. (London: George Allen and Unwin, Ltd., 1931.) 7*s.* 6*d.* net.

"THE lever which lifted political and religious boulders will snap when used to move economic mountains" expresses a pessimistic outlook which does not appear to be shared by Prof. Tawney. Nor does he believe that our present social and economic maladjustments are the inevitable results of original sin. "It is more contemptible to be intimidated by distrust of human nature than to be duped by believing in it." His book is an interesting examination of political and economic equality as an ideal, and involves an analysis of the causes, social and psychological, which have resulted in our present degree of inequality. The chapter on "Equality and Culture" is a good tract for the times, and reiterates the useful truth that, if the Kingdom of Heaven is not eating and drinking, "neither is civilisation the multiplication of motor-cars and cinemas, and of any other of the innumerable devices by which men accumulate means of ever-increasing intricacy to the attainment of ends which are not worth attaining".

Critique of Physics. By L. L. Whyte. Pp. xi + 196. (London: Kegan Paul and Co., Ltd., 1931.) 10*s.* 6*d.* net.

THE main purpose of this inspiring book is to propose a new structural method of physics where relativity and the quantum theory are shown as special cases of a more general limitation on the classical frame. The proposed method, which the author calls 'unitary theory', is a deductive theory of measurement and of the relations holding between measured quantities, based on a theory of the structure of rods and clocks, in which all theoretically significant lengths, times, or masses appear as functions of one primary length, time, or mass.

It can be gathered, therefore, that the author's method does not arise out of experimental necessities, but is shaped merely on logical postulates based on a searching analysis of the assumptions of modern physics. Without adequate mathematical and experimental developments, it would be difficult to pass a final judgment on the author's endeavour. But he is himself aware of the provisional character of his suggestions, and likes to call his method heuristic rather than scientific. At any rate, if it inspires physicists to look with a constructive suspicion at the postulates of their theories, and try to remedy their obvious logical defects, the labours of the author will not have been in vain.

T. G.

A Defence of Philosophy. By Ralph Barton Perry. Pp. 56. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1931.) 4*s.* 6*d.* net.

PROF. PERRY says there is a sort of gentlemen's agreement not to ask ultimate questions. "People do not as a rule insist upon knowing the meaning of things, further than to assign them a place in their world of familiar objects." Yet philosophy differs from other studies in that it continues to press inquiry beyond the point where it customarily stops. "It sets no limits to the questions it asks, save to insist that they shall really be questions." When it is objected that if inquiries are carried too far the methods of science have to be left behind, the philosopher's reply is that he will use what methods he can. Yet the questions which he asks are all familiar in kind: What is real? Why did it happen? How do I know? What ought I to do? Everyone philosophises up to a point; the difference between the metaphysician and the rest of the world is one of degree only, and lies in the thoroughness and obstinacy with which the latter pursues his quest. The philosopher is the intellectual frontiersman, who attempts to domesticate the wild areas which lie beyond the cultivated fields of science. Students of science will read this lecture of Prof. Perry's with interest and with a large measure of agreement.

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Letters to the Editor.

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Determination of the Yard in Terms of the Wave-length of Light.

IN the issue of NATURE for May 9, p. 726, a short account is given of an investigation by Dr. A. E. H. Tutton of the length of the yard in terms of the wave-length of light. This being the first occasion on which the value of the yard in wave-lengths has been directly determined, considerable interest naturally attaches to the result.

In the complete account of his work which has now been published,[1] Dr. Tutton arrives by calculation, from the means of several determinations made in the red line of hydrogen and in the strong yellow line of neon, at a value for the length of the yard in terms of the standard cadmium red line which is in good agreement with that derived from the accepted value of the metre in terms of this line, taken in conjunction with the known ratio of the yard to the metre.[2] Unfortunately, however, he gives no adequate investigation of the probable error of his result, which the internal evidence of his paper clearly shows is very large. In fact, from the nature of the procedure adopted it could not be otherwise.

The method consists in actually counting, to the nearest tenth of a band, the number of interference bands corresponding to three intervals each $\frac{1}{16}$ in. in length—that is, a potential accuracy of the order of 1 part in 50,000—and then stepping up to the yard by a process which, apart from any further errors which may be involved, is one of sheer multiplication. Actually the various individual counts of the separate sixteenths of inches in H_α exhibited differences between themselves amounting to as much as 1·6 bands, with an average difference from the mean in each group of 0·44 band, or nearly 1 part in 10,000. Only two counts were made in Ne_c, the average difference between corresponding pairs being 0·5 band.

As a test on the accuracy of the building-up process, the following comparison is informative. On pp. 312, 316, Dr. Tutton gives the final values he obtained for the length of the yard as—

$$1 \text{ yard} = 1{,}393{,}290{\cdot}5\ H_\alpha$$
$$1 \text{ yard} = 1{,}562{,}408{\cdot}6\ Ne_c$$

respectively. From the ratio of these two figures, taking the value of Ne_c as 5852·488 A., the value of H_α can be calculated as

$$H_\alpha = 6562{\cdot}865 \text{ A.},$$

a result which, though somewhat high, is in tolerable agreement with expectation. The building-up process can, however, add nothing to the accuracy of the original counts, and if we take from pp. 301 and 303 the aggregate mean counts of the three separate $\frac{1}{16}$ in. lengths in the two radiations, we get $16{,}266{\cdot}5\ Ne_c = 14{,}504{\cdot}3\ H_\alpha$, from which, using the same value of Ne_c, as above, we find

$$H_\alpha = 6563{\cdot}536 \text{ A.},$$

showing a difference of 1 part in 10,000 as compared with the result derived from the same data after building up to the yard length.

Incidentally, this more direct calculation gives a value for H_α too far removed from the range of values found for this line by other observers to be acceptable, and it is thus clear that the agreement of Tutton's results with expectation, both as regards the wave-length value of the yard in Ne_c and as regards the derived value of H_α, must be entirely fortuitous, both the original counts and the building-up process being liable to errors of the order of 1 part in 10,000. There are other points in Dr. Tutton's paper which might be criticised, but in these circumstances there is no necessity to enter into details.

At the conclusion of his paper, Dr. Tutton generously records his acknowledgments in respect of certain facilities which I was happy to be able to afford him; and having been to this small extent associated with the work, I the more regret having thus to direct attention to the uncertainty of the results. Had they differed from expectation as much as these remarks show that they easily might have done, the necessity would scarcely have arisen, but their chance agreement with expectation involves a risk that they may be accepted at their face value without sufficient scrutiny. It is very important that the wave-length value of the yard should be determined with all attainable precision. Preparations for such a determination at the National Physical Laboratory are well advanced, and it is expected that the results will become available for publication during the course of next year.

J. E. SEARS, JR.

Standards Department, Board of Trade,
6 Old Palace Yard, Westminster, S.W.1,
Oct. 26.

[1] Tutton, *Phil. Trans.*, A, **230**, 293; 1931.
[2] Sears, Johnson and Jolly, *Phil. Trans.*, A, **227**, 281; 1928.

IN rendering due thanks to Mr. Sears, at the conclusion of my paper, for the facilities granted to me for the use of the interferential comparator, which I had the honour to devise and see constructed and installed at the Standards Department of the Board of Trade, in the time of the late Deputy-Warden of the Standards, Major P. A. MacMahon, nothing was further from my intention than to imply any responsibility on the part of Mr. Sears for the results communicated to the Royal Society in my paper. Indeed, he was from the first unsympathetic towards my interferential method. While in Major MacMahon's time the statutory periodic comparisons of the Imperial Standard Yard with its official copies were carried out with my interferential comparator, the interferometric portion was afterwards dismantled, and the instrument used for purely mechanical and microscopic comparisons. Much valuable time had to be spent at the outset of my work in cleaning, refitting, and readjusting the interferometric part, and by the Office of Works electricians in replacing perished electrical fittings, especially those of the thermostat, which maintains the whole comparator room at the official temperature of 62° F. and which had become positively dangerous from disuse. Fortunately, all the base-line work, the actual counting, band by band, of the interference bands (10,846 in yellow neon Ne_c light) in the one-eighth of an inch, was able to be carried out on my own interferometer, an improved copy of that at the Standards Department, in my private laboratory at Cambridge.

The specific criticisms of Mr. Sears are all fully dealt with in the paper. It is unfair to assume an error of one in ten thousand, the true facts being stated on page 318, where it is shown to be less than 0·03 of an interference band, corresponding to about four wave-lengths in the final result. Not two but six counts in yellow neon light are recorded, two on each of three separate sets of Grayson-ruling (half wave-length) fiducial marks, and double this number of counts were actually made with identical results.

As regards the accuracy-test of the building-up process, the calculation of the H_λ wave-length given by Mr. Sears is also unfair, as it is made clear in the paper (p. 321) that the hydrogen results are not relied on, being influenced by the fact that the red line H_α is a doublet, and therefore only used in general confirmation of the neon results. It is the final result with yellow neon Ne_e light, 1,562,409 wave-lengths in the yard, which is alone relied on, the Ne_e line being unresolvably single and its wave-length a standard constant, so that the number of wave-lengths of cadmium red Cd_r light in the yard, 1,420,210, calculated by use of this constant and the standard wave-length of Cd_r, is unimpeachable.

It is, indeed, important that the value of the yard in standard wave-lengths should be known with the greatest possible accuracy, and no one will welcome more than myself the result of the determination by Fabry and Perot's method now in progress at the National Physical Laboratory. My own being a totally different method, it must surely be an advantage if the two different methods eventually turn out to give results in practical agreement.

A. E. H. TUTTON.

Electron Exchange Phenomena in the Excited Atom.

IN an interesting paper recently published,[1] H. S. W. Massey and C. B. O. Mohr have calculated the relative electron excitation probabilities in the case of helium.

These calculations, while following up the previous work of Oppenheimer, Born, and Dirac, take into particular account electron exchange phenomena in the excited atom.

Their final results show that in the case of 200 volt electrons in helium the relative probabilities to be expected are as follows :

Transition .	$1S-2S$.	$1S-2P$.	$1S-3P$.	$1S-3D$.
Singlet . .	0·03	0·09	0·0015	0·00025
Triplet . .	0·001	0·00002	$0{\cdot}0_71$	$0{\cdot}0_61$

It so happens that we have been engaged in an experimental investigation involving this very point, some of our results being published in the *Proceedings of the Leeds Philosophical and Literary Society* in March 1931, and in the *Philosophical Magazine* for November 1931.

Our experiments agree, approximately at any rate, with the above results so far as the 1^1S-2^1P and 1^1S-3^1P transitions are concerned, but *we have failed to find any evidence at all of any transition corresponding to* $1S-2S$ singlet or triplet.

It is clear that we should have found it, if present, according to the relative intensity predicted by Massey and Mohr.

It may not be without interest further to point out that Jones and Whiddington[2] found that in the electron excitation of H_2 there was a marked maximum in the probability of an observed loss of about 9·0 volts in the neighbourhood of 16 volts velocity of impacting electrons. The suggestion made at the time was that this loss was an excitation resulting in the emission of the optical continuous spectrum.

This notion is strengthened if regarded in the light of the work of Massey and Mohr, since the loss in the case of H_2 seems by analogy as likely to be a triplet excitation, the continuous spectrum being produced by transitions to a supposed unstable 1^3S state.

R. WHIDDINGTON.
J. E. ROBERTS.

Physics Laboratories,
University of Leeds, Nov. 11.

[1] *Proceedings of the Royal Society*, vol. 132; 1931.
[2] *Philosophical Magazine*, vol. 6, p. 899; 1928.

The Atomic Weight of Fluorine.

MESSRS. H. S. Patterson, R. Whytlaw-Gray, and W. Cawood have published[1] some preliminary results on a new revision of the molecular weight of methyl fluoride which seems to lead to the value 19·010 for the atomic weight of fluorine. I should like to point out that the references given in favour of this value are by no means trustworthy. In the first place, the work of McAdam and Smith[2] on the analytical ratio, sodium fluoride to sodium chloride, was a preliminary one. The only two transformations carried out give, after correction to a vacuum, fluorine = 19·019 (instead of 19·010). Smith and van Hagen[3] conclude more recently that "the experience of these authors shows that the reaction in question did not proceed smoothly", and that "the errors of experience—traces of water in sodium fluoride and conversion incomplete to sodium chloride—would have increased the value of the atomic weight of fluorine". Germann and Booth[4] have determined the normal density of silicon tetrafluoride, but, as Clarke has pointed out,[5] "do not go so far as to compute from this figure the molecular weight of the fluoride". By comparison with the deductions of Jacquerod and Tourpaian,[6] Clarke obtains for the molecular weight 104·47 and hence for the atomic weight of fluorine 19·09 (not 19·010). Van Laar, on the other hand, assuming that the critical constants for silicon tetrafluoride as determined by Moissan are incorrect, has calculated the molecular weight as 104·13 and hence they find 18·995 for fluorine.

The most recent work of Smith and van Hagen has proved that the ratio of fluorine to another halogen, say chlorine, may be established analytically much more readily by an indirect comparison—say, by converting a sample of a suitable compound to the choride and another sample of the same preparation to the fluoride by an independent method. With borax as such an intermediate compound, Smith and van Hagen have established many cross-ratios between sodium fluoride and sodium chloride, sulphate, nitrate, and carbonate. With the most probable values for chlorine, nitrogen, sulphur, and carbon we get for fluorine 19·002, 19·001, and 19·000. Only the conversion from borax to sodium carbonate, which would be incomplete, gives fluorine 19·006. The other exceedingly reliable values support the value 19·000 as found by Moles and Batuecas.[7]

Aston, using the new mass-spectrograph and with boron trifluoride, deduces 19·000 as the atomic weight of fluorine, in agreement with our conclusions.[8]

With reference to the criticisms on our work on the normal density of methyl fluoride, I should like to point out that the gas was prepared by two different methods : by the reaction of potassium fluoride with potassium methylsulphate and by the action of methyl iodide on silver fluoride. The mean values for the density from the two methods agree by 1·7 part in 10,000. For the compressibility measurements, only the gas from the second source, which will certainly not be contaminated with methyl oxide, was employed.

The method of Collie (decomposition of tetramethyl ammonium fluoride by heat) has been tested in my laboratory by Gonzalez.[9] By heating the salt to 160° over phosphorus pentoxide in a vacuum for several weeks, it was not possible to obtain an anhydrous product. Traces of water are retained by the fluoride, and by heating this salt to 180°, decomposition and at the same time a secondary reaction with production of ammonia, nitrogen oxide, and methane take place. Purification of the evolved gas with potash, ferrous sulphate, sulphuric acid, and phosphoric anhydride and repeated liquefaction and fractionation give a gas fraction with constant density

and constant boiling point which contains about two per cent methane.

If we use the constant litre weight found by Gonzalez, 1·5363, and the results of Patterson, Whytlaw-Gray, and Cawood at 21°, to calculate the coefficient of thermal expansion of methyl fluoride, we get the normal value 0·0037. On the other hand, van Laar,[10] with the critical constants as determined by Collie with the impure gas, has calculated the compressibility coefficient 1·0094, which approaches the value deduced by Patterson, Whytlaw-Gray, and Cawood, namely, 1·0109. It seems very probable that the methyl fluoride used by the latter workers was contaminated with some two per cent of methane.

It appears to be highly improbable that the atomic weight of fluorine should exceed 19·000. A detailed paper will appear soon elsewhere. E. MOLES.

National Institute of Physics and Chemistry,
University, Madrid,
Oct. 15.

[1] NATURE, **128**, 375, Aug. 29, 1931.
[2] *Jour. Am. Chem. Soc.*, **34**, 592; 1912.
[3] Carnegie Institution, Report No. 267, p. 47; 1918.
[4] *Jour. Phys. Chem.*, **21**, 81; 1917.
[5] "Recalculations on Atomic Weights", 4th edition, pp. 273 and 315.
[6] *Jour. Chim. Phys.*, **11**, pp. 1 and 273; 1913.
[7] *Jour. Chim. Phys.*, **18**, p. 353; 1920.
[8] *Proc. Roy. Soc.*, A, **115**, p. 503; 1927.
[9] *Anales Soc. esp. Fis. Quim.*, **20**, 539; 1922.
[10] "Zustandsgleichung", p. 46.

Respiration of Healthy and Leaf Roll Potatoes.

IN the study of virus diseases of plants, comparatively little attention seems to have been paid to the effect on metabolism. This is particularly surprising in the case of potato leaf roll where the retardation in growth, pallor of the foliage, and the accumulation of carbohydrates in the leaves at the expense of the tubers, point to the disease effecting profound changes in normal metabolism. In the belief that this modified metabolism would be reflected in the rate of respiration, a comparative study of the respiration (as measured by the weight of carbon dioxide evolved per gram fresh weight and dry weight) of healthy and leaf roll potatoes has been made at various stages in the life-cycle.

Briefly, the work has shown that the respiration of the immature healthy tuber is higher than on maturation in storage, and again rises with the development of sprouts. On the first unfolding of the leaves there is an enormous rise in the respiration rate, followed by a gradual, though slight, fall as new tubers are produced. The cycle of events is much the same in the infected potato, but with important differences in detail. The infected immature tuber respires at a higher rate than the healthy tuber when first lifted, then falling, on storage, to a level slightly below that of the healthy mature tuber. On sprouting, the respiration rate lags behind that of the healthy tuber until the sprouts break into leaf, when the great increase in carbon dioxide production noted in the healthy plant is exceeded by the diseased one. This higher rate of respiration of infected foliage is evident, therefore, before any rolling or excess accumulation of starch occurs in the leaves, but not necessarily before sugars begin to accumulate. It remains at a higher level than the respiration of the healthy plant during the rest of the growing period. It is of interest to recall that Thung, though mainly working with detached leaves floating on water, also found a higher rate of respiration in leaf roll than in healthy leaves.

Anaerobic respiration in nitrogen is unaffected by the virus; the tuber—whether diseased or not—producing 70-80 per cent of the carbon dioxide evolved under aerobic conditions. The growing plant is able to emit as much carbon dioxide anaerobically as it does aerobically, whether infected or healthy. The changes in respiration during the life of a potato could therefore be represented by much the same curve for anaerobic as for aerobic conditions. It is higher in the diseased immature tubers, about the same in diseased and healthy after prolonged storage, lower in diseased sprouting tubers, but much higher than the healthy plant once leaves have developed.

Glasshouse plants growing in pots have been used throughout this work, whilst tubers in different stages of maturity have been obtained from plants growing under normal field conditions. No explanation of these results can be offered at present, but it is hoped that further studies will not only throw some light on the nature of the metabolic disturbances caused by the leaf roll virus, but also provide a new angle from which to view the inter-relationship of respiration, available respirable material, and growth in normal plants.

T. WHITEHEAD.

University College of North Wales,
Bangor, Nov. 6.

Eurytemora thompsoni, A. Willey: A New European Record.

IT is a common, but none the less mistaken, conception that the be-all and end-all of the systematist is the discovery of new species. In reality, the discovery of well-known species in remote parts of the world has a far greater fascination and is infinitely more important. It is perhaps no exaggeration to state that the world-wide distribution of common species of animals and plants is the basis of one of the most fundamental conceptions of the whole of the science of biology, since on it rests almost our only data for observing the influence of environment.

In June of the present year, on visiting a brackish-water pool, removed but not far distant from the sea at South Lancing, Sussex, I came across numerous specimens of a species of *Eurytemora*, a well-known genus of copepod.

Close investigation showed that the species was not British or even European, and it was, in fact, *Eurytemora thompsoni*, Willey, of which no other record existed beyond that of Prof. Arthur Willey, of McGill University, who took it from the stomach of a fish caught in a weir near the low-tide level at Scotsman Bay, Nova Scotia.

The species had also been found, but not recorded so far, by Prof. Smirnov, of Leningrad, in the brackish waters of the Sea of Okhotsk. A truly remarkable distribution as it stands, but it is more than likely that the species exists in many other brackish-water localities, but so far it has escaped detection.

A full description of the species has just been published in the November part of *Annals and Magazine of Natural History*. A. G. LOWNDES.

Marlborough College,
Wilts, Nov. 14.

Uteroverdin.

ONE of us [1] has recently isolated oocyan—the blue-green pigment of the shells of many birds' eggs—and characterised it as an ether-soluble pyrrol pigment closely related to the bile pigments. We have now found a second example of this class of substances in the green pigment of the dog's placenta, the properties of which are very similar to those of oocyan. This pigment was examined in 1871 by Etti,[2] and considered to be biliverdin; it is formed by the transformation of the blood-pigment in the extravasates of the dog's placenta.[3] While the methoxyl content

of the ester of oocyan indicated a molecule with only three pyrrol nuclei, the analysis and methoxyl content of the methyl ester of uteroverdin (as we will call the substance) show that we are dealing with a substance with four pyrrol nuclei. From its composition ($C_{35}H_{38-42}N_4O_6$) it appears that it is the dimethyl ester of a dehydrobilirubin or dehydromesobilirubin. The values for C, H, and N (not, however, the methoxyl content) of the ester of oocyan agree also with the formula $C_{37}H_{42}N_4O_8$; that is to say, with that of the trimethyl ester of a substance which differs from uteroverdin only in possessing one more carboxyl group. A further investigation of oocyan by one of us (R. L.) is in progress.

Oocyan differs from the synthetic tripyrrenes of H. Fischer [4] in its absorption and in giving a clearly positive Gmelin reaction. Attempts are being made to pass from bilirubin to this new class of substances, to which probably belong one or other of the green oxidation-products of bilirubin, obtained by very different methods, hitherto considered to be 'biliverdin'.

We do not know yet what is the significance of the fact that the decomposition of hæmoglobin in the dog's placenta—and in other cases of blood extravasates in the uterus—leads to such pigments instead of to bilirubin. It has not, up to the present, been possible to demonstrate an enzymic formation of uteroverdin by placenta tissue or tissue extract, any more than in the case of bilirubin.

R. LEMBERG.
J. BARCROFT.
D. KEILIN.

Biochemical and Physiological Laboratories
and Molteno Institute, Cambridge.

[1] R. Lemberg, *Liebigs Ann.*, **488**, 74; 1931.
[2] Etti, *Malys Jahresberichte*, p. 233; 1871: p. 287; 1872.
[3] On the histological findings, see B. Schick, *Zeit. für Kinderheilkunde*, **28**, 231; 1921. N. Lieberkühn and H. Strahl, *Arch. für Anat. und Physiol.*, p. 196; 1889.
[4] H. Fischer and E. Adler, *Zeit. für physiol. Chem.*, **200**, 209; 1931.

Properties of Aerosols.

MESSRS. W. Cawood and H. S. Patterson's letter [1] describing "A Curious Phenomenon shown by Highly Charged Aerosols" is very interesting from the viewpoint of spontaneously electrified aerosols, as well as from that of aerosols electrically charged from an independent source such as they used.

The work of W. A. D. Rudge,[2] showing that most aerosols initiate static charges owing to the movement of the constituent particles through the gaseous dispersion medium, has led to the theory of A. Stager,[3] who experimented with driven snow-dust on the Jungfrau, that in a spontaneously charged aerosol the smaller particles become charged in one sense and the larger ones in the other sense. On *a priori* grounds this theory does not seem capable of satisfying the facts save where the disperse phase of an aerosol consists of particles of but two sizes. For, where particles of several sizes were involved, any dimension except the smallest and largest would be both 'larger' and 'smaller' by alternative relation with respectively juxtaposed sizes. On the other hand, the phenomenon observed by Messrs. Cawood and Patterson seems to confirm selectivity of charge-sign dependent on variation in particle size in so far as electrification due to an independent source can be compared with self-electrification of an agitated aerosol.

In Messrs. Cawood and Patterson's experiments both types of electrification would, presumably, exist, and although one does not know what degree of spontaneous electrification would arise on, say, *p*-xylene-azo-β-napthol under the conditions they imposed (Blacktin and Robinson [4] find that 0·0011 oz. av. per cubic foot of coal dust of fineness 83·5 per cent through 200 I.M.M. sieve, whirled at 45 feet per second, rapidly initiates a potential of more than 4000 volts), it may well be that 'clusters' might be formed in their chamber, (*a*) merely on fanning without independent electrification, or (*b*) partially due to the additional spontaneous electrification as a significant superposed factor. If the former proved correct, a great step would have been taken in establishing the sign-particle size theory of spontaneous electrification in aerosols.

It may be worthy of note that if, as Messrs. Cawood and Patterson suggest, globular lightning may owe its origin to an effect analogous to the phenomenon they observe, the "very much higher potential" involved would be of spontaneous, rather than independent, origin. This would be a tentative reason for expecting the phenomenon they observed to show itself as producible merely through controlled spontaneous electrification without the necessity for introducing an independent source of electrification.

S. C. BLACKTIN.

1 Adelaide Road,
Andover, Hants, Nov. 5.

[1] NATURE, **128**, 150, July 25, 1931.
[2] *Phil. Mag.*, **25**, 481; 1913.
[3] *Ann. der Physik*, **76**, 49; 1925.
[4] Safety in Mines Research Board, Paper No. 71. London: H.M. Stationery Office.

Carbon Contacts.

IN his delightful article on the Hope-Jones clock, in NATURE of Oct. 17, Prof. Boys refers to the difficulty of obtaining sure and certain contact for electrical purposes with light pressure. This difficulty may be overcome by using carbon contacts. I have had a station voltage regulator in operation for some twenty years with carbon contacts and the result has been quite satisfactory, the carbon being pure and free from ash. The microphone provides another instance of such contact operated in circumstances which are delicate. Probably there are many instances in the laboratory where carbon contacts for working apparatus through relays would be of service.

C. TURNBULL.

Electricity Works,
North Shields, Oct. 31.

THE contact difficulties to which I referred were those of fifty years ago with light or hesitating contacts backed by insufficient volts. I did not intend to imply that at the present time with new materials and abundant volts contacts need give any trouble. I have for a long time recommended Acheson graphite made at Niagara, from which all other matter has been volatilised, and this, I expect, is what Mr. Turnbull has used. There are also the more modern mercury in nitrogen contacts which are admirable where the larger movement necessary to operate them and the slight time delay do not matter.

Where there is much self induction in the circuit to be broken, plenty of capacity as a shunt across the break is desirable, and thanks to wireless dealers this can now be obtained for fewer shillings than the cost in pounds at the earlier date. I used at Oxford when weighing the earth in place of a capacity a pair of electrolytic cells in series with platinum electrodes which I still have, the current coming from a pair of secondary cells. At each break every second a bunch of microscopic bubbles of the electrolytic gases were evolved, but the spark was absolutely quenched. Such a device is the electrical analogue of the water ram. Not one contact ever failed. I consider it better than a true capacity.

C. V. BOYS.

Electrical Conditions in Stratified Clouds.

IN preparing a paper on "The Physics of High Altitudes" for the Dublin meeting of the British Association in 1908 (Climate and Health Committee), I spent some days on one of the central heights of Madeira observing atmospheric electrical conditions during the placid season of summer weather.

The wind was steadily N.N.E., and except for ascending masses of vapour the inflowing sea-breeze from solar generation had wasted before reaching my station 5700 feet from the sea. The mountain collar cloud formed with great regularity, and varying slightly with barometric pressure became a stationary mass, perhaps 500 feet thick, at an altitude between 2500 feet and 3000 feet.

The upper surface waste of constant evaporation was steadily recuperated by the arriving cloud vapour, visible or condensed, which spread out as a lower layer of the collar.

Now this collar cloud took, always in calm weather, a distinctly stratified form, and on one or two occasions when in exceptionally high barometric conditions the collar rested at an unusual height—6000 ft. or 7000 ft. —I was able to fly my kites into close proximity with the arriving vapour masses which were to maintain the collar in structure and position.

These arriving masses were always electrified, that is, clothed with an envelope of positive electricity varying in intensity as indicated by Thomson's portable electrometer, to which my kite was attached by a wire conductor twisted with the string; and the vapour masses, thus clothed, seemed on arrival at the cloud under-surface, itself positively electrified, to hesitate and to be kept apart, thus giving a clue to the stratified appearance which it is here my object to illustrate.

By and by distinct coalescence would occur, but the cloud never lost entirely the stratified arrangement of its component layers. My kites were made of thin glazed lining, for paper would collapse under aqueous vapour, and I was able, with an improvised oiled silk receptacle fitted with spirit and provided with a spreading unlighted wick, to provide the waste of substance accomplished by the burning match or water dropper.

MICHAEL GRABHAM.

Madeira, Oct. 6.

The Band Spectrum of AsH.

THESE bands were obtained by photographing a carbon arc, the negative electrode of which had been drilled and filled with arsenic, run in an atmosphere of hydrogen at a potential of 110 volts. No bands were obtained with the arsenic in the positive electrode. The electrodes were composed of Acheson graphite. The spectrograph used was a Hilger three-metre quartz prism instrument.

Three bands were found. Two, the origins of which were at 32,380·2 cm.$^{-1}$ and 31,636·9 cm.$^{-1}$, had very wide spacing between the lines, and appeared to be typical hydride bands. The other band was unresolved and was probably due to As_2. The head of the band was at 31,802·6 cm.$^{-1}$.

The AsH bands were shaded to the red and consisted only of P and R branches. The lines of the band at 32,380·2 cm.$^{-1}$ were fitted by the formula

$$\nu = 32{,}380{\cdot}18 - 11{\cdot}186\,M - 4{\cdot}474\,M^2 + 0{\cdot}0485\,M^3 + 0{\cdot}01027\,M^4,$$

but since the origin lies in the head of the band we have not yet been able to assign definitely the true quantum numbers. There was no sign of doubling in any of the lines. The electronic transition is, therefore, probably of the type $^1\Sigma - {}^1\Sigma$.

The other hydride band is badly confused by the As_2 band, and no analysis has yet been attempted. Further work will be carried out in the near future.

GEORGE E. KIMBALL.
JOHN R. BATES.

Frick Chemical Laboratory,
Princeton University,
Princeton, N.J.,
Oct. 14.

Branching of Lightning.

SCHONLAND and Allibone, in NATURE of Nov. 7, contribute what seems to be conclusive instrumental evidence that lightning discharges proceed from a negatively charged cloudbase. Confirmation (if any were required) may be obtained optically by the observation of very distant flashes, on the assumption that lightning consists primarily of direct electronic movement.

If the discharge is sufficiently far away, the subtended angular motion is so small that it is possible, in the duration of the flash, actually to see which way it is moving. I have noted several such discharges, particularly under the favourable conditions prevailing in sub-tropical China, and in every case the flash could be seen to start from the cloud and 'grow' downwards.

J. L. P. MACNAIR.

Military College of Science,
Royal Arsenal, Woolwich, S.E.18,
Nov. 17.

Esperanto in Scientific Literature.

UNTIL quite recently the use of Esperanto for scientific purposes was usually regarded as a matter of jest. This is still the attitude of many who, while they readily appreciate how immensely valuable an easy but complete, precise, and euphonious international language would be, do not realise that Esperanto not only possesses these claims in theory, but has also been tried out in practice with most encouraging results. Several entire papers have been published in Esperanto from the Institute of Physical and Chemical Research at Tokyo, and other Japanese (and also European) institutions issue bulletins in this language. Esperanto may certainly be considered a satisfactory medium for composition on physical and chemical themes, as during the last three decades various commissions, societies, and individuals have carried out translations and compiled lists of technical terms which have been officially accepted. Consequently, a complete system of chemical nomenclature and a very complete physical and chemical vocabulary have now been available for several years.

An efficient medical language has been developed lately through an international society of medical men, and a monthly review which has flourished since 1923. In the more general field of biology, however, the language has been much less widely employed, though here again various individuals have performed notable spade-work in the compilation of technical vocabularies and in working out systems of nomenclature. A group has recently been formed to take stock of the existing material and to develop its use by the translation of biological papers. I shall be glad to send particulars to anyone interested in the subject.

R. M. MORRIS-OWEN.

Balliol College, Oxford.

Research Items.

Folk-Tales of the Cochita, New Mexico.—A collection of tales told among the Cochita Indians of New Mexico, collected by Ruth Benedict, is published as *Bulletin* 98 of the Bureau of American Ethnology. As the tales were recorded in a house open to all, they form a selected group; for there is a taboo against telling certain tales to whites, just as there is a taboo against whites seeing masked dances or dancers. The tales fall into certain classes, such as stories of the katcinas, hero tales, true stories, and the like. Some are obviously of European origin; but the great majority are fictional. Under the influence of the study of the European folk-tale, which is obsolete, the significance of the fictional story among primitive peoples is often overlooked. The fictional story, notwithstanding its imaginative character, deals with incidents, situations, and problems which are real in the culture of the people. Among the katcina stories, that of the quarrel between two sisters is the origin story of the Cochita; but owing to the prejudice against telling it to the whites, only the culminating incident is given. In the hero tales, the heroes are insignificant, poverty-stricken, and ridiculed boys who are successful in overcoming their enemies and mockers. The Twin Heroes, the protectors of the helpless and the institutors of custom, are mischievous and irresponsible; the Arrow Boy does not hunt and spends all his time courting girls; the Poker Boy is ugly and untidy, and so forth. Montezuma, though a mythological culture hero, is ridiculed as a half-wit. The novelistic tales are fictional versions of Pueblo life, excepting in two respects, one difference being a contest over food stores, the other, marriage to multiple wives, polygamy being absent both in the old culture of the Cochita and at the present time under Roman Catholic teaching. Throughout the stories, the initiative and independence of the women is strongly marked.

Song of an American Oriole.—From observations made in the neighbourhood of Pinole, California, Alden H. Miller is of opinion that his countrymen have not given proper credit to the song of Bullock's oriole, *Icterus bullocki* (*Wilson Bulletin*, June 1931). At any rate he gives an interesting story of the relationship of the song to territorial claims. In spring the male bird precedes the female by one to two weeks, and establishes a singing post. When the hen arrives she combines in the defence of the territory, but the co-operation is imperfect until the nest is built, in the sense that the hen drives away females only, and the cock, males only. Indeed, the female during this period may actually court strange males in the reserved territory (which scarcely seems to be playing the game), but the attachment of the male is equally diffuse. The song of the hen oriole in defence of the territory and in association with males is in every way comparable to the songs of the cocks, and may be regarded as a true territorial song. The songs of the sexes are similar in rhythm, pitch, and quality, except that the final notes of the female's song are slightly harsher, of somewhat less range, and show modifications of rhythm. Before or during nest-building the songs of females may, on occasion, be even more abundant than the songs of the males.

Musculature of Crustacea.—The main portion of the Report for 1930 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool edited by Prof. James Johnstone and Dr. R. J. Daniel (Liverpool University Press: 1931), is taken up with a continuation of Dr. Daniel's researches on muscles of certain Crustacea: "The Abdominal Muscular System of *Homarus vulgaris* (L.) and *Palinurus vulgaris* (Latr.)": "The Abdominal Muscular System of the Shore Crab (*Carcinus mœnas*) and of the Zœa I and Magalopa Stages": and "Comparative Study of the Abdominal Musculature in Malacostraca. Part I. The Main Ventral Muscles of the Typical Abdominal Segments." In this last paper the author compares all the types investigated both in the present work and in previous reports. *Paranaspides lacustris*, *Praunus flexuosus*, *Meganyctiphanes norvegica*, *Crangon vulgaris*, *Homarus vulgaris*, and *Palinurus vulgaris* have all been examined. The main conclusions are that the ventral muscles of the Decapoda chosen may be derived from the Paranaspides type by the addition of true transverse and dorso-lateral muscles; those of *Praunus flexuosus* and *Meganyctiphanes norvegica* being very much specialised. In the case of *Carcinus mœnas* it was found that both in the first zœa and in the megalopa the musculature of the abdomen is very simple and anticipates that of the adult crab, where the abdomen is so much reduced.

Respiration of Wheat at Low Temperature.—The commercial importance of frost resistance in Canadian agricultural practice has led recently to a large number of studies of the physiological mechanism underlying hardiness or resistance to frost injury. Newton and Brown (*Canad. Jour. Research*, **5**, 333) have investigated the degree of catalase activity shown by juice pressed from wheat plants of various hardy and non-hardy varieties. Under the conditions employed, the activity is greatest in the juice of hardy plants. On the other hand, a subsequent investigation of the rate of respiration of similar varieties of wheat by Newton and Anderson (*Canad. Jour. Research*, **5**, 337) showed that the plants of hardy varieties have a smaller respiration rate at temperatures below the freezing point, which agrees with a previous observation that their reserves of sugar are maintained at a higher level during winter than are those of non-hardy varieties. The difference in respiration rate is not, however, observed at higher temperatures.

A Satellite Missing from Ever-Sporting Stocks.—A cytological study of certain ever-sporting races of garden stocks—singles which throw doubles—by Dr. J. Philp and Prof. C. L. Huskins (*Jour. of Genetics*, vol. 24, No. 3), has revealed a striking explanation. The strains were obtained from Miss E. R. Saunders, who has done much genetical work on the genus. Examination of the somatic chromosomes ($2n = 14$) shows that one pair (A) in the pure single and pure double strains has a subterminal fibre-attachment constriction and a trabant or satellite attached to the short arm. In ever-sporting singles one of the A chromosomes lacks the trabant. Such plants are heterozygous for the recessive doubleness, these factors being carried in the A chromosome but not in its satellite. Pollen grains which contain the chromosome lacking the satellite do not function in fertilisation, while this condition is lethal in only part of the female gametes. On this basis the long-known ever-sporting behaviour is explained in general accord with Frost's earlier hypothesis. The authors also show that in a trisomic mutation called 'Crenate' by Frost, which behaves as a trisomic for singleness-doubleness, three A chromosomes are present, two of them having a satellite. Frost's variety 'Snowflake' and its trisomic mutants are found to have long

meiotic chromosomes, a confirmation of observations by Lesley and Frost. It is suggested that this condition has arisen from the normal by a mutation which delays slightly the onset of chromosome contraction in the heterotypic prophase.

Timber of the British Douglas Fir.—*Bulletin* No. 10 (August 1931) from the Forest Products Research Laboratory at Princes Risborough treats of the timber of home-grown Douglas fir, now termed *Pseudotsuga taxifolia*, following the International Rules of Botanical Nomenclature, instead of *P. Douglasii*, the name which has been so long in use in Europe. The bulletin has been written by Mr. B. J. Rendle, and comprises the investigations carried out by him with the view of indicating "to growers and users the possibilities and limitations of the timber". Mr. Rendle's investigations have shown several most interesting and reassuring factors on the subject of the home-grown wood of Douglas. The logs investigated came from Benmore and Kilmun in Argyllshire, Taymount in Perthshire, Longleat in Wiltshire, and Highclere in Hampshire. The age of the trees varied between fifty and sixty years, except in the case of Highclere (thirty-five to forty years). This implies that in no case had the trees reached maturity, and consequently contained a high proportion of the rapid-grown timber of the early years as compared with the slower-grown material of later life. It is believed from the examination of the latter that maturer trees would show a greater percentage of the better-class timber. The wood can be readily seasoned, both in the open and in the kiln. For the private proprietor of woods an important outcome of the tests has been that Douglas pit-props have approximately a strength equal to home-grown Scots pine and to that of imported Baltic and French timber, and this in spite of the rapidity of growth in early years. This rapid growth and the question of slowing it down in order to obtain a larger number of rings to the inch (not less than six or seven and preferably ten) is one of the economic problems which will require settlement according to the objects for which the woods are formed: that is, to give a quick and early return, to provide as large an amount of mature timber as possible, or to achieve a middle course. It is mainly a sylvicultural problem. Mr. Rendle's study has been systematic and thorough. The bulletin deals with investigations on structure, seasoning, strength, preservation, working qualities and grade, and uses.

Southern Rhodesian Geology.—The geology of the country around the well-known Shamva Mine, north-east of Salisbury, is described by R. Tyndall-Biscoe in *Bulletin* 18 of the Geological Survey of Southern Rhodesia (pp. 87 and geological map, 1931). The greater part of the area is made up of Archæan rocks, the oldest of which consist of highly metamorphosed basic volcanic rocks (greenstones) with interbedded strips of recrystallised sediments. The "Shamva Grits" follow, including arkoses and greywackes, and conglomerates that carry pebbles of the older series. Both sets of basement rocks are invaded by gneissic granite and associated intrusions. It is fairly well established that the gold-bearing quartz-reefs and other gold deposits of the region are to be correlated with the later stages of this igneous cycle. It is concluded that the gold of the Shamva Mine was originally a constituent of the magma which solidified to form the two granite stocks now exposed to the north-east and south of Shamva. The next recognisable episode was the intrusion of dolerite dykes and sills. In part these belong to the late Karroo, but as dykes of three or four different ages are known it is likely that some were injected during earlier geological periods. An excellent series of chemical analyses by E. Golding deserves special mention. These continue to confirm a geochemical generalisation that has already been noted in these columns, namely, the unusual abundance of strontium and paucity of barium in the rocks of Southern Rhodesia.

Atmospheric Ionisation.—Prof. J. J. Nolan and Dr. P. J. Nolan have published in the *Proceedings of the Royal Irish Academy* (vol. 40) an account of their observations on the state of ionisation of the air at Glencree, in the Wicklow hills. This station can be regarded as uninfluenced by large towns, except when the wind blows directly from Dublin, and to a less extent from smaller places to the east. The data obtained for different winds thus provide information about both clean and contaminated air, and show clearly the effect of the city in producing condensation nuclei, probably products of combustion, in large numbers. The smaller ions are less affected, and after eliminating, so far as possible, all disturbing influences, it was found that about five hundred were present in a cubic centimetre with a positive charge, and 375 with a negative charge; the disparity of the concentrations was diminished by rain. The ratio of concentrations also shows a diurnal variation corresponding to that of the vertical field in the air, and there is evidence that the rate of formation of ions fluctuates in a similar way. An appendix to this paper contains the results of all the observations made between October 1928 and December 1930, and should prove valuable for comparison with readings taken at other stations.

Distillation of Dry Liquids.—It has been observed by several investigators that dry liquids boil with difficulty. The abnormal behaviour observed with liquids after intensive drying might be due, in part at least, to the slowing down of the rates of evaporation and condensation of liquids after such treatment. In the October issues of the *Journal of the Chemical Society*, J. W. Smith records experiments with intensively dried ethyl bromide. This was contained in a bulb connected with a second empty bulb, a wide tube containing phosphorus pentoxide being sealed to the tube connecting the first two bulbs. In this way no obstruction to the vapour was introduced. All air was removed from the apparatus. It was found that the time of non-ebullitional distillation increased markedly with drying, and it was difficult to obtain ebullition with the very dry liquid even with violent shaking in a bath at quite a high temperature. The effect was not removed by a period of heating of the liquid, which is considered to indicate that polymerisation is probably not responsible for the change, since this polymerisation might be expected to be broken down by heating. No change in the vapour pressure of ethyl bromide due to intensive drying could be detected, this result being in contradiction to those of Smits, who found an increase, but after a longer period of drying than that used by Smith. No separation into fractions by distillation could be achieved. The change in rate of distillation is very slight in the first period of the drying, but then increases sharply, afterwards decreasing again. The results are interpreted as showing that intensive drying does not disturb the internal equilibrium of a liquid, but that the effects are due to some form of superheating, probably induced by the removal of nuclei of some type during the treatment with phosphorus pentoxide.

Heat Insulation of Furnaces.—The issue of *Chemical and Metallurgical Engineering* for July contains an account by Messrs. J. B. Barnitt, research engineer

of the Aluminium Company of America, and R. H. Heilman, fellow of the Mellon Institute of Industrial Research, of their search amongst the aluminium compounds for a material which would withstand temperatures of the order of 1000° C. and at such temperatures have a low heat conductivity. They find that aluminium monohydrate, bauxite monohydrate, and a waste product from the extraction of pure aluminium material from bauxite are the most promising materials, and that their heat conductivities, which all increase with rise of temperature, are in the ratios of 15 : 9 : 6. The latter is cheap but heavy, the bauxite monohydrate is less expensive than the aluminium monohydrate, but will not stand such high temperatures as the latter. If the heat insulating material is required in brick form and not as a powder, the authors find that bauxite monohydrate, with certain additions to increase its strength at high temperatures and decrease its shrinkage, is best, and blocks of this material 12 in. by 36 in. and of various thicknesses are now on the market.

Distance Thermometers.—In an illustrated pamphlet of 40 pages, Messrs. Negretti and Zambra discuss the relative merits of gas, vapour, and liquid thermometers for use at a distance from the observing station, and come to the conclusion that mercury in steel thermometers with dial scales are the most serviceable. The errors to which such thermometers are subject are considered, and conclusions are drawn as to the best methods of eliminating them. The capillary tube connecting the bulb to the Bourdon tube which carries the pointer has its bore reduced to 0·005 in., so that the error due to it may in most cases be neglected. Fatigue of the Bourdon tube material has been overcome by the use of a special steel and a section which distributes the stress in the material more uniformly.

Astronomical Topics.

The Leonid Meteors.—A Science Service bulletin, dated Nov. 16, reports a fairly active shower of these meteors in the early hours of Nov. 16, observed by seven students of Columbia College, Dubuque, Iowa, under the direction of Rev. J. Theobald, professor of mathematics. In spite of a slight haze, 289 meteors were observed in six hours; the maximum rate of fall was 90 per hour at 4.45 A.M. (that is, 10.45 U.T.). These meteors came about eighteen hours before the slightly less active shower observed in England by Mr. Prentice and Mr. King.

Drs. Johnstone Stoney and Downing, in their work on the return of the meteors in 1899, introduced the terms "ortho-Leonids" and "clino-Leonids"; the former are a comparatively compact clump, which are seen only in the years round about the comet's perihelion-passage. Since the earth takes only five or six hours to traverse the ortho-stream (Olivier, "Meteors", p. 36), one or other, or perhaps both, of the displays described above must have belonged to the clino-Leonids; these are scattered around the whole of the long elliptical orbit, but more thickly in the neighbourhood of the comet. When the ortho-stream is entered, the hourly rate sometimes goes up to thousands. Even in the comparatively poor displays of thirty-three years ago, 800 meteors were recorded in a few hours, both in 1898 and in 1901.

Father O'Connor reports that arrangements were made at the Stonyhurst College Observatory to keep the sky under observation during the nights of Nov. 15–18. Rain or clouds prevailed almost the whole time, but it cleared up somewhat about 4.0 A.M. on the morning of Nov. 17. "Between 4.15 A.M. and 6.0 A.M. I observed 13 Leonids, of which four, observed at 4.32, 5.2, 5.3, and 5.42, were considerably brighter than first magnitude stars. The one at 5.3 in particular was exceedingly bright, and distinctly illuminated the surrounding country."

The Mass of Saturn's Ring.—H. Slouka contributes a paper to *Scientia* for August in which he traces the history of investigations on Saturn's ring, beginning with Galileo's well-known anagram announcing the triple nature of the farthest planet. Next comes Cassini's detection of the great gap in the ring, and Laplace's investigation of its stability. Bessel was the first to make any attempt to determine the mass of the ring, which he did from the observed motion of the apse of Titan's orbit: he gave the two values 1/213 and 1/118 of Saturn's mass; both are now known to be much too large, and his revision made things worse instead of better. Clerk-Maxwell, after proving that the rings must be composed of cosmic dust, made an estimate of the number and size of the particles, from which he deduced the very low value 1/50,000,000 for its mass. Tisserand, from the motion of the apse of Mimas, found the large value 1/620; Meyer revised Tisserand's work, using improved values of the constants; he first gave 1/1960, but reduced this later to 1/26,700. H. Struve's exhaustive researches on Saturn's system are well known; he found it impossible to assign an accurate value for the ring's mass; he proved that it could not exceed 1/314, but regarded 1/26,700 as more probable.

The estimate which H. Slouka considers the most reliable was made by Louis Bell from a study of its albedo, based on the photographs taken by Wood in 1916 in light of different wave-lengths; he deduced that the thickness of the rings does not exceed 15 km., and is still less in the less luminous regions; he gave 1/1,000,000 as a maximum value of the mass.

The general conclusion is that an exact determination of the mass is impossible, but that most of the gravitational determinations are much too high. The research is made more difficult by the fact that the polar flattening of Saturn acts on the satellites in the same manner as the ring, but with much greater effect.

Theories of the Birth of the Planetary System.—Most upholders of the tidal theory postulate that another sun made a near approach to our own, and that its immense tidal action caused a filament of matter to leave the sun, which afterwards broke up into the different planets. Dr. H. Jeffreys suggested, a year or two ago, that an actual collision of the two suns would give a better explanation of some features of the solar system. A report by Science Service, Washington, D.C., dated Oct. 27, describes a lecture given to the Washington Academy of Sciences and the Society of Sigma Xi, by Prof. Willem de Sitter. He prefers the collision theory to the purely tidal one, on the ground that it gives an easier explanation of the rotations of the sun and planets. He supposes that in addition to the matter of the planets there was a large amount of diffused gas expelled from the sun. Much of this was later reabsorbed by the sun, but it had in the meantime acquired moment of momentum from the other star, which it imparted to the sun in the form of rotation. The gaseous medium also helped to make the planetary orbits more circular.

Anniversary Meeting of the Royal Society.

SIR F. GOWLAND HOPKINS delivered his first anniversary meeting address as president of the Royal Society on Nov. 30. Referring to the Society's activities during the past year, Sir Frederick remarked that the Council is well satisfied with the change of policy initiated last year, whereby it was decided to expend accumulated trust funds on the active support of current fundamental researches. While the Council no longer has accumulated funds at its disposal, it is proposed to do all that is financially possible in support of individual research.

This year the following grants have been made: From the Messel Fund: £800 a year for five years to Dr. Honor B. Fell, of the Strangeways Research Laboratory, for the support of her valuable work on tissue culture; also £150 for the current year, and, after the termination of his 1851 Exhibition Scholarship, £600 a year for two years, to Dr. M. L. Oliphant, of the Cavendish Laboratory. From the Caird Fund: £2200 to Prof. O. W. Richardson for the purchase of optical apparatus of high resolving power. From the Donation Fund: £400 to Dr. L. S. B. Leakey towards the cost of his East African Archæological Expedition. From the Darwin Fund: £500 a year for four years to Mr. C. S. Elton for research on wild vole populations, together with an additional grant of £250 for capital outlay and field equipment. Dr. S. Adler's researches on kala-azar continues to receive support from the Anonymous Bequest Fund.

During the year the Society has received three bequests—£10,000 under the will of Sir Otto Beit, £3000 from the estate of Dr. A. Muirhead, and about £250 from that of Dr. C. W. Andrews. These bequests were left without restrictions, and have been added to the General Fund.

Sir Frederick also stated that arrangements have been completed with the University of Cambridge for building and equipping a cryogenic and magnetic research laboratory at Cambridge, towards which the Royal Society is contributing £15,000. The laboratory will be known as the "Royal Society Mond Laboratory" as an acknowledgment that the Society was able to forward the enterprise through a benefaction received from Dr. Ludwig Mond.

We print below extracts from the remarks made by the president in bestowing the Society's medals.

Presentation of Medals.

COPLEY MEDAL, AWARDED TO SIR ARTHUR SCHUSTER.

Sir Arthur Schuster was the first to show the important information to be got by measuring quantitatively the magnetic deflection of cathode rays. He showed how, by combining this measurement with the potential difference which generates the rays, it was theoretically possible to determine without ambiguity the velocity, and the ratio of charge to mass, of the particles constituting the corpuscular stream. We owe to him other almost equally fundamental contributions to the study of electric discharge in gases. Thus, he showed that the passage of a luminous discharge put the gas temporarily into a conducting state, due to the presence of charged ions: these ions were able to diffuse into a space screened from the discharge by a wire gauze partition, and they could then be put into evidence by showing the conductivity of the gas under electromotive forces of a fraction of a volt. Sir Arthur was the first to show by experiment that in Crookes's radiometer the reaction was not on the sun but on the glass case of the instrument, thereby connecting the action with the residual gas. He has also made many important contributions to terrestrial magnetism. In spectroscopy he formulated independently the Rydberg-Schuster law. He invented the periodogram method of looking for periodicities in statistical material, a method which has been widely adopted by workers in many branches of inquiry, extending even into economics.

ROYAL MEDAL, AWARDED TO SIR RICHARD GLAZEBROOK.

For fifty years Sir Richard Glazebrook has been closely identified with research on physical standards, and particularly electrical standards. For many years he conducted researches associated with the absolute measurement of resistance, current, and inductance, and the results of this work is reflected in the present remarkable accuracy of electrical measurements. The name of Sir Richard Glazebrook is also world-known on account of his directorship of the National Physical Laboratory; it is largely due to his influence on the researches at that Institution that aeronautical science has made such vast progress. Physical science is also indebted to him for that great work, the "Dictionary of Physics", and in international science he has played a conspicuous part.

ROYAL MEDAL, AWARDED TO PROF. W. H. LANG.

Prof. Lang's work on the fossils of the Old Red Sandstone is of high scientific importance. It has led to the discovery and description of a new and unexpected group of plants in which root, stem, and leaf are not differentiated. For the first time it thus becomes possible to trace in a circumscribed group the probable origin of these structures from a source in which they did not exist as distinct members. The work was begun in collaboration with the late Dr. Kidston, and continued by Prof. Lang after the death of his colleague in 1924. Prof. Lang's previous intensive studies on the morphology of the liverworts and ferns had eminently fitted him to provide a morphological point of view which has given most important results.

DAVY MEDAL, AWARDED TO PROF. A. LAPWORTH.

Prof. Lapworth's work has been largely concerned with the application of physical methods to the investigation of the reactions of organic chemistry. His study of the bromination of acetone yielded results of primary importance in relation to the reactivity of carbonyl compounds and has formed the basis of many subsequent investigations. His researches on the addition of hydrocyanic acid to organic compounds, besides leading to results of theoretical and synthetical importance, made clear the mechanism of the formation of cyanhydrins. His investigations of the effect of small quantities of water in diminishing the activity of acids in alcoholic solution indicated the existence of the oxonium ion and added considerably to our knowledge of catalysis by acids. Among his more notable synthetical achievements are the synthesis of zingerone, derived from the pungent principle of ginger, and of homocamphor. His work on the mutual influence of groups in the same molecule, his recognition of induced alternate polarity, and his classification of reagents as anionoid or kationoid have played an important part in the development of the present state of knowledge of the reactivity of organic compounds.

SYLVESTER MEDAL, AWARDED TO PROF. E. T. WHITTAKER.

Prof. E. T. Whittaker is one of the best known of British mathematicians, his work showing extraordinary versatility. He has written five books, on entirely different subjects, and numerous papers which touch on almost every branch of mathematics. All his books show, besides their more technical qualities, powers of arrangement and exposition of a most unusual order; and the "Modern Analysis" and "Analytical Dynamics" have had a considerable influence on mathematical thought. Prof. Whittaker has made important additions to the theory of the solution of differential equations, ordinary and partial, by definite integrals; to the theory of Lamé and Mathieu functions, the functions of the elliptic and parabolic cylinders, and the integral equations associated with them; to the theory of interpolation; and to the theory of the solution of dynamical problems by trigonometrical series. He has also in recent years made a number of interesting contributions to the pure mathematics of relativity, electromagnetism, and quantum theory.

HUGHES MEDAL, AWARDED TO PROF. W. L. BRAGG.

Prof. Bragg's recognition of the fact that the Laue diffraction spectra could be considered as produced by reflection from the planes of the crystal lattice, besides being a great simplification of a difficult geometrical problem, was the starting-point of two important and fruitful lines of physical investigation, namely, the measurement of X-ray wave-lengths and the elucidation of crystal structure. Work on the first of these led to Moseley's discoveries and their subsequent developments. Bragg's concentration on the second has resulted in a wonderful extension of our knowledge of the structure of crystals, both simple and complex, and of inter-atomic distances and linkages. His work may truly be said to have laid the foundations of a chemistry of the solid state.

The Wellcome Research Institution.

ON Wednesday, Nov. 25, Lord Moynihan of Leeds, president of the Royal College of Surgeons, laid the corner stone of the new buildings for the Wellcome Research Institution, which are to occupy a site at the corner of Euston Road and Gordon Street, immediately north of University College.

The architect is Mr. Septimus Warwick, F.R.I.B.A., who has designed the building to meet the requirements of the different research laboratories and museums. The building materials are practically all of British origin.

Lord Moynihan, in the course of his remarks, outlined the development of the various research laboratories and museums founded by Dr. Wellcome, who, in the year 1894, founded his laboratories for physiological research, which were followed two years later by laboratories for chemical research.

On the recapture of the Sudan by Kitchener, Dr. Wellcome was one of the first civilians to visit that country, and he there saw, and for some time watched, conditions as they then were; and he found great opportunities for public service. It was in the year 1899 that he founded the Tropical Research Laboratories in Khartoum, the first director of which was Sir Andrew Balfour, who served there for twelve years. Attached to that research institute was a floating laboratory, which cruised through all the waterways of the Nile within reach, giving the opportunity there for continued research, and for carrying the benefits of research to the people who live far south.

Dr. Wellcome's activities continued also in Great Britain. In the year 1913 he established the Bureau for Scientific Research, and the Historical Medical Museum. In 1914 he established the Museum of Medical Science, including Tropical Medicine and Hygiene, and in 1920 he founded the Entomological Field Laboratory. All these institutions, or many of them, suffered, however, under one great disadvantage, which all research students will appreciate at once: they were separate from one another, giving no opportunity for that hour to hour, or minute to minute, consultation which is one of the great advantages of having collective research under one roof; but from to-day we see the possibility of that being altered. Under the roof of the Wellcome Research Institution the following subjects are to be studied: medical zoology, parasitology, entomology, tropical medicine and hygiene; there will be physiological and chemical research laboratories, the historical medical museum, and a museum of modern medicine. It will be agreed that this is a formidable and very impressive list. Dr. Wellcome's activities, however, have not been confined to Great Britain. He also gave great help towards the foundation of the Gorgas Memorial Laboratory, near the Panama Canal.

One of the conspicuous features of Dr. Wellcome's life-work has been at once its relevance and its opportunism. In all his investigations of tropical diseases he begins in an almost virgin country, and the harvest gathered has been such that not only have many lives been spared and much suffering saved, but also vast tracts of country have, for the first time, been made fit for human habitation.

At home, as all of us will agree, the great need of medicine to-day lies in the direction of increasing the opportunities for medical research, and not less in the opportunities for creating those competent to undertake medical research. Physical observation alone, from the time of Hippocrates through our great students, Sydenham, Addison, and James Mackenzie, has revealed many secrets which have been so long hidden in connexion with diseases that lay within the orbit of pure investigation, and the conquests of mere observation have been innumerable and of a value beyond all reckoning. Upon it a virile and beneficent art has found its opportunities extended and its thought affected by the encouragement and adoption of methods which are seeking to change a practical art into an applied science. Difficulties, of course, have been found all along the way, but experiment in medicine is for ever inevitable.

As a result of experiment in medicine we are, happily, gradually replacing anatomy by physiology, and if disease is, in many respects, merely altered function, then we are about to create a science, new to the human race, of comparative function in health and in disease. But experiment has done even more for us than that. It has strengthened the arm of medicine, and it has made the tests more severe for the acceptance of evidence which has been derived by the methods of observation.

Medicine depends, of course, not only for its present stability but also for its future advance, upon a large number of ancillary sciences. Those sciences are to be studied in the new building. The effect, therefore, on medicine will be considerable, but it is hoped something better even than that will come out of the work

done in this institution, and similar institutions; that is, to create in the minds of the leaders of the profession what Sir Walter Morley Fletcher would call "The Religion of Research". Lord Moynihan said he hoped that the date would not be far distant when those who are to serve upon the teaching staffs of hospitals throughout Great Britain will be permeated by "The Religion of Research", and in time to come all members of the teaching staffs will themselves have undergone, in institutions similar to this, a discipline of research.

In concluding, Lord Moynihan said that by his constant thought Dr. Wellcome has done as much as any man has ever done in Great Britain to make it possible to advance both the science and the art of medicine.

By placing the Museum of Medical Science, including tropical medicine and hygiene, and the Historical Medical Museum under one roof, there is no doubt that in London there will be a combination which will be unequalled in the world.

The associated Physiological Research Laboratories will remain at Langley Court, Beckenham, and the Field Entomological Laboratory at Claremont, Esher.

Plant Breeding in Germany.

THE acceptance by Dr. Baur of the invitation of the Royal Horticultural Society to give the Masters Lectures in 1931 has resulted in the publication, in the *Journal of the Horticultural Society*, vol. 56, Part II, of two lectures which contain, in the first place, a most effective short statement of the present position of evolution, and in the second, a very interesting summary of the work in plant breeding that is being carried out, under Dr. Baur's direction, in the Kaiser Wilhelm Institut für Züchtungsforschung at Müncheberg.

Dr. Baur concludes that the experimental study of genetics has shown clearly that "inheritance of acquired characters in the sense of Lamarck does *not* exist". He argues that the main cause of what Darwin called hereditary variation is the combination of characters provided for by biparental inheritance, but differs from Lotsy because he considers that such variations are too limited to supply the needs of progressive evolution. Continued breeding of *Antirrhinum* has led him to the conclusion that the frequency of mutation is no less than 1·3–7 per cent, though such mutations are mainly recessive and therefore only distinguished on extensive and continued breeding trials. Most of these mutations are small, and a striking mutation is usually associated with loss of vitality. Dr. Baur concludes that through the selection of small mutations the differentiation of species out of parent species can be explained, and that wider differences may gradually arise because two such new forms, as they become separated by an increasing number of such 'small-point mutations', tend also to become infertile to one another.

Dr. Baur's account of the work of the Kaiser Wilhelm Institute is full of interest. The extensive breeding work, coupled with patient testing, which permits the isolation of a lupin free from poisonous alkaloids, after a million and a half plants have been examined, is a striking example of selection work. The recombination of Mendelian characters is carried out on normal lines, but on an extensive scale, with wheats, grapes, etc.; whilst new experiments are proceeding with attempts to induce variations artificially by chemical methods, as has been done so successfully in recent years by X-rays.

University and Educational Intelligence.

CAMBRIDGE.—The Vice-Chancellor has received a letter from the Trustees of the British Museum offering the sum of £2000 for the use of the Scott Polar Research Institute. This sum represents the greater part of the balance remaining of the sum which was subscribed to meet the cost of publishing the scientific results of Capt. Scott's *Terra Nova* expedition.

LONDON.—The title of professor has been conferred on the following: Mr. F. W. Twort (bacteriology), in respect of the post held by him at the Brown Animal Sanatory Institution; Dr. H. A. Harris (clinical anatomy), in respect of the posts held by him at University College and University College Hospital Medical School; Dr. F. A. P. Aveling (psychology), in respect of the post held by him at King's College

The title of reader in eugenics has been conferred on Miss E. M. Elderton, in respect of the post held by her at University College.

OXFORD.—On Nov. 17, Congregation passed a decree recording the grateful thanks of the University to Prof. J. Mark Baldwin, for a gift of £1000 for the capital endowment of the Edward Bagnall Poulton Fund, established for the encouragement of research in the subject of evolution. This fund has already been of much service in assisting work of the kind indicated.

At the same meeting of Congregation the thanks of the University were accorded to the Royal Astronomical Society for a generous gift to the Lewis Evans Collection of a set of more than fifty astronomical and mathematical instruments.

SHEFFIELD.—Prof. J. H. Andrew, professor of metallurgy at the Royal Technical College, Glasgow, has been appointed to the chair of metallurgy in the University in succession to Prof. C. H. Desch, who has been appointed superintendent of the Department of Metallurgy at the National Physical Laboratory.

ON Nov. 29 the Cinema Hall, which is maintained by the Empire Marketing Board at the Imperial Institute, South Kensington, reopened with a series of cinematograph displays, many of which are travel films of geographical interest. In future an admission charge of one penny is being made for each session. Monthly programmes of the films and lectures may be obtained on the payment of two shillings, being subscription for one year.

THE following scholarships will be offered by the Institution of Naval Architects Scholarships for competition in 1932: Naval architecture, Martell scholarship (£130 a year for 3 years); Denny scholarship (£75 a year for 4 years): Marine engineering, Parsons scholarship (£150 a year for 3 years); Denny scholarship (£75 a year for 4 years). The Denny scholarships are open to boys less than nineteen years of age from public or secondary schools who have not yet begun their apprenticeship, and are tenable at the University of Glasgow. The remaining scholarships are open to apprentices less than twenty-three years of age, and are tenable at the Royal Naval College, Greenwich, the University of Glasgow, Armstrong College (University of Durham), the University of Liverpool, and the City and Guilds (Engineering) College, London. Particulars may be obtained from the Secretary of the Institution of Naval Architects, 2 Adam Street, Adelphi, London, W.C.2.

Birthdays and Research Centres.

Dec. 6, 1858.—Prof. HANS SCHINZ, professor of systematic botany, formerly director of the Botanical Gardens and Museums of the University of Zurich.

At present I am engaged on the fifth edition of the "Flora of Switzerland", and on a flora of South West Africa, and I am also working on the Swiss Myxomycetes.

Dec. 7, 1855.—Prof. HENRY LOUIS, consulting mining and metallurgical engineer, and emeritus professor of mining in Armstrong College, University of Durham.

Since my retirement from active work in the Armstrong College, University of Durham, my opportunities for engaging in actual researches have been somewhat limited. I am, however, continuing to take a keen interest, though now more in an advisory capacity, in researches bearing upon the subjects with which my work has been principally identified. One of the most important of these is probably the work that is being carried out by the Support of Workings Committee of the North of England Institute of Mining and Mechanical Engineers, of which I am secretary. Whilst the direct object of this Committee is a study of the conditions producing falls of ground in collieries, which are to-day the most serious source of mine accidents, its operations necessarily throw much light upon other important points, such as surface subsidence, the subsidence of the immediate roof of colliery workings, and the best form of support to be employed in such workings. I need scarcely say that this last aspect of the question is very closely connected with my metallurgical work, because it is becoming more and more evident that the replacement of timber by steel is playing an increasingly important part in the solution of this problem.

I am, of course, able to give a certain amount of time to reporting upon, and the valuation of, mineral deposits. Necessarily, much of this work, although involving a good deal of research, and not infrequently geological research of a tolerably high order of difficulty, is confidential, and must always remain unpublished. I have, however, in the press, a book on "Mineral Deposits" which will, I hope, embody the results of some personal observations. From the very nature of the work these observations must, of course, be somewhat out of date when published, but I hope that they may, nevertheless, be found of value.

Dec. 9, 1855.—Dr. F. A. DIXEY, F.R.S., Hon. Fellow, late subwarden and bursar of Wadham College, Oxford.

I am, at present, examining the evolutionary relationships of various lepidopterous groups, as disclosed by the study of their structural characters; together with the phenomena of sexual and seasonal polymorphism and of mimicry in various forms, exhibited within the same groups.

Observations in the field on all bionomic details in the life of insects, in relation with their environment, whether organic or inorganic, are worthy of attention. Special consideration should be given to their means of protection against the attacks of predaceous organisms; the evidence of absolute or relative immunity conferred by their own defensive qualities; and the various influences which may affect the vigour of the assaults made upon them by their enemies. These interactions are all important from the evolutionary point of view, and the value of many of them can only be appraised by direct observation in the field, prompted by work done in the laboratory and museum.

Dec. 10, 1855.—Mr. H. N. RIDLEY, C.M.G., F.R.S., former Director of Gardens and Forests, Straits Settlements.

I am now turning my attention specially to the geographical distribution of plants and animals in various regions of the globe, with the view of showing the relationship of the present constituents of the floras and faunas of different countries to the previous geological history, and especially to the former distribution of land and water. Though the accounts of the floras of various regions have been extensively compiled geographically, so that comparisons may readily be made in most areas, this has been seldom the case in the matter of faunas, which have not often been treated geographically, and this would be most desirable. I am also continuing my researches into the flora of Borneo and the Malay islands.

Dec. 10, 1878.—Dr. W. K. SPENCER, F.R.S., H.M. Inspector of Schools.

As my time for research has been limited, it has been necessary to confine myself to the palæontology of a small group of animals, the starfish and brittle starfish. The advantages of work upon a small group with which one can become well acquainted are now becoming evident.

The evidence of evolution afforded by the group shows that recent starfish are only remnants of an originally very diverse Palæozoic fauna, and that the lines which are able to initiate new inventions leading to greater command over environment are those which survive. I hope shortly to put forward a new classification of starfish based on observations of progressive evolution.

The distribution of Palæozoic starfish shows correspondence with that of other Palæozoic fauna, leading to conclusions regarding the currents of these older seas and the land boundaries. The form and ornament of isolated ossicles of Chalk starfish form a valuable accessory in zonal determination. The many groups of fossil animals and plants afford abundant opportunity to the non-professional scientific worker willing to concentrate on a small field.

Dec. 11, 1860.—Dr. LEONARD HUXLEY, editor of the *Cornhill Magazine*.

Tuberculosis, yellowjack, malaria, typhus—these are a few names to remind us that science has sent her spies out against the great and terrible enemies ambushed along the path of life, and that her workers follow in battalions to consolidate the victories of knowledge. Great are the material gains, great, too, the relief of mind. The formless dragons of the dark are stripped of half their terrors. These are great and imposing victories: others no less great and imposing are on the horizon. But meantime there are certain elusive and disabling plagues, so common as to be vulgar, so repulsive, when not actually dangerous, as to earn more contempt than commiseration, so universal as to produce vast cumulative loss. What honour would not the long-suffering multitude accord to their deliverer from that 'horrid cold', that 'vile 'flu', to which they are so fatalistically accustomed to-day?

Dec. 12, 1855.—Mr. A. W. CLAYDEN, formerly principal of University College, Exeter.

I am chiefly interested in the observation of cloud forms and their relation to weather.

If observations on the variations of the lapse rate,

similar to those carried on at Duxford and elsewhere, could be made near the western seaboards of the British Isles, say Penzance and southern Ireland, the results would be interesting and might very well be important.

An interesting point which does not appear to have been much studied is the condensation of water vapour at low temperatures. Rime sometimes takes one dominant form, sometimes another. The crystals in one shower of fine snow are frequently of one type, while those of another shower show quite a different figure.

Dec. 12, 1866.—Prof. E. W. MACBRIDE, F.R.S., professor of zoology in the Imperial College of Science and Technology, South Kensington, London.

The following problems are being investigated under my supervision :

(1) An attempt to repeat the experiments of Metalnikoff, which indicate the inheritability of acquired immunity.

(2) An attempt to repeat Kammerer's experiments on *Salamandra maculosa*, which indicate the responsiveness of its skin-colour to the background.

(3) An attempt to repeat Kammerer's experiments on *Alytes*, indicating the re-adaptation of this terrestrial type to aquatic life.

(4) An investigation by experimental methods of the late stages in the development of echinoderm larvæ. During these stages the possibility of evolving 'suppressed complexes' is indicated.

(5) An investigation into the action of various reagents on the eggs of the frog in producing abnormalities in late larval development.

Societies and Academies.

LONDON.

Mineralogical Society, Nov. 4 (Anniversary Meeting).—**F. C. Phillips** : On crystals of brookite tabular parallel to the basal plane. Small yellow-brown rectangular plates in heavy residues from Middle Jurassic sandstones of N.E. Yorkshire are shown by optical and X-ray examination to be brookite of normal optic orientation but unusual crystallographic habit, being tabular parallel to the basal plane. They are associated in the residues with brookite of normal habit, abundant anatase, and rutile.—**T. Ito** and **T. Shiga** : On scorodite from Kiura Mine, Bungo, Kiushiu, Japan. The mineral occurs as small dark-brown and green crystals associated with vivianite, fluorite, and quartz in druses in veins of arsenopyrite intruded into limestone. Chemical analysis on carefully selected material gives a result consistent with the formula $FeAsO_4 . 2H_2O$. Forms present are (001), (100), (011), (120), (111), (201), (211), and (322). The crystals are orthorhombic with $a : b : c = 0{\cdot}865 : 1 : 0{\cdot}972$. The habit is pyramidal equidimensional. The 111 faces show abundant vicinal faces belonging to two principal zones $\{01\bar{1}\}$ and $\{10\bar{1}\}$.—**W. Campbell Smith** : On a new meteoric stone from Suwahib, Arabia. The stone was found in 1930 on the sand near Buwah, in Suwahib, by one of the Arabs accompanying Mr. Bertram Thomas on his journey across the Rub' al Khali. As found, it weighed just over 238½ gm. It is coated with limonite and shows no definite crust. It is a black chondrite belonging to Prior's Cronstad type, with more than ten per cent of nickel-iron. The density is 3·52.—**Edward S. Simpson** and **D. G. Murray** : A new siderolite from Bencubbin, Western Australia. A mass weighing 119·5 lb. (54 kgm.) was found in 1930 near Bencubbin, about 150 miles north-east of Perth. It consists of a skeleton of nickel-iron (68·8 per cent) with enclosed crystals up to 1 cm. across, of greyish-white enstatite (13·5 per cent) and dark olivine (12·5 per cent). In the metallic portion Fe : Ni = 15 : 1. The meteorite is classed as a mesosiderite with an unusually high proportion of nickel-iron.—**A. R. Alderman** : The meteorite craters at Henbury, Central Australia. The locality is known locally as the Double Punch-bowl, from the two largest adjoining craters. It is situated seven miles west-south-west of Henbury cattle station on the dry Finke river, and about fifty miles south of the McDonnell Ranges in the very centre of Australia. Within an area of 500 yd. by 500 yd. thirteen craters were mapped. The largest is oval in outline, measuring 220 yd. by 120 yd. across, and with a depth of 50-60 ft. The other craters are roughly circular, with diameters ranging from 10 yd. to 80 yd. The walls consist of powdered rock and shattered blocks of Ordovician sandstone and slaty rock. Owing to the craters acting as collecting pans for rain-water in this arid region, the spots are prominently marked by the growth of mulga trees, acacias, and coarse grass. Scattered around the craters are numerous pieces of metallic iron, usually angular in shape, and ranging from a fraction of an ounce to 52½ lb. in weight. In one area of 6 ft. by 6 ft. more than a hundred fragments were collected. Only two masses (one of 13 lb.) were found within the crater walls ; and in one of the smaller craters a borehole to a depth of 8 ft. through fine silt down to coarse rock fragments yielded no mass of iron. Fragments of iron rust are also abundant ; and some glassy material, suggesting fusion of the country rock, was found. These craters, which are very similar, were evidently formed by the impact of a shower of meteoric irons at some remote period.

Geological Society, Nov. 13.—**E. J. Wayland** : The Katwe crater-lake, Uganda. Lake Katwe occupies the bottom of an explosion crater of the caldera type and is the source and centre of a flourishing native-managed salt industry. Lake Edward oscillates in accordance with the sunspot cycle, while Lake Katwe does not. While the level of the former is above the water-table, that of the latter is determined and maintained by it. Although the volcanic vent passes through the saturation zone, its upper parts are more or less completely sealed off from the surrounding ground-water by deposits of the less soluble salts thrown out of solution at successively lower levels as temperature decreased with time. Within the tube so formed, aqueous circulation is produced by the temperature gradient, and the most soluble of the salts, derived at depth from decomposing alkali lavas, are thereby brought to the surface and, as a consequence of solar evaporation, are deposited in the shallow lake.—**Arthur Holmes** and **Henry Francis Harwood** : Petrology of the volcanic fields east and south-east of Ruwenzori, Uganda. Towards the close of the period in which the Kaiso lacustrine beds were deposited, volcanic activity broke out along a series of belts extending north and south of Fort Portal and north and south of the Kazinga Channel. The first phase (Lower to Middle Pleistocene) is represented by sub-aqueous tuffs. Post-Kaiso rifting movements followed, and were succeeded in turn by a second phase of vulcanism, in which explosion vents were blown through the rift-valley floor, the bordering scarps, and the adjoining plateau. The rocks of this stage include tuffs and agglomerates, ejected blocks, and volcanic bombs. Throughout the area the earlier tuffs appear to represent melilite-basalts. The tuffs are followed by others having compositions transitional towards that of leucitite. The later cognate

ejected blocks include melanocratic varieties of potash-nephelinite and leucitite. Accompanying them are bombs of leucitite and olivine-leucitite, some of the latter being sufficiently rich in olivine to be regarded as a volcanic equivalent of kimberlite. The volcanic belts together constitute a co-magmatic region of a highly individualised kind.

PARIS.

Academy of Sciences, Oct. 26.—**P. Villard**: The reduction of soda. Caustic soda is reduced to sodium by heating with manganese (or ferromanganese) at 700° C. Some potassium was also obtained from caustic potash. The manganese can be replaced by chromium (800° C.), iron (750° C.), cobalt, nickel (600°-750° C.), or tungsten. No reduction was observed with zinc.—**Léon Guillet, Albert Roux, and Jean Cournot**: New remarks concerning the influence of occluded gases on the mechanical properties of metallurgical products. The authors have repeated the experiments of Guichard, Claussman, Billon, and Lanthony and arrive at a different conclusion. They consider it is impossible to agree with the statement that the hardness of electrolytic iron is completely independent of the proportion of hydrogen present in the metal.—**P. Vincensini**: Isotropic congruences and minimum surfaces.—**Gaston Julia**: The trend of iterated series in the neighbourhood of boundaries of convergence.—**Maurice Gevrey**: The determination of the integrals of systems of linear partial differential equations of the elliptic type.—**Arnaud Denjoy**: The Riemann definition of the Lebesque integral.—**J. Le Roux**: The conditions of application of the principle of relativity.—**J. Rossignol**: The problem concerning cylindrical vortices of finite section.—**Henri Quillery**: A method for securing fixed ratio of air to petrol in carburettors.—**Th. Got**: The calculation of the critical velocities of rotating shafts of constant section and non-negligible mass, carrying perfectly centred thin discs.—**D. Barbier**: Remarks on the dynamical parallaxes of double stars.—**J. Dufay**: The spectrum of the eclipsed moon. The moon, when passing through the earth's shadow, is illuminated only by the rays refracted by the earth's atmosphere, and hence the study of its spectrum allows the observation on an unusual scale of the effects produced by diffusion and selective absorption of our atmosphere. Photographs taken during the eclipse of Sept. 26 showed the solar line $C(H\alpha)$, two oxygen bands (one very strong), and others not identified.—**René Gindre**: The photometric study of the eclipse of the moon, Sept. 26, 1931.—**A. Danjon**: Photometric and colorimetric study of the total eclipse of the moon of Sept. 26, 1931.—**Ernest Esclangon**: Remarks on the preceding note.—**L. Eblé and E. Salles**: Some measurements of gravity in the Paris region.—**Dalloni**: A scientific expedition to Tibesti.—**B. Decaux and Ph. Le Corbeiller**: A self-maintained electrical system utilising a neon tube. If a battery, a neon tube, and a condenser are mounted in series, flashes in the tube separated by periods of longer duration are noted. As an example, with an e.m.f. of 200 volts, a condenser of 6 microfarads showing a leak resistance of 20 megohms, a neon lamp of the night-light type gives flashes every 20 seconds. A theoretical explanation is given.—**Edgar Pierre Tawil**: The origin of the third fundamental frequency of oscillating piezo-electric quartz.—**G. Bruhat and J. Thouvenin**: The realisation of a quarter wave plate for the ultra-violet with the aid of oblique quartz.—**R. de Mallemann**: Molecular dissymmetry.—**Pierre Lambert and Ion Agarbiceanu**: The magnetic change of the absorption lines of nitrogen peroxide.—**H. Forestier and M. Galand**: The study of beryllium ferrite and the ferric oxide arising from its decomposition. The variation of the magnetic properties with temperature and the X-ray study (Debye-Scherrer method) lead to the conclusion that the mechanism of formation of the ferric oxide attracted by a magnet, starting with beryllium ferrite, is the same as that of Malaguti's oxide, formed by the dehydration of certain natural and artificial oxides of iron. The atom of beryllium in the ferrite has the same function as that of the molecule of hydrogen in the hydrate $Fe_2O_3 . H_2O$.—**Ch. Marie and N. Marinesco**: The volume contraction produced by the hydration of proteins. The contraction of volume produced by the solution of gelatin proves that strong compressions exist between the dispersing medium and the particles of the dissolved body. The variation of this contraction with the hydrogen ion concentration allows the swelling and viscosity of the same colloid to be interpreted with regard to its isoelectric point.—**P. Mougnaud**: The note of MM. Carrière and Janssens relating to the estimation of fluorine. The author still considers the precipitation of calcium fluoride in ammoniacal solution is too inaccurate for practical use.—**Jacques Maroger**: The reconstitution of the painting technique of Jean Van Eyck. Details are given of the preparation of an oil medium which can be regarded as a reconstitution of the medium used before the beginning of the nineteenth century.—**Jean Chevrier**: Researches on the electrical field of the air at Djesireh.—**E. Chemin**: The protein crystals in some marine species of *Cladophora*.—**A. Famin**: The action of temperature on the nucleus and karyokinesis in *Vicia faba*.—**Marc Bridel and Mlle. A. Kramer**: The constitution of asebotoside (asebotine): its identity with phlorizoside (phlorizine). The comparative study of the glucoside extracted from the leaves of *Kalmia latifolia* (asebotoside) and the glucoside extracted from the bark of apple and pear trees (phlorizoside) has proved the complete identity of these two substances. It follows that the name asebotoside should disappear from chemical literature.—**Pierre Chouard**: Analogies between the development of the young plant and the annual push of the leaves in the Liliaceæ.—**A. Vandel**: The existence of two species of *Spiloniscus*, hitherto confused, and their reciprocal relations.—**J. André Thomas**: The action of sea water, in which carotene has remained, on the experimental development of the sea urchin *Paracentrotus lividus*. The carotene employed, although theoretically insoluble in water, communicates properties to sea water affecting the experimental development of the egg of the sea urchin.

CRACOW.

Polish Academy of Arts and Sciences, Oct. 5.—**Ladislas Natanson**: General propositions connected with Fermat's principle and certain other associated theorems.—**St. Rafalowski**: The Raman bands in water. In the case of a solution of hydrochloric acid it has been found that the extreme components of a band weaken as the concentration in acid increases, whilst the middle component widens. This is not in agreement with the statement of Rao (see also NATURE, 128, 546, Sept. 26, 1931).—**K. Dziewonski and Zb. Reicher**: Studies on 2-benzylfluorene.—**A. Gawel**: The granites of the Carpathian flysch of Krosno in the neighbourhood of Sanok.—**J. Kuhl**: The formation of kaolin and of alunites in the eastern part of the Ste. Croix mountains (Montagnes du Poivre) in the neighbourhood of Sandomierz.—**E. Malinowski and Mlle. A. Smólska**: The mosaic strain of *Petunia violacea*.

Diary of Societies.

FRIDAY, DECEMBER 4.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.
INSTITUTION OF WATER ENGINEERS (at Institution of Civil Engineers), at 10.30 A.M.
ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir George Birdwood Memorial Lecture.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.
BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (Annual Meeting) (at Bedford College), at 5.30.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Dr. S. L. Pearce: Presidential Address.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.
RAILWAY CLUB (at 57 Fetter Lane), at 7.30.
INSTITUTE OF BRITISH FOUNDRYMEN (Middlesbrough Branch) (at Cleveland Scientific and Technical Institute, Middlesbrough), at 7.45.
ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.

SATURDAY, DECEMBER 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.
GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.
INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at College of Technology, Manchester), at 4.

MONDAY, DECEMBER 7.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory, Cambridge), at 4.30.
ROYAL SOCIETY OF EDINBURGH, at 4.30.
ROYAL GEOGRAPHICAL SOCIETY, at 5.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.
SOCIETY OF ENGINEERS (at Geological Society), at 6.
INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Birmingham University), at 7.
INSTITUTION OF RUBBER INDUSTRY (at Engineers' Club, Manchester), at 7.
BRITISH KINEMATOGRAPH SOCIETY (at Gaumont Theatre, Wardour Street), at 7.45.
ROYAL SOCIETY OF ARTS, at 8.
SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.

TUESDAY, DECEMBER 8.

MANCHESTER UNIVERSITY CHEMICAL SOCIETY (at Manchester University), at 5.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.
INSTITUTE OF MARINE ENGINEERS, at 6.
INSTITUTE OF METALS (Swansea Local Section) (at Y.M.C.A., Swansea), at 6.15.
LONDON NATURAL HISTORY SOCIETY (Ramblers' Section) (at London School of Hygiene and Tropical Medicine), at 6.30.
INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section—Manchester and District Branch) (at Engineers' Club, Manchester), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel), at 7.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at 39 Elmbank Crescent, Glasgow), at 7.30.
INSTITUTE OF METALS (North-East Coast Local Section) (jointly with Society of Chemical Industry) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.
INSTITUTION OF WELDING ENGINEERS (North-Western Branch) (at College of Technology, Manchester), at 7.30.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section), at 8.30.
PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.
INSTITUTION OF ELECTRICAL ENGINEERS (East Midland Sub-Centre) (jointly with Institute of Fuel) (at University College, Nottingham).

WEDNESDAY, DECEMBER 9.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.
INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.
INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at Municipal College, Portsmouth), at 7.30.
ROYAL SOCIETY OF ARTS, at 8.30.—Sir Henry Maybury: Roads and Road Transport (Trueman Wood Lecture).

THURSDAY, DECEMBER 10.

ROYAL SOCIETY, at 4.30.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Col. W. P. MacArthur: The Surgeon and Old-time Plague (Thomas Vicary Lecture).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.
INSTITUTE OF MARINE ENGINEERS (Junior Section), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.
INSTITUTE OF CHEMISTRY (at Derby Technical College), at 7.15.
INSTITUTE OF METALS (London Local Section) (jointly with Institute of British Foundrymen) (at 83 Pall Mall, S.W.1), at 7.30.
SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (jointly with Chemical Engineering Group) (at Bristol University), at 7.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.
INSTITUTION OF MECHANICAL ENGINEERS (Yorkshire Branch) (Annual General Meeting) (at Hotel Metropole, Leeds), at 7.30.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough) (jointly with Institution of Electrical Engineers—Tees-Side Sub-Centre), at 7.30.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.
INSTITUTION OF WELDING ENGINEERS (at Institution of Mechanical Engineers), at 7.45.
ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at London School of Hygiene and Tropical Medicine), at 8.15.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—H. G. Watkins: The British Expedition to Greenland.
DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall).
INSTITUTION OF MECHANICAL ENGINEERS (Glasgow Centre) (at Glasgow).—Ll. B. Atkinson: Thomas Hawksley Lecture.

FRIDAY, DECEMBER 11.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.
BIOCHEMICAL SOCIETY (at London School of Hygiene and Tropical Medicine), at 3.30.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. Freundlich: On the Gravitational Deflection of Light (Total Solar Eclipse, 1929, May 9).
ROYAL GEOGRAPHICAL SOCIETY, at 5.
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Royal Eye Hospital, St. George's Circus), at 5.
MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.
INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 6.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.
SOCIETY OF DYERS AND COLOURISTS (jointly with Manchester Literary and Philosophical Society—Chemistry Section) (at 36 George Street, Manchester), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 7.
GEOLOGISTS' ASSOCIATION (North-East Lancashire Group) (at Blackburn Technical College), at 7.
ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 7.—Sir Francis Goodenough: Presidential Address.
WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.15.
SOCIETY OF CHEMICAL ENGINEERS (South Wales Section) (at Thomas' Café, Swansea), at 7.30.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at College of Technology, Manchester).

SATURDAY, DECEMBER 12.

GEOLOGISTS' ASSOCIATION (Demonstration at Natural History Museum), at 2.30.
NORTH OF ENGLAND INSTITUTE OF MINING AND METALLURGICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.

Public Lectures.

SATURDAY, DECEMBER 5.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College for Women), at 3.—J. W. N. Sullivan: Mathematics and Culture (Presidential Address).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth-Davis: Insect Pests and their Enemies.

MONDAY, DECEMBER 7.

UNIVERSITY OF LEEDS, at 5.15.—Prof. G. Barger: Ergot and Ergotism.

TUESDAY, DECEMBER 8.

IMPERIAL INSTITUTE, at 2.15.—Major H. Lockwood Stevens: Unknown Nepal.

WEDNESDAY, DECEMBER 9.

IMPERIAL INSTITUTE, at 2.15.—Miss Margaret Green: Our Voluntary Hospitals and the Nurse's Vacation.
ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. E. L. Collis: The Health of the Industrial Worker.
SCHOOL OF ORIENTAL STUDIES, at 5.15.—A. W. G. Malcolm: Medicine in Africa.
BELFAST MUSEUM AND ART GALLERY, at 8.—E. E. Evans: The Beginnings of our Civilisation.

THURSDAY, DECEMBER 10.

IMPERIAL INSTITUTE, at 2.15.—Comdr. the Hon. S. Hay: A Midshipman's Experiences in the Pacific.
SCIENCE MUSEUM (South Kensington) (in connexion with Exhibition of Modern Glasses), at 4.45.—E. A. Coad-Pryor: Glass in the Foodstuffs Industry.
KING'S COLLEGE, LONDON (at 16 Russell Square, W.C.1), at 5.30.—S. P. Turin: Russian Imports and Exports.
BATTERSEA POLYTECHNIC, at 7.—Dr. H. Phillips: The Walden Invasion: the Mechanism of the Substitution of Groups in Saturated Organic Compounds.

SATURDAY, DECEMBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: Negroid Peoples of the Pacific Islands.

Official Publications Received.

BRITISH.

North-East Coast Institution of Engineers and Shipbuilders (Incorporated). Report of the Council, 1930-1931. Pp. 18. (Newcastle-on-Tyne.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1930. Part 3. Pp. v+92+5 plates. (London: H.M. Stationery Office.) 2*s*. net.

Canada: Department of Mines: Geological Survey. Memoir 166: Geology and Ore Deposits of Rouyn-Harricanaw Region, Quebec. By H. C. Cooke, W. F. James and J. B. Mawdsley. (No. 2267.) Pp. ix+314. 45 cents. Memoir 167: Fort William and Port Arthur, and Thunder Cape Map-areas, Thunder Bay District, Ontario. By T. L. Tanton. (No. 2268.) Pp. ii+222. 30 cents. (Ottawa: F. A. Acland.)

Canada: Department of Mines: National Museum of Canada. Bulletin No. 67: Annual Report for 1929. Pp. 58. (Ottawa: F. A. Acland.)

Public Library, Museum and Art Gallery of South Australia. Records of the South Australian Museum. Vol. 4, No. 3, June 30th. Pp. 275-408. (Adelaide.)

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