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School Science and Educational Values.

WHETHER one agrees with Prof. H. E. Armstrong or not—and frequently one does not—there is always to be found in his utterances much that is arresting, and in his writings much that stimulates. One is often grateful to him for saying things which one is glad should be said—by someone else. Even when his characteristic, pyrotechnic methods of expression become familiar, one is forced into the position of an attentive, if critical, student of his views. One can enjoy his serious humour, admire his courage, deplore his exaggeration, but one seldom fails to experience the fresh air of common sense and the provocation to renewed thought about fundamental things which he offers to his audience. When, in particular, he expresses an opinion on the teaching of science in our schools and universities, it is possible—rather it is profitable—to follow with care his exposition without necessarily finding oneself in complete agreement either with his generalisations or with his proposed remedies. This attitude is presumably exactly that which our critic would wish to produce, for the policy of follow-my-leader is above all distasteful to him, and he would have both teachers and taught think and work out their scientific salvation each for himself.

In a recent address to the West Kent Scientific Society, as reported in the *Kentish Mercury*, Prof. Armstrong offered a vehement criticism of the type of education provided in both schools and colleges ; his title was "Our Present Curse of Education", and his war-cry "Down with the outside examiner". Teachers who are wise enough to read his address must expect to receive a 'wigging', and their anticipations will be duly realised. They will, nevertheless, be indebted to him for his persistence in stepping on the weak planks in the educational platform, and might even forgive him his failure to commend the general stability of the structure which they have laboured, not unintelligently or unsuccessfully, to erect. It is safe to say that Prof. Armstrong is not alone in being dissatisfied with methods or with results ; the urge to progress is a fairly common experience in educational circles. It is equally safe to assert that our *Weltanschauung* has changed more rapidly than our educational technique. But when Prof. Armstrong asks us to agree that our schools remain happy hunting-grounds for pottering pedagogues, or that the admirable qualities of which the world is in need are the very opposite of those which characterise teachers as a class, or that no subject

is or can be properly taught in girls' schools, he will not be surprised to detect a suspicion of hesitation about our applause. Nevertheless, if it is necessary to throw a few bricks in order to concentrate attention on the fact that we are not yet a scientifically equipped nation, that our only chance of happy survival is to make ourselves such, and that our leaders into the future must be scientifically-minded men and women, then bricks let there be, and Prof. Armstrong throws as devastatingly as any.

Scientific or not, however, a nation may reasonably be expected to express itself adequately in its native language, and widespread inability to do so is specially to be deplored among its rising scientific generation. English, he says, should be taught at all times and through all subjects of instruction; we can but agree. Such incompetence is within the everyday experience of those who have to read science students' essays, and is still frequently noticeable in the reports of original work written by experienced investigators. Latin, adds Prof. Armstrong, is the only subject that is and can be properly taught to-day—apparently because our schools are practically all 'in Latin hands'; there are no skilled teachers for the other subjects, and foreign languages, in particular, are not regarded seriously. Languages and mathematics, as he truly says, may be taught as definite subjects; the objective is clear, whilst in other class subjects there is no fixed method of approach.

It is not entirely obvious whether it is for this reason, or in spite of it, that Prof. Armstrong urges that more time should be devoted to the subject of languages; in his conclusion, however, he is probably correct. Intercourse between the nations of the world is in a stage to warrant the extension, and mutual goodwill and understanding, whether scientific, commercial, or political, cannot fail to profit thereby. Moreover, the taste for languages is a good and useful taste, and good taste should be acquired in early life. He would next study geography; not geography as we ourselves were taught, but a living geography including geology, agriculture, etymology, and anthropology. When we add the necessary basis of physics and chemistry, not forgetting also biology, we have the group of concrete sciences which, called geography or anything else, is bound to figure in any intelligent story of man and his home. Greater informality in school science there probably should be, but it will become doubly necessary to guard against permitting the book of knowledge to degenerate into a mere album of entertaining snippets. Even more probably there should be some broadening of the scientific basis of instruction, particularly in the direction of simple biology. This extension here and broadening there will, however, fail in its immediate purpose if it has in view merely an ideal universal code of education; it should be conceived as part of an elastic system adaptable to varying intellectual and material requirements. Neither pupils nor teachers are cast alike in the same mould, so that we need not expect, however emphatic or unorthodox our views, to discover a universal solvent for such problems.

Wholesale condemnation falls not only on school science as taught to-day, but also on external examiners and all their works. "If", says Prof. Armstrong, "the external examiner is allowed to pursue his fell and cursed commercial purpose much longer, schools throughout the country will be ruined; they will lose all liberty to experiment, all liberty of teaching, and will turn out only automata." It can scarcely be supposed that Prof. Armstrong, a scientific man, is attempting to deny the appropriateness of an independent test in helping to determine how a pupil is reacting towards his educational environment, so that it would appear that this is only his playful way of recommending modification in the nature of the tests to be applied, and in the circumstances of their application.

In any event, the vocational significance of such educational tests is a matter to be reckoned with nowadays, when most men's brains have to earn their bread, and acceptable tests of some kind of commercial significance there will have to be. It is not evident whether the stimulus of independent tests in promoting application to study is equally denied, or whether one is in future to rely on a universal consuming desire to acquire more knowledge and to acquire it in a logical way, on an irresistible impulse in youth to discover and apply scientific method. The heuristic procedure is admittedly a potentially effective instrument in the skilled teacher's hands, and given a suitable medium it is no doubt capable of highly successful application. The inquisitiveness of the scholar, constantly directed in logical channels by a sympathetic and provocative teacher, can be turned to good account in setting in motion the wheels of the mind, but even a well-oiled engine requires fuel, as an agile mind requires a generous knowledge of fact. That is not to say that fact is more important than method; it is to say that instruction has its proper and fundamental place in education. Early specialisation is, of course, to be avoided, and a pass degree may have merits

unshared with an honours degree where the dissemination of knowledge rather than its acquisition is in question. Specialists are frequently heard to complain of the narrow outlook which the present stage of development of science has forced them to maintain in the pursuit of their objective. Is not therefore the danger in loosening external control of progress accentuated rather than reduced? It might reasonably be argued that the heuristic method of all methods requires the watchful eye of an outside examiner, albeit a wise and sympathetic one. It is the very narrowness of school science of which Prof. Armstrong complains.

It is, indeed, even an open question whether research, by members of the teaching staffs of our universities, is not being exalted above its proper place in the scheme of things; whether the student is not being subordinated to the published paper; whether the teaching function, with its concomitant requirement of leisure for thought and reading, should not receive greater attention and recognition. This is a matter which has recently been discussed by the president of the Association of University Teachers, who views the present tendency with some concern. The question, however, bears only indirectly on our subject; another consideration has a more direct influence. It appears impossible under existing conditions to remove Prof. Armstrong's engaging and important problem from the domain of theory to that of practice, for the essence of the method is greater informality, elasticity, and individuality than is usually possible in a school or graduate college class of the usual size and heterogeneity. Large classes, or even classes less large, are scarcely amenable to real heuristics, and failing the substance the shadow is probably of negligible value in comparison with the conventional article.

A. A. E.

Britain's Coal Resources.

PROF. J. H. JONES gives a very complete and useful summary of the existing conditions of the coal industry of Great Britain in a paper entitled "The Present Position of the British Coal Trade" in the *Journal of the Royal Statistical Society*, Vol. 93, Part 1, 1930. He has collected valuable statistics from British and foreign sources and has published these in some twenty-nine tables by way of an appendix to his paper; these figures form also the basis of the paper.

Prof. Jones has dealt with these statistics in the effective manner that might be expected from so accomplished a statistician. Any defects in his treatment of the subject are due to the fact that he is a statistician and not a miner, and, therefore, overlooks some of the points which to a mining engineer would have been comparatively obvious. Thus he deals in considerable detail with the falling off in British output, which he determines by a comparison of the present condition with conditions in 1913, the last pre-War year. He apparently overlooks the fact that 1913 was an exceptionally prosperous year for the coal trade, and should not be used as a basis for comparison.

In any case, however, the fact that the British coal trade has fallen off compared to what it was in the years immediately preceding the War cannot be disputed. Prof. Jones does not, however, appear to see, as a mining engineer would, that this falling off is an inevitable consequence of the lead which Britain enjoyed for so long among coal-producing nations. He has overlooked the fact that coal, like every other mineral deposit, is a wasting asset, and that the nation which, like Britain, first developed and worked its richest seams, thus supplying the markets of the world, must inevitably sooner or later come to the stage when, with incipient exhaustion of these exceptionally fine and accessible seams, other nations are able to enter into competition with it on more equal terms.

The conclusion that Prof. Jones reaches is as follows: "The machinery which is now being established serves merely to relieve the pressure of excessive competition. . . . The cause can only be removed by a reduction in the producing capacity of the industry to the volume of demand which is likely to exist under the new conditions, . . . I believe . . . that we may reasonably expect the industry not only to recover some of its lost markets on the Continent, but also to benefit from a growing demand for home consumption."

As a statistician, Prof. Jones is perhaps justified in his conclusion from a study of the statistics of the industry, but it is scarcely one that can be justified in the eyes of those who know all the circumstances of the case.

Even a statistician might, however, find grounds for apprehension, seeing that Britain's probable coal resources are only about 3 per cent of the probable resources of the world, whilst Britain's coal output, as Prof. Jones shows, is approximately one-fifth of that of the whole world and fifty years ago was practically forty-four per cent. These figures surely indicate that Great Britain could not possibly maintain its leading position at the above rate of output for more than a limited period.

Letters to the Editor.

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Organic Chemistry in Peril.

THE *Times* of Feb. 21 contains a remarkable article by Prof. George Forbes, in which he describes his experience in 1877 when endeavouring to act as war correspondent in the Russo-Turkish war. He was foiled by the Russian officials in every attempt that he made to join their army, until he met with a Prince Swiatipolk Mirski—a distinguished supporter of literature and the arts, well known in Parisian society—who was in charge of Transcaucasia. After they had talked together for some time, the Prince suddenly asked him: "Are you any relation of the late Principal James David Forbes?" When Forbes replied that he was his son, the Prince grasped him by the hand—'was very pleased to meet him', he had so much admired his father's discoveries in relation to glaciers and other branches of science—and roared with laughter as he remarked: "And to think that they looked upon you as a Turkish spy". (I wonder if the prince did begin his sentence with that conjunction?) From that moment Forbes's difficulties disappeared: he soon received a permit and was free to go under fire; he did so right valiantly. "Thus, as constantly in my life," writes Forbes, "I was given the chance to do greater things than my own merit deserved, through the esteem, veneration and affection in which that great man, my father, was held." A more moving expression of filial reverence, of justified ancestor worship, has not been penned.

All this by way of showing that it pays to have a father and have him remembered. In London, we are in danger of forgetting our fathers, especially the fathers of organic chemistry and of disregarding their work—of showing ourselves unable to appreciate its value and the supreme importance of carrying it on, with ever-increasing intensity of effort. Two most weighty letters were printed in NATURE of Feb. 15 from Sir William Pope of Cambridge and Prof. Jocelyn Thorpe of the Royal College of Science, London, both protesting against the proposed substitution of physical chemistry for organic chemistry, when Prof. Robinson leaves University College, London, to succeed the late Prof. W. H. Perkin, jun., at Oxford. I agree with every word they say. To adopt the policy that is advocated will not be merely suicidal but criminal, at a time when the two great organic chemical industries of dyestuffs and pharmaceuticals are beginning at last to flourish here. It involves going back upon every argument we have used, during and since the War, in support of the promotion of chemistry as the backbone of manufacturing industry. Take the extreme case of the production of ammonia from atmospheric nitrogen—this is sometimes spoken of as if it were an achievement of physical chemists: in fact, it is almost entirely a capitalistic and engineering triumph; there is very little chemistry in it that is in any way special. Whatever it be, it is useless as a practical enterprise without organic chemistry. Anyone, given the capital, can now make ammonia: the difficulty is to sell it with advantage. The whole commercial future of nitrogenous fertilisers is a problem of the very highest organic chemistry—of agricultural and physiological chemistry. As a matter of fact, the nitrogen industry, at present, is working in physical-chemical blinkers; it has put itself far too much under the guidance of men without vision.

We need to go back to the 'forties to read what was said by the late Lord Playfair—one of the very few broad-minded scientific men who have advised Great Britain, one of the chief founders of our system of scientific technical education. In the Hofmann Memorial Lecture (Chemical Society, 1893), he tells how the illustrious Liebig, in 1841, published his celebrated work—"Chemistry of Agriculture and Physiology"—and of its magic effect. Personally conducted by Playfair, he toured England in 1842, with the immediate effect of making chemistry a popular science. The School of Mines was opened in Jermyn Street, University and King's Colleges began to give attention to laboratory teaching, then in 1845 came the Royal College of Chemistry, with Hofmann at its head, next to Liebig the greatest organic chemist—taking the times into consideration—the world has known.

Such is the debt of chemistry to agriculture—it were time that it returned the compliment and gave competent chemists to agriculture—competent organic chemists but also sons of the soil, with full understanding of living things. Even physical chemistry to-day, great as has been its vogue, is neither physics nor chemistry; its business is but to point the bricks of the great structure laid by the chemist's trowel, chiefly the organic chemist's. We have not a competent agricultural chemist to-day (there has not been one since Liebig); we have not a competent physiological chemist, that is to say, one sufficiently gifted with the divine afflatus of chemical science and also a 'physiologist'. To arrive at full understanding of the right ways of feeding the soil, the plant, the animal—ourselves included—we must be chemists, especially on the organic side.

I have long foreseen the danger. In an article which I wrote for the *Manchester Guardian* (special Levinstein number), during the War, I contended that, if Manchester wished to give chemistry a recognised position consonant with its industrial importance, a special chair should be endowed in the University to which a stipend of at least £5000 should be attached. It mattered not whether anyone were worth so much at the moment: demand would create supply. Chemistry is dead in Manchester to-day and not fully alive elsewhere—yet Manchester is the metropolis of the great organic textile industry. Only one organic chemist of high degree is left to us now that we have lost Perkin. Something we must do, to counter the selfish action of industry—this, too, in the ultimate interest of industry. We hear of commercial magnates with salaries up to £30,000. No commercial magnate can have the same ultimate value as a real organic chemist.

Claiming, as I can, Hofmann as my spiritual father, I am able to look back sixty-five years across the field of chemistry and, in some measure, evaluate the progress made in its several sections. Progress there has been—great general progress—but the mathematical physical section has been too much pampered. It has even brought the wrong type of mind—the accountants'—unduly to the fore. Chemistry, after all, is a science of deeds; things have to be made, not merely talked about hypothetically and weakly measured—it is largely an affair of fingers and an art. The organic chemist, in particular, is highly imaginative but his imagination rests upon an entirely sane background: X-rays are but serving to justify his highest flights of imagination—going no further.

We are not really getting down to the big problems. We have to view with concern the slowness with which our attack upon the carbohydrates matures. Little more is *settled* of the nature of starch than was established by O'Sullivan and Horace Brown in my early days. We have not yet *decided* even the contexture of the glucoses. Beilstein, the record of organic chemistry, already has 12 large ordinary and 3 supplementary volumes and will not be completed in less than ten more. It already costs £60. Only real men can teach a subject of such magnitude.

To serve the ends of the British Empire, we have to strain every nerve to secure more competent chemists of all kinds—no delay is permissible. At the moment, industry here and, particularly, in America is thwarting academic efforts to produce them, by tempting men of potential ability prematurely into industry, before their intelligence is sufficiently ripened: by confining their labours, it is tending to promote intellectual sterility; parents so trained cannot have healthy offspring.

University College, in virtue of its Medical School, is marked out as the great biological centre of the future. That future will be indefinitely postponed, unless the College maintain a highly developed, complete Department of Organic Chemistry—pure and applied. To think that a few calculating machines will suffice us in producing a great work of art is obviously absurd.

Prof. Forbes was helped by a single father. I can claim the support of several—of an entire organic ancestry. Hofmann put me to work under Frankland and Frankland sent me on to Kolbe: three lineal descendants of Liebig. Returning, I was adopted by Williamson of University College and became the first Perkin's colleague. Being of such organic parentage, I may claim to speak with some authority. I would urge that it is impossible to think of the service Williamson rendered to organic chemistry, by resolving the chaos surrounding alcohol and ether: then, in the College where he taught, to do the great wrong to organic science that is now threatened. It cannot be! It must not be!

HENRY E. ARMSTRONG.

The Scientific Principle of Uncertainty.

"IF the actual history of science had been different, and if the scientific doctrines most familiar to us had been those which must be expressed in this [statistical] way, it is possible that we might have considered the existence of a certain kind of contingency as self-evident truth, and treated the doctrine of philosophical necessity as a mere sophism."

This is not a quotation from an exposition of the quantal doctrine of the essential uncertainty of physical knowledge, which recently startled the philosophical world. It is taken from the inaugural lecture at Cambridge in 1872 by Clerk Maxwell, the creator, in conjunction with Boltzmann, of the science of dynamical statistics, the development of which gave promise of rapid progress about that time.

The essence of the matter is that in this subject, as it gradually emerged in close connexion with gas-theory, the primary feature was the invariant specification of the differential receptacles or cells for the statistics, propounded as an analytical result by Liouville in his *Journal*, vol. 3, pp. 342-9 (1838), and rediscovered to some purpose by the redoubtable pair, Maxwell and Boltzmann, about 1876. They were stimulated to the broadening of the subject by introduction of generalised co-ordinates in the modern manner, by the physical vitalising of the Hamiltonian revolution in dynamics of date 1834, by Thomson and Tait in their "Natural Philosophy" in 1868. This re-statement in generalised form appears to have been first exhibited in H. W. Watson's tract on gas-theory in 1876, written with access to Maxwell's private notes published in his memoir of 1879, and its lucidity was remarked on by Boltzmann. The essential point was that in the specification of these invariant cells, a range of any co-ordinate δq occurred multiplied by a range of the cognate momentum δp, and that the factors of this product could not be separated, so that any refinement of exactness in one variable involved a loosening in the other.

JOSEPH LARMOR.

Cambridge, Feb. 14.

Unemployment and Hope.

IT is certainly a hopeful sign to find in NATURE of Feb. 15, p. 225, the interesting article under this heading by Mr. W. G. Linn Cass, ending with the plea that originality and freshness of view in this old question were never in the history of the world more or more urgently needed than now. I trust it may not fall on deaf ears, for in my experience, hitherto, scientific men have shown themselves in this question perhaps rather more bigoted and intolerant than can be wholly accounted for by their natural conservatism. Possibly it is a suppressed consciousness of guilt, for, after all, unemployment or leisure, two ways of stating essentially the same condition, is the most natural as it is the inevitable consequence of their achievements.

In any conceivable economic system, labour-saving is the unquestioned goal of the application of science to industry, but few dare to see the process through to its absurd end under the present system. As science multiplies by n the productability of labour, $(n-1)/n$ lose their livelihood and with it their title to consume, so that, but for the 'dole' and similar confiscatory legislation, consumption would be reduced to $1/n$. No more stupid or criminal waste of creative effort surely could be imagined.

It may be comforting, but it is certainly very short-sighted to argue that it will all come right of itself in the end, because scientific invention and discovery create more work than they displace. Admittedly, at first the $(n-1)$ surplus goes to feed the $(n-1)$ displaced men who are put to create new productive enterprises. When these, in turn, produce, the original deadlock returns in exaggerated form. In this respect New Testament economics was clearer than that taught in modern universities, since it distinguished the category of the wealth which perishes from its negative form, debt, which accumulates at interest. Unemployment, or leisure, should be the avowed object, as it is the inevitable consequence of scientific production.

I cannot subscribe so heartily to the Biblical economics, which I suspect has influenced Mr. Cass to invert the natural function of industry, and to put production as second to the exercise of faculty and the growth of character. The right use of leisure is—Who can doubt it?—one of the dominant problems of a scientific civilisation. But why should industry be necessarily charged with this alien function? It is educational, and should be the care of universities, training schools, theatres, the churches, the Press, and so on. The end is surely easier of attainment by leisured people, supported by what science is capable of supplying without taking their entire lives for it, than as a means of livelihood in competition with scientific methods. Much as onlookers may deplore the mechanicalisation of industry,

Mr. Ford is probably accurate as to the present psychology of the worker in his belief that what they want is to be told what to do, how to do it, and be allowed home in the quickest possible time. They prefer, as most of us scientific workers would, leisure to task work, however interestingly it may be disguised.

It is also hopeful to note the growth, if slow, of the conclusion reached by all who have recognised that the problem is not one of production but of distribution, that no reform is possible without reform of the money system. Mr. Cass refers very cautiously to "financial reform in the direction of a measurable amount of inflation, possibly on the lines suggested by Arthur Kitson, Douglas, and others", as a possible way of approach to the unemployment problem. The present state of inflated France, reported to be able to find work for a million alien workers, and deflated England with between one and two million workers permanently unemployed, is eloquent of the importance to industry of the distributing mechanism, the money system. Both rob Peter to pay Paul, the creditor class in the one case and the taxpayer in the other, bearing the loss.

I differ from the reformers cited, while in general agreement with their diagnosis of the industrial and economic situation, in the belief that it is not only possible for a scientific era to devise a stable monetary unit of value, but that it is of far more consequence to its social well-being, even than invariable standards of weights and measures. To me, the present system, in which the quantity of money in circulation is a function of the extent people are allowed to overdraw their accounts and spend what no one knowingly has given up, is mere 'account cooking', already responsible for much if not most of the present deadlock. To believe that greater laxity in accounting is going to produce anything but more confusion and bitterness is impossible. What I think is needed is a much clearer perception of what each expansion of industry involves, the permanent locking up of some definite quantity of wealth in the enlarged flow—not the same wealth but the same quantity permanently—and the necessity of accounting for this quantity just as for capital expenditure in a straightforward manner, without as at present simply drawing upon the general purchasing power of money to meet the outlay. Granted this, with the accountancy of the monetary system kept according to the ordinary laws of arithmetic, I do not see any difficulty in maintaining a monetary system with an invariable standard of value and yet capable of distributing all that society is willing and able to produce.

FREDERICK SODDY.

APPRECIATION by some of our leading men of science of the difficult problems raised by the increasing application of science to industry is to be welcomed, whether it be due to a less suppressed consciousness of guilt or to greater leisure; and the position calls not for less science but more, especially in the sociological sphere rather than in the physical. Progress in the social sciences has probably not kept pace with that in the physical, so that there is some uncertainty and bewilderment as to the best and wisest organisation and utilisation of the marvellous wealth and resources placed at our disposal by chemistry, physics, and engineering. A greater knowledge and more skilful use of the statistical method in economics and politics as exemplified in Sargant Florence's great work and others, together with more boldness in making social experiments, would greatly accelerate progress in the desired direction. Definite measurement and experimentation, and ultimately we shall hope, prediction also, are probably much more possible in the social sciences than is commonly supposed, and can alone justify the appellation of 'scientific'. They should replace the vague evolutionary fatalism, by which things will eventually right themselves, and the unsubstantiated hypotheses which still cloud our horizon.

Prof. Soddy suggests that in one important respect, which appears to be that of relative values, New Testament economics, or the ancient oriental theocracy, is clearer than that taught in modern universities, and if this be so, then one should be the more, rather than the less, disposed to subscribe to the Biblical economics which may have induced me to invert the natural function of industry, making production secondary; for here also we are dealing with the determination of relative values. But perhaps this division of the aims of industry into moral or spiritual, on one hand, and material on the other, was not the best or most complete analysis that could be made, and was done chiefly with the view of emphasising one aspect of industrialism that might just possibly be overlooked.

It is not easy to agree that unemployment and leisure are essentially two statements of the same condition except by violent distortion of definitions; or that industry should have no responsibility in connexion with the right use of leisure. Of course, under modern conditions, industry is not actually "charged with this alien function", but industry certainly largely determines the amount of leisure, and its proper use is by no means a matter of indifference to the prudent and up-to-date employer. He does not think it advisable entirely to disclaim all responsibility herein, and rely wholly on the theatres, churches, and Press, or even on the universities and schools. Even Mr. Henry Ford, or perhaps he more than anyone else, realises the importance of a right use of leisure; and in proportion as Mr. Ford is correct in his view of the relations between man and his work, a rather hopeless view it seems, so much the more important is leisure and its use.

W. G. LINN CASS.

An Apparent Rôle for the Thymus (in Calcium Metabolism).

IT has already been reported (Harris and Moore, *Biochem. Jour.*, **23**, 261: 1929) that hypervitaminosis D always involved an atrophy, indeed eventually virtual disappearance, of the thymus, and similar changes in other lymphadenoid tissue—a discovery which has since led us to the observation that an equally remarkable fall occurs in the lymphocyte count in the same circumstances, for example, down to a reduction of more than 90 per cent below the normal average range. The atrophy of the thymus might perhaps have been accounted for simply as a feature of the general inanition: a similar change is seen in vitamin B deficiency and sometimes in starvation: yet this explanation seemed unsatisfactory. Loss of weight, for example in vitamin A deficiency, does not always produce such an effect.

In searching for a meaning for the atrophy of the thymus, and bearing in mind that the other manifestations of hypervitaminosis were the opposite to those of vitamin D deficiency, one could not overlook the suggestive fact that in clinical rickets the organ is indeed frequently hypertrophied. Yet current physiological text-books are unanimously in agreement with a recent monograph on the thymus (Hammett; Berlin, 1928) which asserts that "the function of the thymus

is unknown". Similarly it was authoritatively stated (Park, *Physiological Reviews*, 1923) that a belief that the thymus was concerned in calcium metabolism had "been challenged and overturned". However, on assembling the relative material one is confronted, once more, with a significant set of observations which, although mostly long since forgotten, and originally given a far different emphasis and interpretation, have for the most part been confirmed or extended.

(1) Atrophy of the thymus occurs in hypervitaminosis D (this is, *hyper*phosphatæmia, hypercalcæmia, hypercalcification, etc.). (Harris and Moore, 1929; Harris and Stewart, *Biochem. Jour.*, **23**, 207; 1929.)

(2) Hypertrophy of thymus occurs, conversely, in rickets (that is, *hypo*phosphatæmia, etc.) (Marfan, 1922).

(3) Extirpation of thymus gives rise to rachitic lesions (Basch, 1906; Klose and Vogt, 1910; Matti, 1913), or to a typical osteomalacia (Scipaldes, 1919), or, in birds, to a deficiency of shell (or albumin) in the eggs (Riddle, 1924).

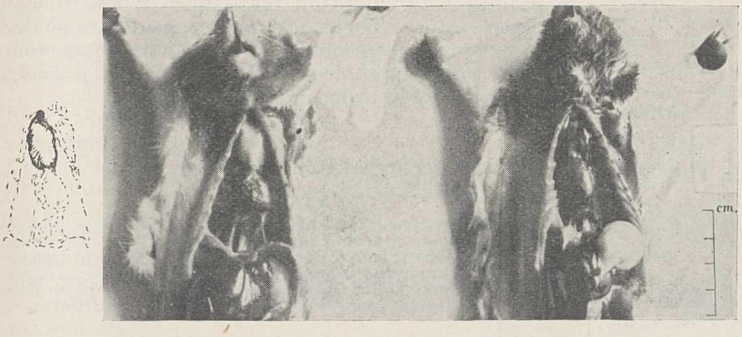

FIG. 1.—On right, hypervitaminosed rat (after 8 days feeding on synthetic diet containing 0·1 per cent of irradiated ergosterol) showing disappearance of thymus. On left, a normal control litter-mate (fed on non-irradiated ergosterol) to show the size of normal thymus (marked in solid outline in key diagram at side).

(4) Similarly, atrophy of thymus, induced by thymotoxic serum, was accompanied by diminished density of and lowered CaO, MgO, P_2O_5 content of bone (Ogata, 1917).

(5) Conversely, grafting of thymus into a normal animal results in increased compactness of its bone (Demel, 1922).

(6) Feeding of thymus to salamanders in the larval stage (that is, when they have as yet no parathyroids) produced typical tetany, relieved by calcium administration (Uhlenhuth, 1918).

(7) The thymus partly involutes at adolescence.

With these observations before us, there seems no escape from adopting as a working hypothesis the view that the thymus is involved in calcium and phosphate (the two are interconnected) regulation. Thus, if one assumes, as a simplest form of this hypothesis, that the thymus is concerned in promoting calcification, one can explain very readily the facts summarised above. In rickets the organ would be hypertrophied as a result of 'overwork'; the reverse effect would naturally be seen in excessive vitamin D intake; excision of the thymus clearly would tend to prevent normal calcification, while thymus grafting or feeding would obviously have the reverse tendency; and, finally, there would certainly be a lessened need for such an organ once the laying down of the bony frame had been concluded, at adolescence.

As already indicated, several of the observations recorded above have been overlooked or disputed. In the latter connexion it is easy, however, to see why some difficulty was experienced in confirming any early work in relation to rickets; for at the time the various causative factors (Ca : P balance, vitamin deficiency) were far from being understood, so that even in control animals experimental rickets could not be satisfactorily produced. For example, it is sufficient to mention that the accepted disproof of any possible connexion between the thymus and calcium metabolism rested on evidence no more substantial than that of Renton and Robertson (1916). These workers dismissed the possibility of a relationship between rickets and the thymus on the grounds that they found it impossible to keep their normal control dogs any more free from rickets than they did their thymectomised dogs. With modern technique and knowledge different conclusions may be drawn.

The parathyroids, as is now well known, must be included among the factors concerned in calcium regulation. Admittedly, the mechanism of calcium metabolism as a whole is complex, and it is further certain that interrelations between the thymus, parathyroid, and other organs of internal secretion must become involved, quite apart again from separate questions of absorption in the gut under the control of vitamin D. The intricacies of the question cannot be gone into here, except to emphasise that it is desired to say nothing which might appear to exclude the other apparent activities of the thymus (in relation to the lymphocytes, or to the bone marrow, or nuclear metabolism); or, again, to draw a distinction between the thymus and other lymphoid tissue. But, in the almost unexampled chaos which prevails in the extensive literature describing the supposed functions of the thymus — 'antitoxic', 'immunological', 'sexual', 'epithelial', and so forth—or its supposed irregularities—status lymphaticus and the like—a single working hypothesis which serves like the above to unify so many experimental observations deserves careful consideration.

LESLIE J. HARRIS.

Medical Research Council's
Nutritional Laboratory,
University of Cambridge.

The Quantum Theory of the Kinetics of Homogeneous and Heterogeneous Reactions.

CLASSICAL physical chemistry cannot explain a whole number of questions connected with the kinetics of homogeneous and heterogeneous reactions. For the explanation in particular of unimolecular reactions the constant of velocity of which does not depend on pressure, it is necessary to postulate a more or less complex mechanism (Lindemann, Lewis and Perrin, etc.). A number of investigators (Oppenheimer, Bourgin) have recently pointed out that, from the point of view of quantum mechanics, spontaneous disintegration of molecules which had not received the activation energy required by the classical theory is possible. In the present communication we give some preliminary considerations resulting from a study of the problem of kinetics of reactions.[1]

If spontaneous disintegration of the molecule is possible, there must be supposed a mechanism analogous to the mechanism of emission of α-particles by the nuclei of radioactive elements (Gamow), or ionisation of an atom by the outer electric field (Oppenheimer) or Auger effect. These phenomena may be schematised, as was done by Gamow in his case, making use of the idea of the transition of particles through the

potential jump. Similarly, quantum mechanics describe the emission of electrons from metals effected by the electric field (a number of papers by Fowler and Nordheim, and others). In the case of spontaneous disintegration or rearrangement of the molecules, we may assume, for example, the scheme shown in Fig. 1, of dependence of the potential energy on the distance between the parts of the molecule, where A is the activation energy of the molecule; W the

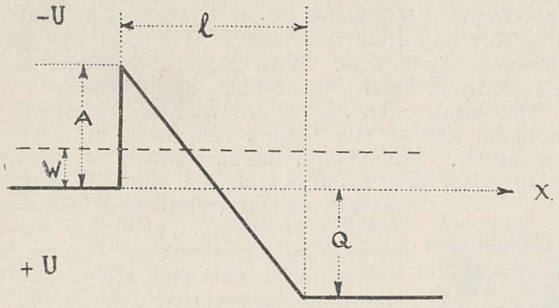

FIG. 1.

vibrational energy; Q the heat of reaction; and l the distance from the equilibrium position in which the molecule ceases to exist as a whole.

Assuming for this scheme the probability of disintegration (or rearrangement) at $|A| > |W|$ to be approximately

$$D(W) = (4/|A|)(W)^{\frac{1}{2}}(|A| - W)^{\frac{1}{2}} \exp \frac{-4k(|A| - W)^{\frac{3}{2}}}{3a(Q - A)/l} \quad (1)$$

where
$k^2 = 8\pi^2 m/h^2$ (Fowler and Nordheim, $F = a(Q - A)/l$), taking $D(W) = D_1(W)$ at $|A| \leq |W|$ (Fowler and Nordheim, *Proc. Roy. Soc.*, **119**, 181; 1928) and using the formula

$\frac{M}{\sqrt{T}} e^{-W/kT}$ for the probability of the state with the energy W, we obtain for the constant of velocity of the reaction (v)

$$v = \frac{\beta M}{\sqrt{T}} \left[\int_0^A e^{-W/kT} D(W) dW + \int_A^\infty e^{-W/kT} D_1(W) dW \right] \quad (2)$$

where βM is the proportionality coefficient.

The character of the function $v(T, Q, A, l)$ obtained by different methods is qualitatively confirmed by experimental data. A similar formula (expressing the dependence on temperature) was obtained by Bourgin.

The analysis of the assumptions on which the deduction of the formulæ is based, and their detailed comparison with experiment, will be given in a subsequent comprehensive paper. For the present we may point out that the heat of activation A, contained in them, is not identical with the heat of activation determined experimentally from the temperature dependence of v.

According to (2), v is independent of the concentration, which is in agreement with the well-known properties of typical unimolecular reactions. However, the influence of temperature on the vibration levels of the molecule is such that it renders possible the formation of Bodenstein's energetic chains, which cannot exist under very low pressures. Only in the presence of chains can the almost complete cessation of the unimolecular reaction under very low pressures be accounted for (Sprenger).

The influence of the surface on the reaction cannot be reduced simply to a superposition of a field of double surface layer on the molecule. The phenomena of catalysis require another treatment, but they also appear to be fully explained from the point of view of quantum mechanics. We should consider disintegration of a molecule as a phenomenon analogous to spontaneous ionisation of an excited helium atom. Both the component parts of the molecule should be considered like two electrons of helium. This is connected with the probable emission of free atoms into the volume during absorption.

It is also evident that, from this point of view, the unimolecularity of the majority of reactions, taking place in the superficial layer, can be easily explained (spontaneous disintegration becomes possible near the surface) as well as a series of other peculiarities of catalysis (the action of promotors, interface action, etc.).

In a similar way there follows from it the increased probability of the disintegration of molecules when united into complete aggregates (or under increased pressure). The same circumstance provides a method of extension of quantum mechanics to reactions of a higher order. Thermodynamic considerations lead to analogous conceptions, if we assume the equilibrium process to be unimolecular in one direction and a reaction of higher order in the other.

S. ROGINSKY.
L. ROSENKEWITSCH.
Physical-Technical Röntgen Institute,
Leningrad, Dec. 26, 1929.

[1] After this communication had been posted, there was pointed out to us the preliminary paper of Langer (*Phys. Rev.*, **37**, 92; 1929) devoted to the quantum mechanics of chemical reactions. This communication (and especially our further investigations) seems to us to have an interest of its own, since we put the question (and solve it) in a way which differs in many respects from Langer's. (*Added in proof.*)

Galls.

THE paradoxical interrelationship between the plant and the gall-producer, the larva, led to a correspondence between Mivart, Romanes, and other biologists, which appeared in NATURE of 1889 and 1890, and has since been extensively reproduced in works on cecidology, such as Küster's "Die Gallen der Pflanzen" (pp. 365-372; 1911). I have attacked the problem from a purely chemical point of view, my results leading me to the conclusion that the interrelationship between the gall-producing larva and the plant may be regarded as one of intercompensation.

In 1786, Scheele recorded the observation that *freshly-collected* galls produce gallic acid from gall infusions, and that old galls are not capable of inducing this reaction. This was confirmed by Robiquet, senior (1836), and Robiquet, junior (1854); but was discredited by Van Tieghem (1868), who concluded that the previous workers had been dealing with material infected by *Aspergillus* and *Penicillium*, which fungi have since been shown by Fernbach and Potevin (1901) to contain the enzyme tannase, which hydrolyses gallotannin into gallic acid.

The remarkable fact that Scheele and the two Robiquets were so definite in their assertion led me to repeat their experiments, with the result that I have confirmed Scheele's original observations. The production of gallic acid by freshly collected galls obviously shows that plant galls contain tannase, at the same time suggesting that the tannase is present in the gall-producing larvæ and not in the galls themselves. To test this hypothesis, the larvæ of *Pontania proxima* × *Salix caprea*, were chosen, and, using the method elaborated by Nicholson and Rhind (1924), it was found that they contain comparatively large quantities of tannase, about eight times as much as is found in the same weight of *Aspergillus niger*. The gall produced by this larva had the obvious

advantage of being free from inquilines, and the larva is known to deposit its waste products outside the gall.

The presence of tannase in the larvæ of the gall-producer throws new light on the points raised in the above-mentioned correspondence in NATURE. It has been shown by Küstenmacher (1895), Magnus (1914), and others, that the larva lives on the plant by the production of diastase and invertase. This is counteracted on the part of the plant by an increase of tannin (thus, the oak tree contains from 5 to 10 per cent tannin, whereas oak galls contain as much as 60 per cent), which is known to precipitate both these enzymes. The decisive action, however, remains to the larva, since tannase destroys gallotannin. The accumulation of gallic acid thus produced is also effectively disposed of by the larva, as previously shown by me (1919), when I found that dryophantin (the red colouring matter of the pea-gall) is a glucoside of purpurogallin, an oxidation product of gallic acid.

These observations, which may be represented as follows:

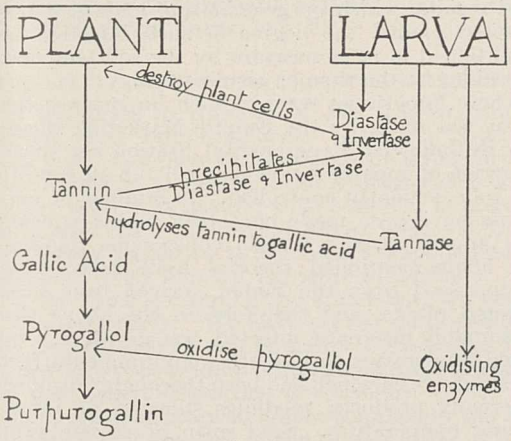

FIG. 1.

suggest that the interrelationship between the gall-producer and the plant is therefore parasitic, the initial action of the larva being counteracted by tannin production on the part of the plant.

M. NIERENSTEIN.

The University, Bristol.

The Original Mode of Constructing a Voltaic Pile.

A SHORT time ago I had occasion to turn up a number of papers in *Nicholson's Journal* on early electro-chemical research in England. I was puzzled to find there certain statements regarding Volta's pile which, at first sight, seemed directly at variance with modern views.

Nicholson and Carlisle, after constructing a pile "of seventeen half-crowns with a like number of pieces of zinc and of pasteboard soaked in salt water", showed by the aid of Bennet's electrometer that the silver end of the pile "was in the minus and the zinc end in the plus state".

At first, I believed this to be a mistake in the text, but the same statement was found in the early papers of other workers; for example, William Cruickshank, Colonel Haldane, and Humphry Davy. Davy and Cruickshank each state that hydrogen and metals (or alkalis) are disengaged at the "zinc wire", that is, the wire connected to the zinc plate, and oxygen and acids at the "silver wire".

Being at a loss to account for these statements—all consistent but apparently contrary to fact—I made a silver-zinc pile, arranging twenty shillings and twenty discs of zinc in series as shown, each pair being separated by blotting paper (Fig. 1).

(This is the arrangement given in most text-books of physics and is analogous to Volta's arrangement of pairs of plates in his "couronne de tasses".)

The pile gave an appreciable current when soaked in brine and behaved quite normally, liberating iodine from potassium iodide at the end of a wire joined to the silver. The apparent inconsistency was explained by a further reference to Nicholson's paper. His description of the construction of the pile is as follows:

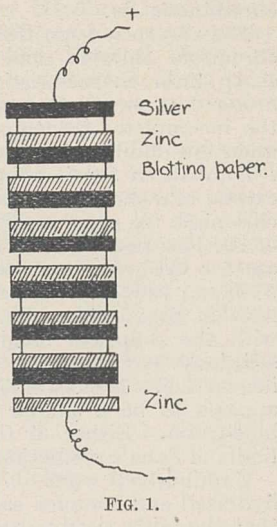

FIG. 1.

"Take any number of plates of copper, or which is better, of silver, and an equal number of tin, or which is better, of zinc, and a like number of discs or pieces of card or leather, or any porous substance capable of retaining moisture. Let these last be soaked in pure water, or which is better, salt water or alkaline lees. The silver or copper may be pieces of money. Build up a pile of these pieces; namely, a piece of silver, a piece of zinc, and a piece of wet card; and so forth in the same order till the whole number intended to be made use of is builded up" (page 179 *Nicholson's Journal*, July 1800).

The arrangement of the discs is as shown in Fig. 2. Apart from a negligible contact potential difference between the two end pairs of plates, the voltage of this pile will be the same as the one represented in Fig. 1. In other words, the extreme silver and zinc plates of the series A and B (Fig. 2) are practically useless and merely conduct the current to or from the next plates. The wire connected to the silver plate will thus have the same potential as the next zinc plate, which is negatively charged, while the 'zinc wire' will have the same potential as the next silver plate (positively charged). This construction was evidently the outcome of the theory of Volta, who regarded the points of contact of the pairs of plates as the main source of the electrical energy.

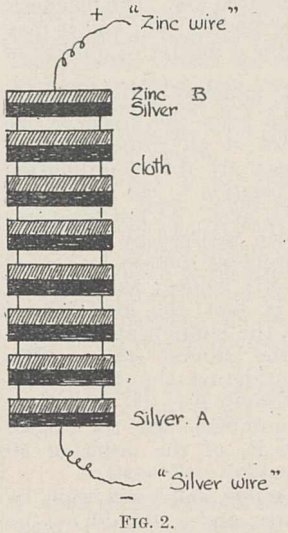

FIG. 2.

W. CAMERON WALKER.

Minchenden School,
Southgate, N.14, Jan. 21.

Colours of Inorganic Salts.

PROF. SAHA'S suggestion (NATURE of Feb. 1, p. 163) that colour in inorganic compounds depends upon the existence of an electronic state of the metal ion separated from the ground state by about 18,000 wave-numbers finds some support at least from work which has been begun here upon the general problem

of crystal spectra. There is a mass of evidence for his theory from the study of the rare earths (see particularly Freed and Speeding, *Phys. Rev.*, September 1929); but since the rare earths are exceptional because of the incompleteness of an inner quantum group with a consequent shielding of f electrons in it, it is more interesting to consider the spectra of chromium salts.

The absorption spectrum of a crystal of anhydrous chromium chloride does not, of course, show the sharp lines characteristic of rare earth salts. As Stoner has shown, for any transition element where the incomplete quantum group is of highest total quantum number there is an interaction between the l moments of the ions in the lattice, that is, in the crystal of a chromium salt the outer electrons of each chromium ion exert an effect upon the outer electrons of the ions near to it in the lattice. Actually, there are for $CrCl_3$ four or possibly more bands between 5700 and 7200 A.; the bands, much broader than the lines of rare earth salts, are yet narrow compared with the shapeless bands common in crystals and solutions, and show the spectroscopic effect of the l interaction. Besides these bands in the red, there appears to be a similar but weaker system in the blue-green. Either of these systems is within the limits of Saha's prediction.

Unpublished work on a number of crystals of hydrated and complex salts confirms the supposition that the fairly narrow bands in the red and blue are due to Cr^{+++}. The bands are unaltered in frequency and seem usually to be sharper than in the anhydrous salt. It may be that the sharpening is a real effect, due to the weakening of the l interaction by the presence of the co-ordinated electrons from the H_2O groups; this would lead to $\sqrt{l(l+1)+4s(s+1)}$ rather than $\sqrt{4s(s+1)}$ for the magnetic moment (in Bohr magnetons) of such a co-ordinated ion. The magnetic evidence, which is scanty, is against this, and it may easily be that the sharpness is a matter of quality of the crystals examined.

Besides the narrow bands, however, a broad structureless region of absorption from the green to the orange occurs in the spectra of all hydrated Cr^{+++} salts. It seems to be caused by the co-ordination electrons, and is similar in position to the only band given by the CrO_4 and Cr_2O_7 ions. At low temperatures the Cr_2O_7 band has been resolved by Obreimov into a structure which is probably caused by Cr – O vibrations of different (n', n'') values; the effect of lowering the temperature is, first, the lessening of l interaction, and secondly, the simplification of the vibration possibilities of the ground state. (The effect can be seen by considering the Boltzmann distribution over the intra-group (Cr – O) vibration, of the order of 500 wave-numbers, and the lattice frequencies associated with it, of the order of 50 wave-numbers).

It is expected that chromium salts will soon be examined at low temperatures, and it should not be difficult to decide upon the cause of the band introduced by the co-ordination electrons. The comparison between $CuSO_45H_2O$ and $CuSO_4$ is enough to show further that transitions of low energy content are made possible by the electrons of co-ordinated groups; at the moment it is not certain whether the transitions are confined to the co-ordinating electrons, or whether the co-ordinating electrons merely have a disturbing effect upon the incomplete group of the ion concerned. The answer, particularly for groups of different kinds co-ordinated in various numbers, will bring detail to our knowledge of co-ordination.

Until this is worked out, any account of colour in the compounds of transition elements is incomplete. Of the two possible causes, the one defined by Saha is known and can usually be predicted; the other, which can happen through the formation of complex ions from atoms the incomplete quantum group of which is of highest total quantum number, is still unknown.

C. P. SNOW.
F. I. G. RAWLINS.

Laboratories of Mineralogy and
Physical Chemistry,
Cambridge, Feb. 5.

Angular Leaf-Spot Disease of Cotton.

Bacterium malvacearum, the causative agent of 'black-arm', or angular leaf-spot disease of the cotton plant, has been described in certain recent papers as capable of producing a systemic infection of the plant without, however, causing any manifest symptoms of disease until external conditions become suitable for the development of local lesions. Further, it has been claimed that this infection may extend to the developing ovules, so that internally infected seed results, which on germination may give rise to infected plants, the degree of such infection being conditioned in large measure by the soil temperature prevailing at the time of germination.

These hypotheses were of such importance that a grant was made by the Empire Marketing Board to the Rothamsted Experimental Station for the construction of apparatus in which soil and air conditions are independently controlled. A number of experiments have been made on cotton plants growing in this apparatus, and certain conclusions relating to the above-mentioned theories have been reached. Cotton seed from the Sudan derived from heavily infected plants, and therefore on the above theory presumably internally infected, was grown at a range of soil temperature with all other environmental factors constant. Seed which had been thoroughly disinfected externally produced seedlings showing no infection at any temperature. Seed sown untreated resulted in seedlings with a small degree of infection, showing a maximum at a soil temperature of about 27° C. Plants from seed which had been soaked in a strong suspension of the organism showed a considerably greater degree of infection, again with a maximum at 27° C., but with some disease even at 40° C. (a temperature several degrees above the maximum at which the organism has been grown in pure culture). Finally, seed in which the organism had been artificially introduced within the seed coat produced seedlings nearly all of which were infected at all temperatures, even up to 40° C. It will be seen that these results lend no support to the hypothesis of natural internal infection, but indicate that primary infection arises from the attack of bacteria present on the outside of the seed.

In order to test the theory of latency of the parasite within the plant, these same seedlings which had shown primary infection were allowed to grow on under conditions suitable for the development of the disease, as shown by the fact that plants side by side with them which had been sprayed with a pure culture of the organism developed heavy infection. In no case did the unsprayed plants show any further disease in the newly-formed leaves and stems as would be expected if the theory of internal spread were correct. A detailed account of these experiments will be published at an early date in the *Annals of Applied Biology*.

Returning to the hypothesis of internal infection of seed, attempts in the laboratory to isolate the organism from the tissues of the embryo have invariably failed. Many different kinds of organisms, both fungi and bacteria, occur, however, between the

seed-coat and the embryo, and on one occasion out of many trials *B. malvacearum* was recovered from this position.

A point of interest, and one which may prove to be of great importance in the life-history of the disease, is that this bacterium has been found to show the phenomenon of 'dissociation'. At least three 'dissociates' have been isolated, all of which are culturally, and to some extent morphologically, quite distinct, one being possibly identical with the so-called 'common yellow saprophyte of cotton'. These 'dissociates' arise in single-cell cultures and appear to be produced in an obligate order, that is, 'A' produces 'B', 'B' produces 'C,' and so on, there being some suggestion that the cycle may be a closed one. This phenomenon of dissociation appears to be correlated to some extent with the production of some of the newly-observed growth-forms recently described by me (*Proc. Roy. Soc.*, B, **105**; 1929).

R. H. STOUGHTON.

Department of Mycology,
Rothamsted Experimental Station,
Harpenden, Herts, Feb. 22.

Glasses Transparent to Ultra-Violet Radiation.

IN his letter to NATURE of Jan. 18, Dr. English suggests that our conclusion (NATURE, Sept. 21, 1929) that "complete degeneration by a mercury arc lamp results in a greater loss of ultra-violet transparency than does natural solarisation", is merely a confirmation of his statement (*Glass*, Sept. 1928) that eight hours' exposure to a mercury vapour lamp is equivalent to six months' exposure to sunshine.

So far from confirming his statement, we cannot even agree with it. We have proved quite definitely that an exposure of two hours at a few inches from the mercury vapour lamp produces far more degeneration than would an eternity of sunshine.

Dr. English appears to ignore completely the most interesting phenomenon of the rejuvenation of ultra-violet glasses in sunshine after being degenerated by mercury vapour lamps. Our letter was concerned almost entirely with this discovery, which to our minds proves conclusively that exposure to lamps emitting radiation of wave-lengths shorter than that received from the sun can be no safe guide to the behaviour of glasses when exposed to sunshine. We understand that this discovery of the phenomenon of rejuvenation of artificially irradiated glasses has already been confirmed by the Bureau of Standards.

We are surprised that Dr. English prefers to substantiate his arguments with photographs of spectra, surely a dangerous procedure—he himself condemns it (*Glass*, September 1928, pp. 388, 389)—rather than to consider figures, accurately determined, showing the actual percentage transmission of specimens of identical thickness under different conditions. We believe that all accepted authorities agree that the only trustworthy methods for the comparison of specimens of glass are those employing a photoelectric cell, vacuum thermopile, or similar quantitative instrument. One such method was described briefly in our letter (NATURE, Sept. 21, 1929).

We did not say in our letter that natural solarisation was complete in a few days. Our figures show, however, that it can be practically so in four very bright days.

New glass exposed in winter will, of course, age slowly compared with that exposed in summer.

A. R. WOOD.
M. N. LEATHWOOD.

Research Laboratory,
Crown Glass Works,
St. Helens, Lancs, Jan. 23.

Monomolecular Films of Batyl Alcohol.

SOME measurements which I have made on monomolecular films of batyl and chimyl alcohols (isolated from shark-liver oils by Prof. J. C. Drummond) throw some light on the molecular structure of these compounds. They have been shown to be, respectively, an octadecyl glyceryl ether (Heilbron and Owens, *Jour. Chem. Soc.*, 942; 1928) and a cetyl glyceryl ether (Drummond and Baker, *Biochem. Jour.*, **23**, 274; 1929); whether the hydrocarbon chain is attached to the glyceryl group at the α- or β-carbon atom has not hitherto been decided.

My measurements give 26 sq. A. for the cross-section of the head group of batyl alcohol. This agrees with the value for the α-monoglycerides (Adam, Berry, and Turner, *Proc. Roy. Soc.*, A, **117**, 532; 1928). If batyl alcohol had the symmetrical β-structure, its mode of orientation would require a larger area than this, comparable with the 36 sq. A. found for mono-octadecyl malonic acid (N. K. Adam, private communication).

In view of these facts, therefore, it seems highly probable that batyl and chimyl alcohols have the unsymmetrical α-structure.

B. C. J. G. KNIGHT.

Bacteriological Department,
London Hospital Medical College, E.1,
Jan. 23.

Viruses and Life.

MR. GEOFFREY SAMUEL states in NATURE of Jan. 11, p. 51, that he has difficulty in distinguishing the suppositions vitamol and virus. Virus connotes a something of unknown constitution that can pass through filters and that causes specific disease. Vitamol is supposed to be of molecular structure with attributes of life, and might be parasitic or symbiotic or lead an independent existence. In the study of the viruses the methods of the biologist seem to have reached their limit, and the concept and the word were offered in the hope of attracting the attention of physicists who might be able to cast a ray of light on the matter.

If structure is for function and not function for structure, then function should precede. For the development of structure that facilitates metabolism (say an envelope having certain qualities) there should be metabolism to facilitate.

In the broad theory of evolution there is at present a hiatus between the non-living and the living; a gap which the theory requires should be bridged.

J. J. DAVIS.

University of Wisconsin,
Madison, U.S.A.

A Deep Sea Echinoid in British Waters.

ON Feb. 13 we took a single specimen of the Spatangoid *Urechinus naresianus* in a bucket-sample at 110 metres, seven miles south of Sanda, off the Mull of Kintyre. It was a young individual only, 5 mm. long. The general colour was whitish, and the tube feet yellow; two or three large pedicellariæ on the aboral side were tipped with deep red. The sample was a coarse shell gravel with a fairly large mixture of sand.

This is the first record of the species in British waters; and with the exception of a single record at 760 metres, referred to by Mortensen as untrustworthy, its previously known bathymetric range was *c.* 1450 to 4480 metres.

HILARY B. MOORE.

Marine Station,
Millport.

Scientific Research and Modern Life.

THE recently published report of the Department of Scientific and Industrial Research[1] covers the period Aug. 1, 1928–July 31, 1929. It is signed by Lord Parmoor and includes the short report of the Committee of the Privy Council, and the longer report of the Advisory Council, together with summaries of the work done under the direction of the various research boards and by the research associations which have received grants from the Department, and also appendices dealing with finance, publications, and the organisation of industrial research in various parts of the British Empire.

Originally appointed by an Order in Council of July 28, 1915, the Committee of the Privy Council, consisting of the holders for the time being of certain Ministerial offices, is charged with the duty of directing the application of the sums of money provided by Parliament for the organisation and development of scientific and industrial research. The gross estimate for the present year is £644,379, of which £31,071 is for headquarters administration, £32,000 for grants, £512,570 for research work and research establishments, and £68,738 for the Geological Survey of Great Britain and the Museum of Practical Geology, the administrative control of which was transferred to the Department in 1919.

Much detailed information is given regarding the allocation of the money, from which it is seen that the net cost of the National Physical Laboratory during 1928–29 was £89,861, of fuel research £77,877, of building research £32,362, of forest products research £34,327, and of food investigation £18,546. Of the various research associations, during eleven years the British Scientific Instrument Research Association has received £100,484; the Woollen, Cotton, Linen, and Rubber Research Associations in nine or ten years have received respectively £54,643, £92,662, £57,282, and £30,983; while altogether twenty-three associations have received grants. The total expenditure on the National Physical Laboratory was £195,164, but the receipts from outside bodies, firms and Government departments, amounted to £105,303.

Though, considering the immense interests involved the sum at the service of the Department is comparatively small, it is probable that the influence of the work of the Department is felt in every part of the Empire, while perhaps no portion of the national income is expended with more beneficial results. Agriculture, food, housing, heating, lighting, clothing, transport, and communications, all profit by the investigations either directly carried out by the research boards or assisted by the Department, and science is not only applied to difficult industrial problems, but it is also made to minister to our everyday needs in a thousand ways. The storage of fruit, the production of beet, cutlery manufacture, laundry work, flax growing, boot-making, furniture, anthrax from skins and hides, coinage, the ageing of rubber, dentists' fillings, mites in flour, the cocoa moth, water purification, fish and salt meat, are all among the things which are being investigated and will undoubtedly pay for investigating. No fewer than fifty boards and committees are shown as directing the inquiries, which affect the whole population. On these committees sit some of the most distinguished men of science in Great Britain, and their services to the nation are none the less valuable because in many cases they are given voluntarily. These committees may indeed be regarded as a great general staff organised for the application of science to our common wants.

It is impossible in a short article to do justice to the great range of subjects that fall within the province of the Department, but to illustrate the close relationship of its work and everyday life we have selected the reports of the Fuel, Food, Building, and Forest Research Boards. Second in importance to none is the national question of fuel, whether used for industrial or for domestic purposes. Presided over by Sir Richard Threlfall, the Fuel Research Board has local committees in all the coal-producing areas and maintains the Fuel Research Station at Greenwich. Of this station the Advisory Committee remarks: "We take this opportunity of expressing to Your Lordships our appreciation of the value of the work of this Station. Your Lordships can be confident that we now have a national organisation for fuel research which is not excelled in any other country."

When the Fuel Research Board started its work, it gave a large degree of priority to all problems of carbonisation, these being considered of importance from the point of view of smoke abatement and of the production of oil from home resources. It was also desired to stimulate industrial development. Then, too, the Board was asked to advise on the composition and quality of gas for public supply. In connexion with these matters, problems in both high-temperature and low-temperature carbonisation have been attacked with noteworthy results. Now it is proposed to carry out a general investigation of furnace design with particular reference to the burning of pulverised fuel, which is being introduced both ashore and afloat. The chief technical problem here is to secure complete combustion in a small space; hitherto it has been considered necessary to have large combustion spaces, but for this there does not seem to be any basic necessity. The production of metallurgical coke, the manufacture of water gas, the hydrogenation of coal, and the composition of tar are all being studied. An outstanding feature of the year was the starting up of the low-temperature carbonisation plant at the Richmond Gas Works, erected to the designs worked out at the Fuel Research Station. After preliminary difficulties were overcome, the plant was successfully put into commission, and the new domestic fuel was placed on the market as 'Gloco'.

The Food Investigation Board is presided over by Sir J. G. Broodbank, while Mr. W. C. D. Whetham

[1] Department of Scientific and Industrial Research. Report for the year 1928–29. (Cmd. 3471.) Pp. v+200. (London: H.M. Stationery Office, 1930.) 3s. 6d. net.

is chairman of the management committee of the Low Temperature Station for Research in Biochemistry and Biophysics at Cambridge. Our fuel supplies are ample; our food supplies come from all over the world, and the successful preservation and carriage of fruit, vegetables, meat, and fish affect every home. The storage of fruit has been studied for ten years, and it is proposed to publish a comprehensive report on it. Special attention has been given to apples, and recent investigations show that there is a critical low temperature for each variety of apple, below which the fruit rapidly deteriorates in storage. For the study of fruit an experimental station is being erected at East Malling, and for the study of fish a research laboratory is being inaugurated at Aberdeen. Towards the cost of these the Empire Marketing Board is assisting. The value of the fish landed in Great Britain last year was £18,000,000; the value of the meat imported, £109,000,000—figures which indicate the importance of the trade in these commodities.

While many of the inquiries led to long and difficult experiments in the laboratory, an example of work of more immediate practical application arose through requests made by the Sheffield and Leicester Corporations. The question was whether the hanging of meat improved its palatability. Experiments were made with meat conditioned at 32° F. and 41° F. up to ten days hanging, and it was found that the palatability was improved, the flavour was retained, and the texture and juiciness of the meat improved. In the tests, assistance was received from members of King's College for Women and the staff of Messrs. J. Lyons and Co.

Houses, furniture, and clothing are as necessary as food and fuel, and the work of the Building Research Board, the Forest Products Research Board, and that done by the Cotton, Woollen, Silk, Leather, Boot and Shoe, and other Research Associations, afford many examples of the value of the scientific method applied to age-long problems. Limes, plasters, cements, paints, breeze, artificial stone, the weathering of stone, the vibration of buildings, wind pressure on structures, are being investigated by the Building Research Board, while the Forest Products Research Board is dealing with the anatomical structure of woods, the seasoning of furniture timbers, the shrinkage and deterioration of timbers, the testing of pit props, and the habits of the various insects which destroy our roofs and furniture. Many firms apply to the Boards for information, and, in addition to advisory work at home, much has been undertaken for places so far apart as Burma, British Honduras, Australasia, and Kenya.

In other directions work is proceeding on metals and alloys, boiler plates and ingot steel, corrosion, the fatigue of metals, electro-deposition, springs, radio telegraphy and telephony, lubrication, cast-iron, refractories, and many engineering problems. While one department is engaged on the study of steel, another is considering the advisability of establishing a national locomotive experimental station, and yet another is doing work of value for our cathedrals and churches. Canada, Australia, New Zealand, South Africa, and India are all following in the footsteps of the Mother Country: they all have research organisations, and of their activities the report gives a brief review.

A New High Voltage Research Laboratory.

THE opening by Sir Ernest Rutherford of the high voltage research laboratory of Metropolitan-Vickers Electrical Co., Ltd., at Trafford Park, Manchester, on Feb. 28 is a noteworthy event. The increasing use of the outdoor type of construction for high voltage apparatus makes it necessary to determine how this apparatus will act during gales, thunderstorms, and snow-storms. As the standard pressure for distributing electrical energy in Great Britain is 132,000 volts, and a factor of safety of three or four is desirable, it is very advisable that all devices for use in high voltage lines should be tested at pressures of several hundred thousand volts.

In the present state of our knowledge, the performance of insulating material under very high pressures can in general only be determined by experiment. Although there are now several laboratories abroad which have facilities for testing at a million volts with a large reserve of power, yet with the exception of the high voltage equipment at the National Physical Laboratory, Teddington, there was none in England. It is highly satisfactory, therefore, that one of the largest industrial firms should have built a million volt laboratory under the supervision of its able engineers.

The present laboratory consists of two semi-independent main buildings and an annex. The smaller of the two main buildings, which is 47 ft. long by 67 ft. broad, was built in 1923 as a 500,000 volt-power frequency laboratory. When it was decided to extend the equipment to give a million volts, the second main building, 67 ft. by 86 ft., was laid down with a wall in common with the original building. The latter is now equipped with devices for producing transient voltages and is called the 'surge' laboratory. The annex contains the materials and physics laboratories and a machine room where all the generators and running machinery are isolated so as to reduce noise.

The main electrical equipment consists of two 500,000 volt, 500 k.v.a., 50 cycle transformers, one being located in the main laboratory and the other in the surge laboratory. For producing a million volts, the two transformers are connected in cascade by the well-known Dessauer method. The second transformer, the one in the main laboratory, is shown in Fig. 1. As the primary winding of this transformer has a potential difference to earth of 500,000 volts, the whole transformer has to be thoroughly insulated from the earth. This is done by means of pedestal pillars which support the tank

containing the transformer. The two transformers are practically identical in construction, each being of the core type with each limb wound. They are both immersed in oil.

The accurate measurement of high voltages is a problem of considerable difficulty. The standard method is to use two spherical electrodes; then, if their potentials are equal and opposite at the instant of the discharge, the potential difference between them can be computed with an accuracy of about one per cent, provided that there are no brush discharges taking place in the neighbourhood. When one of the electrodes is earthed, the accuracy obtainable is not so high, possibly because the potential of the 'earthed' sphere is not zero.

The method adopted in the new laboratory at Trafford Park depends on the theorem that the average charging current of a condenser is proportional to its capacity and to the *maximum value* of the voltage. Hence when the capacity and frequency are known and the average current due to the voltage is measured, the maximum voltage can be deduced. A meter is so arranged that its reading gives the voltage directly. The condenser employed consists of large surfaces, each twenty feet in diameter and having air between them (see Fig. 1). The surfaces employed are flattened and symmetrical about a vertical axis. One is supported directly on the bushing insulator of the high voltage transformer, and the other is suspended immediately above it from the roof. This condenser is the largest high-voltage condenser yet constructed.

The power rating of each of the transformers is 500 kilovolt-amperes, so that very large currents can be supplied at the instant of spark-over. In order to get satisfactory results, it is well known that it is necessary to have a large amount of reserve power available. The control of the generators which are housed in the machine room is done from the control desks in the laboratories. Push buttons control the starting and stopping of the driving motors, the rheostats which govern their speed and the frequency meters. The potentiometer regulators which control the voltage are motor-driven and give a uniform rate of voltage variation over the entire range with the motor running at constant speed.

The photograph of a power frequency arc at a pressure of 970,000 volts is shown in Fig. 2. The spark gap is 12 ft. The man shown in the illustration was not present when the arc occurred; if he had been he probably would have been killed. He is merely included in the photograph to indicate the scale of the phenomenon; this was done by a double exposure. On first entering the laboratory, one is impressed by the large amount of floor space which is apparently not utilised. Remembering, however, that at a million volts 12-ft. arcs can occur, it will be seen that any material or apparatus being tested must be at least that distance away from walls and objects connected with the earth. Taking the dimensions of the transformer into account, it was found that a clear space at least 30 ft. in diameter was absolutely necessary.

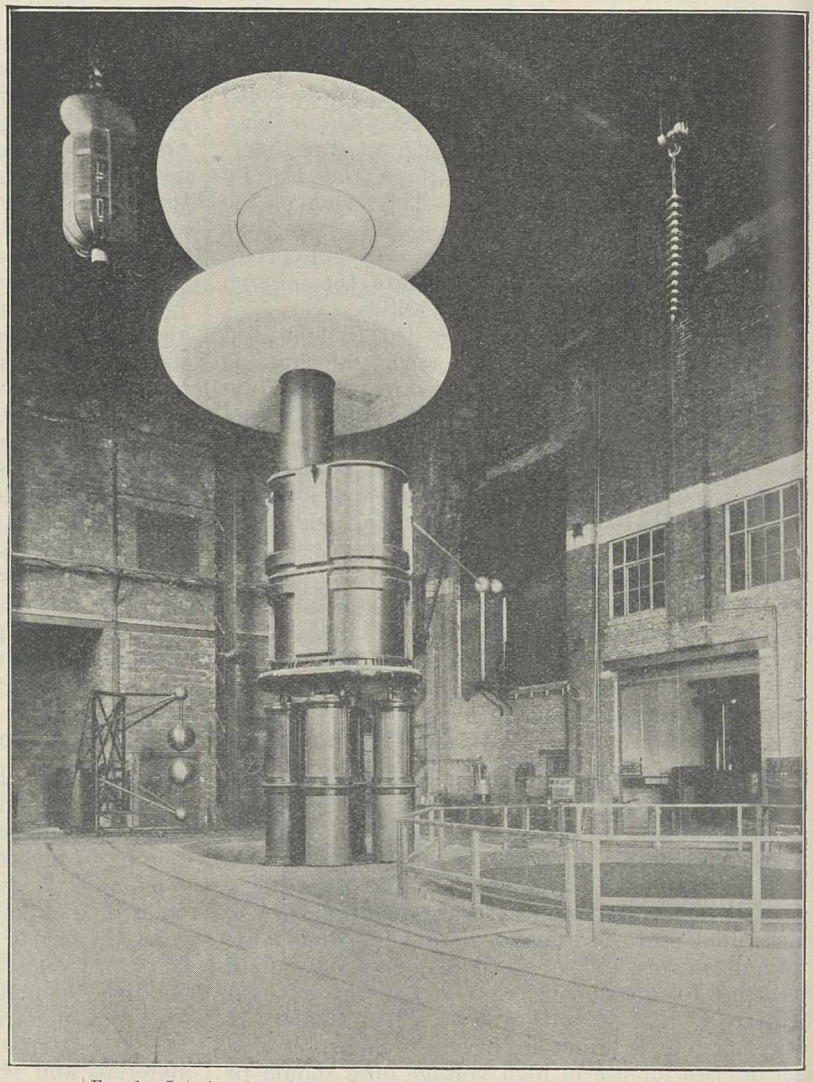

FIG. 1.—Interior view of the main High Voltage Laboratory at Trafford Park.

In order to make full scale tests of large porcelain insulators immersed in oil, it was found advisable to make a tank 25 feet in diameter and 10 feet in depth. This has a volume of about 4000 cubic ft. and would contain about 20,000 gallons of oil. Good insulating oil is not cheap, so this must repre-

sent quite a large amount of capital. The necessity also of keeping it dry and clean must add considerably to the cost. It will be seen that these million voltage tests must be very expensive. The majority of the tests will be carried out by the two transformers used individually at 500,000 volts or less. In the materials laboratory there are three transformers producing voltages of 11,000, 22,000, and 100,000 for ordinary tests. Two tanks are provided, for making tests in hot and cold oil. There are four testing chambers in the middle of the room, where the materials can be tested at various temperatures and humidities.

In the surge laboratory (Fig. 3), apparatus is provided for testing devices and materials when subjected to transient voltages produced in various ways. In systems used for transmitting electrical power, three kinds of surges are recognised: first, those caused by a sudden variation of the load or the 'runaway' of a generator; secondly, those due to high frequency surges of internal origin caused by switching or by an arcing fault; and thirdly, the surges caused by atmospheric disturbances, including lightning discharges. Modern operating experience in Great Britain where the neutral is earthed indicates that lightning is the only source of overvoltage that has to be guarded against. The design of the insulators, therefore, must be such that the minimum amount of damage is done when the lightning arc-over occurs. The dangerous transients are the 'impulsive rushes' which were described fully and experimentally demonstrated by Sir Oliver Lodge so long ago as 1889 (*Jour. Inst. Elect. Engin.*, vol. 18, p. 386; 1889).

By arranging a condenser so that it is suddenly discharged when a spark gap flashes over, it is easy to get what Lodge called an impulsive rush. By arranging a series of them in parallel, we can construct an impulse generator. The generator in the surge laboratory can produce transient voltages up to 1,500,000. A mechanical rectifier is installed which produces a voltage of about 700,000. This is mainly used for operating the impulse generator. Another set equipped with thermionic rectifiers is generally employed for direct current voltage tests. Its maximum voltage is 250,000 volts, and its terminals can either be at equal and opposite voltages or one of them may be earthed.

A special Schering bridge has been constructed for measuring dielectric losses at pressures up to 500,000 volts. Electro-mechanical tests on porcelain insulators, and design studies on switch-gear and transformer parts, have frequently to be carried out in this laboratory. It is one of the best equipped laboratories in the world, and Messrs. Metropolitan-Vickers Electrical Co., Ltd., are to be congratulated on having recognised always that it is necessary to use the best and most scientific methods of testing the materials they use in manufacturing their machines and devices and for determining their factors of safety.

In declaring the laboratory open, Sir Ernest Rutherford expressed the hope that before long we may be able, by using millions of volts, to produce copious streams of high velocity atoms and electrons in the laboratory. An abundant supply of swift particles would open up many new avenues of attack on the fundamental problems of physics. Unfortunately, the finances of the ordinary university laboratory are very limited. It is too much for a university to hope for a laboratory like this one approaching a cathedral in size. It is possible, however, that an apparatus may be devised which can be operated by a small

FIG. 2.—Power frequency arc at a pressure of 970,000 volts in a 12-ft. gap. The man was photographed separately.

transformer in an ordinary-sized room giving ten million kilovolts to a vacuum tube. Such a piece of apparatus would be a great help in physical research; and considering the great progress made by engineers in recent years, Sir Ernest believes that the design of such a device does not offer insuperable difficulties. He congratulated the Metropolitan-Vickers Electrical Co., Ltd., and its research department on its far-sighted policy in initiating high voltage research.

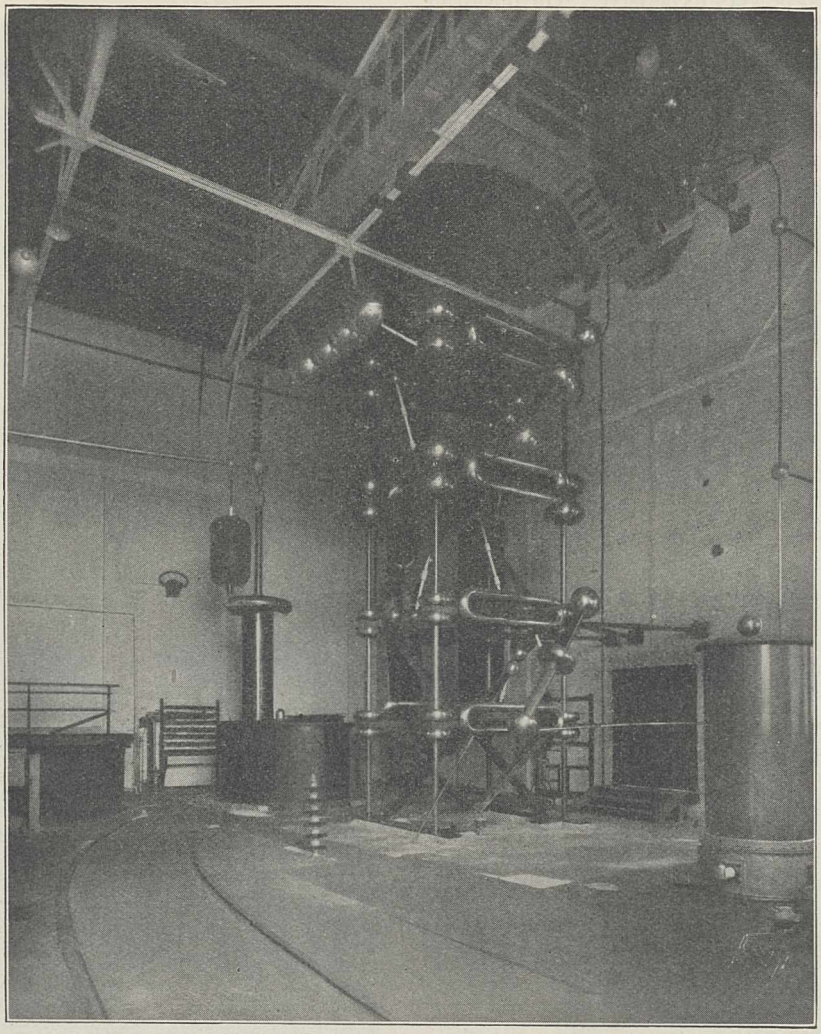

FIG. 3.—Impulse generator in Surge Laboratory.

Obituary.

MR. A. A. CAMPBELL SWINTON, F.R.S.

BY the death of Alan Archibald Campbell Swinton on Feb. 19, scientific research loses one who has done valuable work especially in X-rays and radio communication. The third son of Archibald Campbell Swinton of Kimmerghame, Berwickshire, he was born on Oct. 18, 1863. His father was a professor of civil law in the University of Edinburgh from 1842 to 1862 and was also Brigadier-General in the Royal Company of Archers. He could prove direct descent from the Royal House of Scotland. Prof. Swinton's second son was Captain George S. C. Swinton, who was chairman of the London County Council in 1912 and chairman of the town-planning committee of the new city of Delhi. He was also Lord Lyon King of Arms. Prof. Swinton's sister was the mother of Archbishop Lord Davidson.

When a child, Alan Campbell Swinton showed a bent towards engineering. An oil painting of him when aged nine, with a steam-engine in his hand, was shown at the Royal Scottish Academy

(*Continued on p.* 385.)

Supplement to NATURE

No. 3149 MARCH 8, 1930

Reviews.

"The New Britannica."

The Encyclopædia Britannica: a New Survey of Universal Knowledge. Fourteenth edition. In 24 volumes. Each volume about 1000 pages. (London: The Encyclopædia Britannica Co., Ltd.; New York: Encyclopædia Britannica, Inc., 1929.) Cloth, £27 16*s.* 6*d.*; Half Morocco, £36 17*s.* 6*d.*; Three-quarter Morocco, £49 10*s.*; Full Morocco, £69; Library Bookcase Table included.

IN the opening paragraph of the preface to the fourteenth edition of the "Encyclopædia Britannica", the editor at once strikes the note of innovation which to coming generations will be the distinctive mark of this issue of a great publication. He points out that, from the time of d'Alembert's preface to the great French "Encyclopédie" of the eighteenth century, it has been customary to prefix to encyclopædias a general dissertation upon "the body and divisions of knowledge, its life and advancement, its inspiration and utilities". His own task he has conceived differently. Such a unifying impression, he holds, and all will agree justly, has passed beyond the power of man. He aims now at stating what is the spirit animating "this newest design", the scope of its contents and the methods by which the whole has been formed.

'Monumental' is a word which has been sadly overworked in relation to the heavier literature of to-day and yesterday; but no other is more readily applicable to the "Encyclopædia Britannica". With equal propriety it may be termed "more lasting than brass". Each successive edition falls out-of-date as the volume of knowledge increases; but each remains a landmark in the progress of man towards the completer conquest of his environment—not in the sense merely of his control of material conditions, but in the spiritual knowledge which ultimately informs all interpretations of the universe and its component parts, however much we may try to anchor them to earth with such labels as 'materialistic' and 'mechanistic'.

In every great encyclopædia which is worthy of that name the spirit of the age takes on bodily form. This is as true of the fourteenth edition of the "Encyclopædia Britannica" as it was of the ninth and as it was of the first edition one hundred and sixty years ago. Yet if we would contrast to-day with yesterday, or perhaps more aptly the day before yesterday, we should look to the great "Encyclopédie" of Diderot and d'Alembert rather than to the "Britannica". That momentous French compilation of the eighteenth century sounded the death knell of the old regime. It focused the scepticism of which Voltaire was the protagonist, the idealism of which Rousseau was the prophet, and the realism of Montesquieu and the natural philosophers: it gave general currency to ideas which were to be a driving force in philosophy, in science, in literature, and in politics throughout the French Revolution and the troubled times in Europe of the first half of the nineteenth century.

This spirit still lives. Yet if we seek to draw a parallel in the conditions of this newer world and the old, it is the ninth edition of the "Encyclopædia Britannica" rather than the fourteenth which we would compare with the "Encyclopédie". Just as the latter inspired the French Revolution and its immanent philosophic ideals, the ninth edition paved the way to a revolution in every department of human life which was no whit less far-reaching than the political upheavals of the eighteenth and early nineteenth centuries, and of which no one can yet foretell the full effect. When the publication of the ninth edition began in 1875 the world was still orthodox. The ideas of Darwinism had not yet gained currency: their full implication—all that body of healthy scepticism for which they now stand to us—had not been generally perceived, much less had their ramifications been worked out. The leaven had only begun to leaven the lump. Fourteen years later, when publication was complete, the viewpoint of science and philosophy, of literature and art, was changing from the static to the dynamic. We are no longer in the fixed conditions of a settled universe. Once more the inquirer stands with the first prophet of evolution in a world of flux and can exclaim with Heracleitus πάντα ῥεῖ.

Yet the very moment in which the philosopher seemed to grasp the key which would open the door to the secrets of the universe witnessed the shattering of his hope. The spirit of inquiry which had been released by the break-up of the orthodox world turned to rend its deliverer. On one hand, the sum of knowledge rapidly passed beyond the comprehension of a single synthetic scheme: on the other, the teleological concepts which had been coupled with the evolutionary theory failed to make good their validity—a fortunate chance, can it be called, otherwise had the world of intellect been confined by an idealism as sterilising in the long run as the orthodox conceptions of the mid-nineteenth century.

It is almost a commonplace of criticism to regard the generation which has followed the later years of the nineteenth century as materialistic. A more just interpretation of the intense preoccupation with facts which is perhaps the most salient characteristic of that generation would attribute it rather to the extension of scientific method to all branches of knowledge. Most marked, perhaps, is the application of that method to departments of life which, if hitherto regarded vaguely as subject to general laws, under a regime of *laissez faire* had in practice been left to a more or less informed employment of the method of 'trial and error'.

In those sciences of which the subject matter is susceptible of study by experiment, there has been in the present generation an enormous increase in the volume and intensity of research. But in the biological sciences, more especially in those which bear upon human life, the range of experiment is limited. Here, however, research has been prosecuted with no less activity. This has been rendered possible by a continually increasing appreciation of the degree to which observation can be made to serve the purpose of experiment. By a widely extended record of facts observed in varying conditions which afford material for contrast and comparison, methods of study have been formulated analogous to the 'control' of the experimental laboratory. It is in the light of this conception that there has grown up in little more than a generation the vast body of knowledge which is comprised in the study of heredity and that, very slowly it is true, the study of genetics, of eugenics, of anthropology, and of sociology are collecting facts and formulating principles which are becoming more and more the background in the work of social welfare and to a degree in actual legislation. The effect of scientific method in the attack on the problems of hygiene and public health is too obvious to need comment.

It is, however, to the War that we must look for the most potent stimulus, both directly and indirectly, to the extension of scientific research and to the increased application of its results to the practical affairs of life. The War was universal in its effect. The struggle was not confined to the trenches; 'supply' was not merely a question of maintaining an army in the field. There was no department in the life of the nation so remote that it was not vitally affected. If chemical warfare was the most obvious province of research, it was one only of many. Every effort was demanded from science to help to conserve and extend the resources of the nation in the vital services of life.

For those who look to a scientific attitude of mind as an essential factor in the attack on the many and grave problems of this post-War world, it is of the utmost moment that the significance of science during the War has not been entirely forgotten. The diversion of practically the whole body of scientifically trained men in the country to the service of the nation made the public familiar with certain principles. On one hand, it came to appreciate that scientific research, however apparently remote its object from practical affairs, still has its value, and, on the other, that even in problems in which science is not directly concerned, the scientifically trained mind and 'scientific method' in mode of attack minimise effort and offer the greatest promise of an ultimate solution. Hence since the close of the War a change of attitude towards science has to be noted as an element in the formulation of popular opinion. The age of reason, however, is not yet. Politics still govern legislation. But the attempt, for example, which is being made to formulate basic principles in accordance with scientific fact in questions so tinged with emotion as marriage and divorce is at least significant.

We may appear to have wandered somewhat far from the "Encyclopædia Britannica", but these reflections occur inevitably when both its new form and content are considered. It is a product and a reflection of its age as much as earlier editions have been. At the present day science workers are overwhelmed with the volume of research. Each becomes increasingly absorbed in his own restricted field. Specialisation grows from day to day, and no one can hope to keep fully abreast with advances in fields other than his own. The editors have therefore had a difficult task to perform. The general essays, in their day highly valuable contributions to the advancement of knowledge, which

have been a feature of earlier editions, have tended to disappear. In their place, greater subdivision, entailing a great increase in the number of separate articles, more detailed treatment, and an increased volume of specific information so far as consistent with due regard to the broader outline of each subject, are the salient features of the new edition. Again, borderline territories between the sciences and the interrelation of different sciences, a conspicuous feature in modern research, have had to be adequately covered. It is therefore no matter for surprise to find that the whole editorial organisation has been fundamentally changed in the preparation of the latest edition. The editorial staff has been supplemented, in fact except in its highest functions superseded, by a body of departmental specialist editors. Not only has this given an added guarantee of accuracy; it has ensured a fitting perspective within each department.

A perusal of the list of associate editors reads like a "ministry of all the talents". Without attempting to give a complete list, a few of the more suggestive names may be mentioned. Prof. Andrade is responsible for physics, Prof. Barcroft for physiology, Dr. Cloudesley Brereton for education. Geography is in the hands of Prof. H. J. Fleure. Prof. Julian Huxley is responsible for biology and zoology, and Prof. G. T. Morgan for chemistry. Mr. T. C. Hodson edits archæology and anthropology, and Prof. A. S. Eddington, astronomy. It is unnecessary to pursue the list further. This brief selection suffices for a taste of its quality. In addition, as the "Encyclopædia" is essentially a result of Anglo-American co-operation, a corps of associates, each a recognised expert, was organised in New York, thus effectually securing the full representation of American scientific achievement.

Of the quality of the sections for which the associate editors have been responsible, and of individual contributions, we hope to speak in later issues. For the moment it must suffice to say that the new organisation has fully justified itself. As a work of reference and a source of information on points of detail, the value of the "Encyclopædia", speaking generally, has been much enhanced. The illustrations alone in themselves are a store of information, and both from the artistic and technical point of view are a remarkable achievement. It is, perhaps, hazardous to prophesy that this edition of the "Britannica" will be regarded as a permanent possession for generations to come; it will certainly long be regarded as a monument of technical excellence in book production.

Bacteriology in Medicine.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 4. By H. J. Bensted, W. Bulloch, L. Dudgeon, A. D. Gardner, E. D. W. Greig, D. Harvey, W. F. Harvey, T. J. Mackie, R. A. O'Brien, H. M. Perry, H. Schütze, P. Bruce White, W. J. Wilson. Pp. 482. (London: H.M. Stationery Office, 1929). 21*s.* net.

THIS volume is divided into seven chapters, of which the first four are devoted to the colityphoid group of organisms. All the writers have special knowledge of the subjects with which they have dealt, and the majority have had considerable practical experience in the medical aspect of the disease of which the bacteriology is described. As would be expected, therefore, the articles are of a high standard. Every chapter gives evidence of a very painstaking and weary search through, not only recent, but also somewhat ancient, literature, and some of the chapters must have involved an enormous amount of practical investigation; in fact, it is doubtful whether the book has not suffered to some extent by the publication of the results of elaborate researches which are more of academic interest than of practical scientific value. That problems of scientific bacteriology are at present in a somewhat unstable condition is seen in several of the chapters, and it would, we think, have been better if the work of some of the researchers had been held back until more certainty had been attained.

In the review of Vol. 3, we criticised the position of some of the chapters, and even the desirability of including them in that volume. The same unfortunate grouping is again manifest in Vol. 4. The separation of the *Pasteurella* group and B. *pseudotuberculosis rodentium* from the chapter on B. *pestis* in Vol. 3 is an example of this. The close relationship between these organisms is admitted by the author. He says, "Two bacterial species, B. *pestis* and B. *pseudotuberculosis rodentium* to which the Pasteurella are most closely related. . . ." This may be regarded as a small defect, but surely in a work of the standing of the present one, it is desirable that some definite arrangement of the material should have been made and that chapters dealing with very closely related bacteria should have been in one group, or at any rate in one volume, and not separated by chapters dealing with entirely different subjects.

Chap. i. deals with *Bacillus typhosus*. With his usual clearness and accuracy, Bulloch writes a very interesting, short history of the organism, and an

account of the practical diagnosis of typhoid and para-typhoid, by Perry and Bensted, will prove of great value to all who are dealing with the subject from the clinical side, though more detailed consideration of some points, such as the parts dealing with blood culture, would have improved it. The main part of this chapter is by D. Harvey, and it is a valuable contribution to the literature of typhoid fever. There is nothing new about the article, but it is an excellent summary of a vast amount of original work by other workers. The author has dealt very fully with all the important aspects of the bacteriology of this disease, and has not over-emphasised minor points. It seems unnecessary, however, still to maintain the old statement, repeated in almost every text-book on bacteriology, of the number and length of the flagella. No one has a successful stain for them and the necessary manipulation must render a count and a measurement utterly valueless.

Again, on p. 18—"Blood. At one time it was stated that the finding of Gram-negative bacilli in the blood was a possible method of diagnosis of typhoid fever. But it must be remembered that to obtain a successful culture it is, as a rule, necessary to take at least 5 c.cm. of blood. It is obvious, therefore, that the chance of discovering a bacillus in a drop of blood is remote."

It is correct to say that the finding of the bacillus in the blood is a method of diagnosis, and surely no bacteriologist would misinterpret the statement in the way suggested in the latter part of the paragraph.

Chap. ii., on the *Salmonella* group, is by P. Bruce White. Most bacteriologists have worked on this group, and all such must recognise the enormous amount of work this chapter has demanded. It is not merely a careful review of the very numerous communications on the subject, but much is his own experimental work. That kind of work is very laborious and exacting, and the results are of a very high scientific value. We find it somewhat difficult to appraise its real value, as so many points can only be fully appreciated by those who have themselves worked at the intricate details given in relation to the types, serology, etc., of this group of bacteria. The chapter must be placed as one of the best, if not the best published statement of this group, and will remain a standard of reference for workers on bacteriology. It would, we think, have been better if the details given on p. 101 about the "H" and "O" antigenic variations had been given before the reference made to them on p. 88 had been written.

The pathology of these infections is dealt with very imperfectly and contrasts unfavourably with that of the organisms dealt with in the other chapters. To many of those who are dealing with *Salmonella* infections the pathology is important, and they will get little information of value from this article. The chapter would have been improved if this aspect of the infections had been dealt with by an author familiar with the clinical manifestations of the diseases caused by this group of organisms. In spite of these defects, the value of this chapter to bacteriologists cannot be over-estimated.

In Chap. iii., on the dysentery group of bacilli, a short history is given by Dr. Bulloch, and a brief article, containing the essential details on the production of toxin and antitoxin on the large scale, is written by Dr. O'Brien. Both are well done. The rest of the chapter is divided between Dr. Gardner and Prof. Dudgeon. The whole chapter gives a very complete account of the bacteriology of this disease. A specially valuable feature is the full way in which practical diagnosis in infections with *B. flexner*, *B. shiga*, and *B. sonne* is discussed.

Chap. iv., by W. J. Wilson and W. Bulloch, deals with the Colon group and similar bacteria. This chapter will prove of great value to all workers on the subject. The information is exhaustive, the arrangement good, and the writing clear.

T. J. Mackie, E. D. W. Greig, and W. F. Harvey have contributed Chap. v., on the cholera vibrio and related organisms. The history is again by W. Bulloch and no comment is necessary. Various aspects are dealt with very fully by the different authors. There seems to have been a lack of close co-operation between the authors, and the statements made by each are not always in agreement. To take only two examples: in the examination of water, Greig emphasises the importance of taking surface water for examination. Mackie makes no reference to this important fact. Greig and Mackie, in dealing with selective media for enrichment, give, in the main, entirely different methods. Apart from points of this kind, the whole article is well written and is very accurate and full, and is the work of men who have had considerable practical experience in the bacteriology, epidemiology, and diagnosis of this disease. The discussion of immunisation in this disease, by Dr. Harvey, is a valuable addition to the chapter. With the exception of a few minor points, the part by Greig on the pathogenic action of these bacteria is in keeping with the general excellence of the chapter.

Chap. vi. is by H. Schutze. I have already referred to the misplacing of this chapter. It is perhaps the most unsatisfactory part in the book,

not, however, because of the material and its manner of presentation, but because of the present unsatisfactory grouping of these organisms. Dr. Schutze had made the best of the material at his disposal.

Taken as a whole, the volume under notice will be welcomed by all bacteriologists. It should find a place in every medical library, and to the bacteriologist it will be a most welcome guide in all aspects of his work. Authors and editors are to be congratulated on this production. J. M. BEATTIE.

Petroglyphs of California and Adjoining States.

University of California Publications in American Archæology and Ethnology. Vol. 24, No. 2: *Petroglyphs of California and adjoining States.* By Julian H. Steward. Pp. 47-238 + plates 22-94. (Berkeley: University of California Press; London: Cambridge University Press, 1929.) 2.50 dollars.

THIS publication is issued by the Department of Anthropology of the University of California. It contains much that is of great interest to the student of primitive art, for it is concerned with a quantity of drawings which occur throughout California, being mostly executed on vertical rock-surfaces. There are both carvings and paintings, consisting for the most part of highly conventionalised figures of men and animals as well as what can only be classed as geometric patterns, and the whole forms a most interesting art group.

Although the rock drawings of California itself are the author's chief concern, he has included in his survey those found in neighbouring States, since, naturally, modern political boundaries did not affect the primitive artists. After a brief introduction, there follow short accounts of nearly three hundred sites where drawings occur. These are largely based on materials (now in the care of the Department of Anthropology at the University) which were generally the contributions of private individuals. The author has, however, studied a number of sites himself and his work is far from being purely one of compilation. Next an analysis of the art is given, and the various types of figures to be found are duly classified. Distribution maps show that while certain types of figures occur throughout the area, others occupy a more limited field. The paintings, it appears, are almost entirely confined to the south-west of the area under discussion.

This analysis probably makes the most interesting reading in the whole volume. The human form is represented again and again, and many of the conventions and symbols used in similar art-groups in the Old World are to be observed here too. Naturally, this does not necessitate any cultural connexion between, say, the Copper Age artists of southern Spain and these American draughtsmen of a probably very different date. But it is interesting to note in the New World a similar desire to symbolise and, resulting therefrom, the occurrence of very similar symbols. This is not difficult to explain, however, for conventionalisation in the sense in which we are using the word means the selection and emphasis of certain salient features in the object to be represented and the suppression of all unessential details. For example, in the much older Upper Palæolithic art, conventionalisation also occurs, and such an object as a horse's head, seen 'full-face', is represented as a trident-like figure—to such an extent has the dropping out of detail reduced the picture—and we are left with two ears and the mane (the central prong of the trident) and length! It is therefore not unnatural to find that, given the desire to conventionalise the figure of a man, certain types of symbols appear in widely separated parts of the world. After all, there are only a limited number of symbol-forms to which the human shape can be reduced when treated in the manner just described.

The author hesitates to regard some of the symbols figured on p. 184 as being human-form derivations, but many of them can be matched in the Copper Age art-group of Spain with figures which undoubtedly represent men and women. Certain other figures were, he suggests, phallic symbols. He may be right, but a simpler explanation would seem to be that they are merely drawings of human beings in which the sex is indicated. Every Greek statue is not a phallic representation because the sex is obvious. The animals are, of course, more difficult to 'renaturalise', but some of the species indicated—including sheep—can be recognised.

The geometric patterns include zigzags, concentric circles, spirals, etc. These are of an especial interest, though once again correlations with similar figures in art groups in far-off parts of the world are rash and unwarranted—the number of *simple* geometric designs conceivable being very limited. In any case, however, the Spanish and North African counterparts of these geometric designs show differences which were not so apparent when we were considering the conventionalisations from life.

The author next considers the meaning of the art and its age. As regards the former, he rejects the notion that the drawings were purely decorative in intent, or executed to while away a chance half-hour. They are often found far away from settlement sites, and the Indians to-day, though professing to know nothing about them, nevertheless regard them with awe. On the whole, he seems to consider that they were connected with initiation ceremonies which take place at the age of puberty among many primitive peoples. The question of the age of the drawings cannot be answered with any certainty. Most of them probably date from the Basket-Maker to the Cliff-Dweller or early Pueblo culture. The drawings of the Santa Barbara district (where many of the paintings are situated) have, however, a very fresh appearance and would seem to be the most recent in origin.

In conclusion, there are no less than 94 half-tone plates. It is perhaps a pity that the carvings were almost invariably chalked before being photographed. The process of chalking is in general to be avoided for scientific purposes, since it allows the personal factor to come into the work. Rock carvings will almost always photograph well at those times of day when the sun's rays strike the figures obliquely, and a certain proportion of such photographs would have been very welcome in this volume. Altogether, however, this is a really excellent work, which should not be missed by students of American archæology or primitive art.

M. C. Burkitt.

The Geology of Great Britain.

Handbook of the Geology of Great Britain · a Compilative Work. Edited by Dr. J. W. Evans and Dr. C. J. Stubblefield. Pp. xii + 556. (London: Thomas Murby and Co., 1929.) 24*s.* net.

THIS handbook is a new and enlarged edition of the volume dealing with the British Isles of the "Handbuch der regionalen Geologie", published in Heidelberg about twelve years ago. The general plan of the work is the same as that followed in the German issue with the exception that Ireland is no longer included. The chapter devoted to the geology of the Channel Islands is retained. Seventeen geologists, all authorities on the particular subjects with which they deal, have contributed, and the task of editing the manuscripts must have entailed much labour; but the book makes a notable advance on the earlier volume, and the editors are to be congratulated on the successful completion of their work.

As was to be expected from the names of the contributors, the chapters devoted to the description of the Pre-Cambrian and Lower Palæozoic rocks are excellent summaries of the knowledge now possessed of these formations. A few minor discrepancies, however, may be noted in reading the accounts, but their presence in no wise seriously affects the subject-matter. For example, readers would be enlightened if the phrase "the term Caledonian has come into use in Goodchild's sense" (p. 31) were explained. One reads later (p. 142) that Goodchild used the term for a stratigraphical unit, whilst earlier (p. 2) one finds the more familiar use of the term to denote a system of folding. Again, some confusion is created by the use of the term 'southern Scotland' for southern Highlands (p. 33), more particularly since an unknown outcrop of Dalradian in Devonian is shown on the map (p. 37) as occurring somewhere near Lanark. Less important is the statement that E. B. Bailey accepts the Moine gneiss as altered Torridonian rocks.

The difficulty of keeping abreast with geological literature is probably responsible for the absence of any reference to the occurrence of rocks of Lingula Flags age in a borehole in Essex, and to the discovery of the pygidium of a trilobite (*Calymene* sp.) in the Stiperstones Quartzite. The specimen is now preserved in the Museum of Practical Geology, and an announcement of its presentation was made in 1918.

It would seem that much further study is necessary before the classification of the rocks grouped under Downtonian is finally decided. In the Silurian chapter, an excellent summary of the previous investigations is given under the heading Downtonian, with the provision that it is as yet premature to decide whether the rocks should be regarded as belonging to the lower part of the Devonian system or retained as the upper members of the Silurian. In the brief description of the Downtonian in the Devonian chapter, however, we read that the Downtonian "may be considered to represent a passage from the Silurian to the Old Red Sandstone" (p. 138). It is perhaps not necessary to make further comment on this question of classification at the moment, but my own experience of these beds on the Welsh borderland lends support to the view that the Ludlow Bone Bed forms a natural base to the Devonian System, as advocated by Dudley Stamp and other workers.

By far the most notable contribution to the volume is that made on the Lower Carboniferous rocks. It is concise, lucid, and informative, and

the author, besides incorporating a considerable amount of original work, has shown great skill in marshalling the results attained in England by many workers inspired by the earlier researches of Vaughan and Garwood. Geologists, both in England and Scotland, would, however, have welcomed a more up-to-date account of the Scottish Lower Carboniferous rocks. Much work has been done in Scotland since 1910, and there is, in consequence, a considerable body of palæontological evidence now available to permit a close correlation to be made with the corresponding rocks in England, despite the statement that an application of zonal methods to the Scottish Carboniferous is not possible (p. 224). There is every reason to hope that further study of the Calciferous Sandstone series of Fife and the Lothians will yield useful guide-fossils, and the reviewer thinks it probable that the Rhynchonellids found by Kirkby in Bed VII., a limestone lying about 3350 feet below the Hurlet at Randerstone, St. Andrews, may represent the horizon of *Camarotœchia proava*. It is not without significance that algal remains are abundant about 100 feet lower in the sequence, particularly in Bed IX.

Respecting the Upper Carboniferous rocks, the succinct account of the Millstone Grit is equally valuable in presenting in summarised form the researches of Bisat and those of W. B. Wright and his colleagues. The zonal studies of *Goniatites*, initiated in Great Britain by Bisat, have already borne fruit in elucidating the somewhat complicated stratigraphical relations within the formation. The account of the Coal Measures is somehow less satisfactory. Although the chapter is a veritable store of information, it lacks the precision of other contributions. This is perhaps due to the absence of sections illustrative of the succession in each of the principal coalfields. The author makes full reference to the zonal work of Kidston, Arber, and Crookall on the palæobotanical side, and to the studies of Trueman, Davies, and Miss Dix, which have built up a sound scheme of classification based on the fresh-water Mollusca. No notice is made of the fact that the Mansfield marine band is a horizon that has been recognised in Scotland, Wales, and in other English coalfields outside Yorkshire and Nottingham. It may be of general interest to add that the great series of barren red measures in Ayrshire have recently yielded palæontological evidence which proves the presence of rocks of the Radstockian stage in this coalfield.

The rocks grouped under the Permian, Triassic, and Rhætic receive adequate treatment from their exponents. The writer of the Permian chapter has wisely avoided controversy by stating the connotation of the term Permian as used in his account. That there is a great need for further investigation of the Permian and Triassic strata in Great Britain is clearly revealed throughout the chapters. Thus, on p. 312 we are told that in the district of Mauchline "a volcanic group of strongly alkaline character" is associated with red sandstones, assigned by some authors to the Permian and by others to the uppermost part of the Coal Measures, whilst on p. 335, under the heading of Trias, the same sandstones are referred to the Permo-Trias. These difficulties serve to emphasise the important fact that, without the aid of sound palæontological data, little reliance can be placed on lithological characters as a means of correlation.

In the Rhætic chapter the customary clear diction of the author seems to have forsaken him in writing the second sentence on p. 341. It is so long and involved as completely to obscure its meaning.

The Jurassic rocks are dealt with in a more extended manner than was possible in the first edition, and the zonal succession established in the various groups by the studies of various workers, notably the late S. S. Buckman, the Nestor of British palæontologists, is set forth on four correlation tables. Despite the small discrepancies which may be corrected before re-issue, the tables will prove a boon to students. Readers would be helped, however, if the English divisions were placed in a column to show their approximately equivalent stages, and so avoid the need to make reference to p. 361 where they are tabulated. One is surprised to read that the mutual relations of the Hartwell Clay are still uncertain. The chapters on the Cretaceous and Tertiary rocks are beyond reproach and deserve praise.

Considerable portions of the account of the phenomena associated with the glaciation of Britain taken from the first edition have been incorporated in the present volume; but the contributors have brought to bear on the subject a wide experience and knowledge gained in Great Britain and other countries. This is particularly well shown in the description of glacially disturbed deposits and in the discussion of glacial tectonics. The views expounded will be new to many readers who have not had access to the authors' papers.

In spite of the comprehensive way the subject has been dealt with, notable work in some areas has been entirely overlooked. London geologists, for example, will search in vain for any reference

to Lake Oxford and the Goring Gap. The admirable investigations of Dr. Sandford in the Oxford district are not mentioned in the chapter, although a full account of his studies has been given in the Oxford memoir issued by the Geological Survey in 1926. Again, the fine work of Dr. Bremner on the glacial deposits of the north-east of Scotland is passed over, as is also the results of a gravitational survey over the buried Kelvin Valley at Drumry, an account of which was read at the Glasgow meeting of the British Association. In the latter instance it is possible that the chapter may have been set up in type at the time.

The descriptions of the igneous rocks in the Ordovician and later formations are much the same as appeared in the first edition, but the author has in some cases availed himself of recent work to bring his account up-to-date.

Valuable features of the volume are the correlation tables appearing in most sections and the bibliography appended at the end of each chapter. While the lists of works given are not claimed to be complete, they have been compiled with care and will be of great service to all workers. There is an excellent index containing more than 5000 entries. J. PRINGLE.

The Parachor.

The Parachor and Valency. By Dr. Samuel Sugden. (Twentieth-Century Chemistry Series.) Pp. vii + 224. (London: George Routledge and Sons, Ltd., 1929.) 12*s.* 6*d.* net.

IN 1923 a short paper by McLeod was published in the *Transactions of the Faraday Society*, in which a simple relation between density and surface tension was disclosed, namely:

$$\gamma = C\,(D-d)^4$$

where γ is the surface tension of a liquid, whilst D and d are the densities of the liquid and of its saturated vapour at the same temperature. The significance of this formula was that the influence of temperature on surface tension was now represented in a rational way, since the surface tension was made to vanish at the critical point, when the densities of the liquid and of its saturated vapour become identical, whereas the formula of Ramsay and Shields, in which the density of the vapour was ignored, makes the surface tension vanish 6° after the critical temperature is reached.

Up to this point the surface tension plays the leading rôle, but the author of the present volume discovered a much more far-reaching application of McLeod's formula. Thus, if the surface tension γ divided by $(D-d)^4$ is a constant, it follows at once that $(D-d)$ must be a constant if divided by $\gamma^{\frac{1}{4}}$; in other words, the influence of temperature on specific and molecular volumes can be eliminated completely if D is replaced by $D-d$ and then divided by $\gamma^{\frac{1}{4}}$. The function $M\gamma^{\frac{1}{4}}/(D-d)$, which Sugden calls the parachor, is in fact a molecular volume, M/D, which has been corrected with the help of the surface tension for the overwhelming influence of an internal pressure ranging in typical cases from 1500 to 60,000 atmospheres, and is thus made independent of the temperatures at which it is measured. It therefore replaces, with greatly enhanced efficiency, the old molecular volumes, which Kopp attempted in vain to regularise by measuring them at the boiling-point of each liquid instead of at the atmospheric temperature. These old molecular volumes made only a feeble pretence at being additive functions, since different atomic volumes had to be assumed for oxygen in alcohols, ethers, ketones, etc.; but the molecular parachors need only a single atomic parachor for each kind of atom, and a single constant each for the double and triple bond, or for the formation of a ring of n atoms, whatever the nature of the atoms which are joined by the multiple bonds or included in the ring. It is, indeed, entirely pleasing to encounter a function which vindicates forthwith the Kekulé formula for benzene, even though it admits the existence of an unexplained anomaly in the carboxyl group.

The present writer has a peculiar reason for thinking well of the parachor, since it provided the first experimental verification of his contention that a double bond need not always be a double covalence or a double electrovalence, but may sometimes be 'mixed' (or 'semi-polar' as Sugden has called it), consisting of a covalence and electrovalence superposed on one another. This vindication was particularly welcome in view of the fact that the first paper on the subject had the honour of being consigned to the archives of the society to which it was sent, although the Faraday Society found no difficulty in giving publicity to the 'mixed double bond' as a legitimate extension of J. J. Thomson's theory of 'intramolecular ionisation'. The even more conclusive proof which resulted from the resolution of semi-polar compounds into optically-active components, and the further evidence derived from Dr. Bennett's fascinating studies of stereoisomerism, are set out fully in the volume now under review.

Whilst the discrimination of double bonds, as being either nonpolar or semi-polar, was the first

and perhaps the most important experimental achievement of the parachor, this function is capable of such a wide range of applications that most of the outstanding valency problems in chemistry provoke at once a question as to the verdict which will be given when data from the parachor become available. In some cases the strictly additive character of the parachor precludes the possibility of an answer. Thus it makes no difference to the parachor whether two double bonds are 'conjugated', with one single bond between them, or are more widely separated in the molecule, since there is no echo here of the anomalies which are called to mind by the phrase 'optical exaltation'; moreover, the conversion of two double bonds into one triple bond makes no difference to the parachor, so that equal values are given by systems such as $CH_3O \cdot C \equiv N$ and $CH_3N = C = O$. There are, however, many cases in which the formation of a ring in place of a double bond can be detected, and the later studies of Sugden and his colleagues have revealed an array of positive and negative anomalies which is amply sufficient to keep the parachor in the limelight for many years to come.

Sugden himself has found an explanation of several large and important groups of negative anomalies by calling to life the single-electron bond, which has proved so attractive to students of 'partial valencies' ever since G. N. Lewis declared that it takes two electrons to make a bond. Lewis's contention appears even more convincing at the present time, when physicists have explained that pairs of electrons spinning in opposite directions are required to form a stable electronic system in molecules as well as in atoms or ions; but Sugden has worked out a series of formulæ which are at least consistent with one another and with certain postulates as to the parachor-value to be assigned to this hypothetical type of linking.

Whilst, therefore, both chemists and physicists may look with dislike on odd-electron bonds, it must be admitted that all the alternatives which have yet been devised have been turned down as a result of the experimental work which the author has carried out in order to test them. Unbelievers can, therefore, only take refuge (like the reviewer) in a barren agnosticism, hoping that a function which cannot distinguish between one triple and two double bonds may have failed equally to discriminate between a pair of single-electron bonds and some more plausible electronic configuration.

Here and there the author is perhaps too confident in his statements. Thus, it is not true that diborane, B_2H_6, "contains only twelve electrons" (p. 95) and that therefore "the presence of singlet linkages must be admitted" (p. 130), when there are really 10 *K*-electrons and 6 *L*-electrons available for joining the 8 atoms; and it is only when certain postulates have been accepted, and the possibility of alternative interpretations has been finally denied, that it can be admitted, in the case of basic beryllium acetate, that "the parachor . . . shows conclusively that the singlet formula is correct" (p. 146). Phrases such as these are, however, not easily avoided when describing the results of a battle in which present victory has been won, and the risk of retreat in the future is still too remote to justify the qualifications and reservations which would appear necessary in less favourable circumstances.

If Dr. Sugden had merely collected his published work into a monograph, and discussed its implications in greater detail than is usually possible in original papers, he would have rendered a very useful service both to his colleagues and to their more advanced students. He has, however, done much more than this, since the volume now under consideration also contains chapters on "The Liquid State", on "Associated Liquids", on "Atoms and Spectra", and finally on "The Quantum Theory of Shared Electrons". These are written in the masterly manner of one whose knowledge comes from original sources, and has not been distorted by transmission through intermediate text-books. For this reason the book can be commended to advanced students who are not specially interested in the parachor, but who would like to keep abreast with modern research in atomic physics. Moreover, even the earliest references appear to have been consulted in the original, with the result that the foundations of our modern conceptions are sometimes unexpectedly laid bare. The book is, in fact, exceptionally well filled with information, even for a hardened reader of physico-chemical literature, and familiar facts and theories are often revealed in an unfamiliar light, and with unwonted clearness. On the other hand, the indices and subscripts are printed in such small type that they are often defective or illegible. The rather bewildering electronic formulæ which the author has adopted have also given a lot of trouble to the printer, whose symbol for benzene is a very battered hexagon. It is also curious that, although the symbol for the parachor is given in the first instance on p. 30 as [P], it is nearly always printed afterwards with a superfluous (and unintended ?) full-stop inside the bracket.

In conclusion, since the book deals at length with the methods of determining surface tension, it is difficult to resist the temptation to bring together two phrases in reference to the method of deducing tension from the weight or volume of falling drops. "Iredale has criticised the formula used by Harkins and his co-workers, and suggests a return to an equation given earlier by Worthington." Nevertheless, "the equations of Harkins and Worthington are really identical, for one can be deduced from the other without introducing any approximations". T. M. LOWRY.

Unofficial Pharmacopeias.

(1) *The Extra Pharmacopœia of Martindale and Westcott.* Revised by Dr. W. Harrison Martindale. Nineteenth edition. In 2 volumes. Vol. 2. Pp. xxxviii + 759. (London: H. K. Lewis and Co., Ltd., 1929.) 22*s.* 6*d.* net.

(2) *Pharmaceutical Formulas.* P.F. Vol. 1 being *The Chemist and Druggist* Book of selected Formulas from the British, United States, and other Pharmacopœias, together with Non-Official Formulas from various Sources. Tenth edition, entirely revised and rewritten. By S. W. Woolley and G. P. Forrester. Pp. xvi + 1146. (London: *The Chemist and Druggist*, 1929.) 15*s.*

THE last British Pharmacopeia was published in 1914; a new one is now in preparation and is due to appear in 1931. In the interval, the United States has produced two official pharmacopeias, the ninth in 1916 and the tenth in 1926. The long intervals between successive editions, the wise conservatism of pharmacopeial commissions, and the limitations imposed upon pharmacopeias by their legal status, make it inevitable that there must always be a huge materia medica which does not find official recognition, and this is the happy hunting ground of the compiler of dispensatories, formularies, pharmacopeial companions, and in general of the mass of literature which may be grouped together as 'unofficial pharmacopeias'. Such literature is indispensable to the busy pharmacist and medical man, as is evident from the fact that the two books now under review are in their nineteenth and tenth editions respectively. They both supplement the official pharmacopeia and they are complementary to each other.

(1) The "Extra Pharmacopeia" of Martindale began as a modest pocket volume of 300 pages in 1883, and is now issued in two volumes of 1207 and 759 pages respectively, and even this increase in size is not sufficient to include all that the author would like to put into it, for he is now finding it necessary to refer the reader back to information given in previous editions but omitted from this one. The two features which have contributed more than anything else to the popularity of the book are the author's gift of compressing the contents of a paper into a few lines or a few words, and his conscientious industry in searching the literature and providing the reader with references to papers or abstracts in readily accessible journals. The division into two volumes took place in 1912, and since then Vol. 2 has been a compact manual of chemistry designed to meet the everyday needs of the pharmacist and the medical man. These needs are very varied, and consequently the volume deals with such subjects as indicators for volumetric analysis, the analytical recognition of organic substances used in medicine, water-analysis, embalming, composition of proprietary medicines, mould inhibition by preservatives, etc. The author is one of those fortunate people who is not hypnotised either by authority or the printed word, and his remarks on some fashionable doctrines and processes are shrewd, sometimes piquant, and invariably tinctured by a genial conservatism. Like all editions of this work, this edition is remarkably free from errors and is well up-to-date.

(2) "Pharmaceutical Formulas" is a book of entirely different type, being almost wholly concerned with the compounding of drugs, a subject with which readers of NATURE probably do not desire to extend their acquaintance beyond that casual and involuntary knowledge forced upon them by occasional illness. The real public service rendered by the issue of a book like this may perhaps be illustrated by reference to such a substance as acriflavine. Most organic chemists are aware that the discovery of this material marked a distinct advance in chemotherapy, but few realise that its practical use in medicine depends upon the exercise by the pharmacist of his art, so that it may be presented to the medical man in a form suitable for application. In this volume five preparations of acriflavine—solution, lotion, emulsion, paste, and poultice—are described, and from them the busy practitioner can select the form best suited for any particular case. The book gives the same kind of information for each and all of the hundreds of materials which modern science has placed at the service of medicine.

A pleasant feature of the volume is its insistence upon the historical aspect of the pharmacist's art and the brief but wholly delightful note upon 'honey water' which George Nelson, author of

"The Compleat Course of Chymistry", compounded for King James II. is an example of how such things should be written. It is a little surprising to find that "Confectio Damocratis", invented by Mithridates the Great, 134 B.C., may still figure in modern medicine. It is an ingredient of the original 'Warburg's tincture', a mixture still used by some European residents in the tropics, and it may be regarded as the real ancestor of the aromatic confection invented by no less a person than Sir Walter Raleigh, and which in a modified form is still official in the last edition of the British Pharmacopeia. T. A. H.

Birds and their Ways.

(1) *The Cowbirds: a Study in the Biology of Social Parasitism.* By Dr. Herbert Friedmann. Pp. xvii + 421. (Springfield, Ill., and Baltimore, Md.: Charles C. Thomas; London: Baillière, Tindall and Cox, 1929.) 27*s.* net.

(2) *Birds and Green Places: a Book of Australian Nature Gossip.* By Alec H. Chisholm. Pp. xiv + 224 + 50 plates. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., Inc., 1929.) 15*s.* net.

(3) *The Birds of South-East Devon: being a List of those Species known to visit that part of the County including and lying to the East of the Exe Valley.* By Lewis R. W. Loyd. Pp. 176 + 6 plates. (London: H. F. and G. Witherby, 1929.) 10*s.* 6*d.* net.

(4) *The Birds of Ayrshire.* By E. Richmond Paton and Oliver G. Pike. Pp. xxi + 228 + 25 plates. (London: H. F. and G. Witherby, 1929.) 21*s.* net.

(1) THAT form of parasitism which is familiarly exemplified by the common cuckoo in Europe, and by some other members of its family found in Europe, Asia, and Africa, occurs also among the cowbirds of the New World, among the weaver-birds and the honey-guides of Africa, and in one South American species of duck. As it doubtless originated separately in each of these diverse groups, it constitutes a very remarkable instance of parallel evolution. Next to the cuckoos, the cowbirds are the best known of the groups, and Dr. Friedmann's important monograph brings together the existing information as to their reproductive habits, and adds to it the results of his own intensive observations.

The cowbirds belong to the family of hangnests, closely allied to the finches. There are seven species, in three genera, and six of these belong either to South or Central America: the remaining species is widely distributed in the northern continent. Two of the species are rarities known only from a few specimens, but the habits of the other five present material for an interesting comparative study.

The bay-winged cowbird of South America is parasitic only in that it lays in other birds' nests, taken by force or found disused. If necessary, moreover, it builds for itself; and in any case it incubates its eggs and rears its young in quite a normal manner. The screaming cowbird is truly parasitic, but its sole victim is the preceding species! More than one egg may be laid in the same nest, and there is no removal of eggs of the rightful owner. The shiny cowbird, widely distributed over South America, victimises many species, but its parasitic habit is poorly developed and somewhat haphazard in its operation. Very many eggs are laid, and of these the majority are wasted: the eggs of the victims are frequently destroyed; but so also are eggs of its own species on occasion, so that this cowbird itself exercises a check upon its increase in any locality. The North American cowbird has the parasitic habit better developed and lays a small number of eggs to good purpose: the species which it has been known to victimise number a hundred and fifty-eight, and individual birds, unlike cuckoos, show no very definite specificity in their choice of victims. The red-eyed cowbird of Central America is parasitic upon a limited number of species. The rice-grackle, a close ally of the true cowbirds, is also parasitic.

As with our common cuckoo, the young cowbird usually survives at the expense of the offspring of its foster-parents. These are not ejected but are trampled or starved to death in the struggle for food. Young screaming cowbirds, however, live in amity with the young baywings belonging to the nest: this is paralleled in the Old World by the case of the great-spotted cuckoo and the magpie.

Dr. Friedmann's monograph is a mine of information on the reproductive habits of cowbirds, but it is not a very readable book except for the serious student. A more adequate general survey, summarising the systematic accounts of the several species, would have added greatly to its value, and the brief final chapter discussing the evolution of parasitism might well have been amplified. There are some curious mistakes, as in the naming of the races of the North American species on page 152, and in the description of the diagram on page 263.

(2) Mr. Chisholm's book is of a very different type. It is frankly a collection of 'Nature gossip'

rather than a contribution to science; but the author has the advantage of dealing with an avifauna of which little of a popular kind has been written, that of Queensland, and he describes the habits of many strange and wonderful birds which the reader in Great Britain knows, at most, only from captive or museum specimens. Mobs of emus running on the great plains; the curious bee-like swarming of the wood-swallows; the rare paradise-parrot nesting in termites' mounds; the cradle nest of the fairy-warbler; the truly extraordinary habits of the bower-birds: these are among the subjects on which Mr. Chisholm discourses pleasantly, weaving his account of the birds into the story of his personal experiences in search of them.

(3 and 4) The remaining two books on our list come within the category of district avifaunas. Works of this type fulfil two functions: in the first place, they are of local interest, and, in the second, they provide valuable material for the compilers of books on the birds of the country as a whole. Neither of these works comes up to the very highest standard for this class, but both are competent and useful contributions. Mr. Loyd is at a disadvantage in dealing with an area of which the limits are not recognised, and he does not always observe them himself. He also encumbers his accounts of the local status of each species with brief general remarks which are inadequate for any purpose and irrelevant to the special object in view. The work of Messrs. Paton and Pike contains some very beautiful photographs of birds, although here again relevance may be questioned.

Evelyn's "Fumifugium".

Fumifugium. By John Evelyn, of Balliol College, Oxford, in 1661. Now reissued as an Old Ashmolean Reprint in the Year of the refacing of the Old Ashmolean Museum, which, like 'Fumifugium', was dedicated to King Charles II., founder of the Royal Society. Pp. viii + 49. (Oxford: Dr. R. T. Gunther, Folly Bridge, 1930.) 2*s*. 6*d*.

VOCAL as have been the protests against the emission of smoke and fumes from the chimneys of electric power stations in London, when one reads No. 8 of Old Ashmolean Reprints, the "Fumifugium" of John Evelyn (1661), these modern protests seem couched in language mild and restrained compared with the diarist's wealth of obloquy and sustained invective against the effects of burning of coal by brewers, dyers, lime-burners, soap- and salt-boilers, and other private traders. Additional picturesqueness is obtained, not by the modern method of pictures showing the pall of smoke over our cities or the corrosion of stonework, but by lurid quotations from the classics to heighten the condemnation of "that Hellish and dismal Cloud of Sea-Coale" with its "fuligenous and filthy vapour, corrupting the Lungs", causing the City of London to resemble rather the "Suburbs of Hell than an Assembly of Rational Creatures and the Imperial Seat of our incomparable Monarch". Truly John Evelyn was a man before his time, and his "Fumifugium" characteristically not only describes the grievance, but also indicates the remedy and suggests an amelioration.

Writing so soon after the Restoration, Evelyn philosophises on the effects of pure air, contrasting the proneness to rebellion of northern nations, with the more constant and steady temper of the inhabitants of lands nearer the tropics. His commendation of air "which is cleare, open, sweetly ventilated and put into motion with gentle gales and breezes" would meet with the approval of Prof. Leonard Hill. On the other hand, he recognises that while the effects of ill-conditioned meat may be mitigated by cooking, poisoned air insinuates itself into the vital parts immediately. An eclipse, he declares, darkens the attributes of the otherwise incomparable City of London, on the situation and advantages of which he writes a fine panegyric, and this, not from the "Culinary fires", but from the "Tunnels and Issues" of the aforesaid traders giving off "that pernicious smoake which sullies all her glory superinducing a sooty Crust or Furr upon all that it lights, spoyling the moveables, tarnishing the Plate, gildings, and Furniture and corroding the very Iron-bars and hardest Stones with those piercing and acrimonious Spirits which accompany its Sulphure". Further, it kills flowers, fruit, and bees, so that they can no longer thrive in the neighbourhood of the Strand, unless on such occasion as when coals were scarce by reason of the blockade of Newcastle in 1644.

Worst of all, those who repair to London become immediately afflicted with divers ailments of which detailed and picturesque description is given: "For is there under Heaven such Coughing and Snuffing to be heard, as in the London Churches and Assemblies of People, where the Barking and the Spitting is incessant and most importunate?" In the current of his invective, Evelyn is carried

somewhat to overstate his case when he affirms, "that it is not the Dust and Ordure which is daily cast out of their Houses . . . but this continual Smoake, which renders the Streets of London dirty even to a Proverb".

In Part 2, Evelyn suggests the removal to a competent distance of factories giving off this evil smoke, a remedy which, however suitable to his time, would not be a solution in ours, when to domestic chimneys is attributed at least half of the smoke nuisance. His selection of a site five or six miles distant from London "below the River of Thames" and apparently east of Blackheath, having regard to the prevailing winds and to water transport, is reminiscent of a phase in the present controversy. Not only, however, should the smoking factories be removed, but he would also have banished churchyards, slaughter-houses, gaols, chandlers', fishmongers', and butchers' yards to some place farther off, to prevent their distempering the air breathed by the inhabitants. While these opinions leave no doubt as to Evelyn's fitness for his post of commissioner for improving the streets and buildings of London, it is to be feared that the opportunity afforded by the Great Fire was not seized on to give effect to his views and to Wren's ideas of town-planning in the reconstruction necessary after that event.

As might be anticipated in one so fond of gardening, Evelyn's scheme for "Melioration of the Aer of London" is "by Way of Plantations". In all low-lying grounds near the city, and especially towards the east and south-west, he suggests the plantation of belts of trees, lined with fragrant shrubs, while the spaces between the trees would be used as borders filled with sweet-smelling flowers. It is a pleasure even to read the list of these fragrant plants, and to conceive a London so small as to warrant his hope that "the whole City would be sensible of the sweet and ravishing varieties of the perfumes".

If Evelyn should return to-day as First Commissioner of Works, what would he find in the conditions of the colossal city London has in the meantime become? Still the only partially solved smoke problem of the innumerable domestic fires, but let us hope soon the suppression of smoke and acids from the chimneys of large installations consuming coal; an increasingly healthy city through improved sanitation, rather than diminution of smoke; while perhaps the large area still given up to open spaces and parks would in some measure satisfy the author of "Sylva" and the "Compleat Gardener". R. R.

Hydrogen Ion Concentration.

Hydrogen Ions: their Determination and Importance in Pure and Industrial Chemistry. By Dr. Hubert T. S. Britton. (Monographs on Applied Chemistry, Vol. 3.) Pp. xiv+515. (London: Chapman and Hall, Ltd., 1929.) 25*s*. net.

THE introduction of the osmotic and electrolytic dissociation theories of solutions initiated, as is well known, a new era in the development of chemistry, and the new direction which was thereby given to the interpretation of chemical processes taking place in aqueous solution soon made itself powerfully felt also in the various branches of biological science and in the study of colloids. The influence of different salts on colloidal matter and on the living cells of plants and animals became the subject of extensive and intensive investigation, and it was found that many of the observed phenomena could best be interpreted as due to the specific action of ions.

Although it was to the action of the ions of salts that attention was at first mainly directed, it came to be recognised later that a position of special importance must be assigned to the hydrogen ion; and at the present day the 'acidity' of the medium is known to exercise a profound influence in operations and processes of the most diverse kind. In volumetric and gravimetric analysis, in the precipitation of metal hydroxides, in soil analysis, in bacteriology, and in many industrial operations, the concentration of hydrogen ion is a factor of fundamental importance. The determination and control of the concentration of hydrogen ion in a solution has, in consequence, received a rapidly increasing measure of attention in recent years. In view of the important part played by hydrogen ion concentration and of the widespread necessity of obtaining a knowledge of the methods of determining and controlling the concentration of hydrogen ion, the present work by an author so competent and well-qualified as is Dr. Britton, is sure of a very hearty welcome.

In the opening chapter, the author sets forth the theory of the electrometric methods of determining the concentration of hydrogen ion and adopts the ion-concentration rather than the activity theory in the interpretation of electrode potentials. The decision of the author in this respect has doubtless much to commend it in view of the public for which the book appears to have been written, but even a short discussion of the relation between the ion-concentration and the activity theories would have given an additional

value to the book. Following on the discussion of the theory of electrode potentials there comes a description of the different kinds of electrode, and workers will find the author's account of the use of the quinhydrone and glass electrodes of particular interest and value. The latter electrode, especially, is probably not so well known as it should be.

In the succeeding chapters the author gives a very full, clear, and, on the whole, satisfying exposition of the practical applications of the electrometric and colorimetric methods of determining the concentration of hydrogen ion in solution, and points out the importance of such determinations in analytical chemistry, in the industries of tanning, brewing, baking, dyeing, etc., in the manufacture of paper, and in the refining of sugar. The rôle of the hydrogen ion concentration in connexion with the purification of water, sewage disposal, and the fertility of soils, is also clearly discussed.

In the volume before us, the third of the admirable series of monographs edited by Dr. Howard Tripp, the author maintains the high standard of excellence set by the preceding volumes, and the work is remarkably free from printers' and other errors. The book deserves to be, and doubtless will be, widely read, not only by advanced students of chemistry but also by those who are interested in the many and varied branches of science and industry in which the concentration of hydrogen ion plays a vitally important part. A. F.

The Mechanical State of the Future.

The Conquest of Thought by Invention in the Mechanical State of the Future. By H. Stafford Hatfield. (Psyche Miniatures: General Series No. 26.) Pp. 117. (London: Kegan Paul and Co., Ltd., 1929.) 2*s*. 6*d*. net.

A GREAT deal of thought is being concentrated to-day on the general aspects, the underlying principles, and the probable future of our civilisation, which is supposed to be distinguished from all previous civilisations by a dominating industrialism gradually extending and deepening its hold throughout the entire social organism until it is complete master thereof, holding it under grievous thraldom, body and soul. The present small volume, one of the Psyche miniatures now being published by Messrs. Kegan Paul, attempts to show that this domination will take the form of a perfectly mechanised State in which practically every function and activity of the individual citizen will be a matter of regulated routine, and all his actions will be so guided and prescribed by the State that he will have little or no initiative or volition of his own; he will become a semi-hypnotised automaton, a machine slave. The Machine Age will have arrived, not only in a literal sense wherein every part of manufacture will be done by machinery, but also in a wider and more figurative sense, wherein the machinery of government, of municipal organisation, and of industrial organisation will be so perfected that every circumstance or condition of the individual citizen will have its appropriate formula; and all that he will have to do to achieve a wholly successful life will be to apply formulæ as and when required, and with a minimum of conscious thought, effort, or mental disturbance of any kind. Thought will have been conquered by invention.

This is surely a strange paradox, an apparent contradiction in terms if, as one seems justified in assuming, invention is among the highest forms of thought; but what Dr. Hatfield probably had in mind was the ultimate domination of society by extreme mechanisation based on invention, so that thought might almost seem to become superfluous, and he was probably looking about for a startling or impressive formula for expressing such a possibility. But his definition of invention is not altogether satisfactory; he says:

"The word invention is intended to cover the whole of the means by which humanity makes use of accumulated knowledge to eliminate the chances and difficulties of coping with the external world and to render it more agreeable."

This excludes a considerable field of invention which does not, directly or indirectly, aim at making the world more agreeable, and includes also a vast amount of invention which the author himself is perhaps contemplating under his definition, but which, instead of making the world more agreeable, has had precisely the contrary effect. It may be, however, that the great majority of people would like to be relieved of all responsibility, to have nothing to do but obey rules and regulations, to lead a perfectly safe life sheltered from all the perversities of fortune or misfortune, to become volitionless automata. But whether this is the best and highest and noblest destiny of the human race is another matter. It is true that Dr. Hatfield has made provision for original thought, scientific research and speculation, and original creative work of all kinds, in special segregated institutions, altogether apart from the common herd; and yet it may be questioned if this is quite the best consummation for science itself to aim at.

However, it is only fair to say that the author is not speaking of the 'best', but the inevitable.

On psychological grounds, possibly a plausible case might be made out for predicting some such culmination for our civilisation as that which Dr. Hatfield presents; but it is a hopeless and gloomy picture, an ignoble destiny indeed for the human race, and it does seem that sufficient account has not been taken of all the relative factors and of any possible ameliorative or preventive measures that could be suggested. If one could only regard the book as a very clever and subtle satire, a brilliant caricature of what we are coming to, the outlook would be less hopeless, but the author appears to be in deadly earnest, and he concludes his highly interesting and thought-provocative thesis with the assurance that "All this is happening, so it seems to me, in so inevitable a manner that any argument concerning its desirability appears futile". There is thus no more to be said. W. G. L. C.

Witches, Vampires, and the Devil.

(1) *Witch Hunting and Witch Trials: the Indictments for Witchcraft from the Records of 1373 Assizes held for the Home Circuit* A.D. *1559–1736*. Collected and edited by C. L'Estrange Ewen, with an Introduction. Pp. xiii + 345 + 7 plates. (London: Kegan Paul and Co., Ltd., 1929.) 21*s*. net.

(2) *The Vampire in Europe*. By Montague Summers. Pp. xii + 330 + 8 plates. (London: Kegan Paul and Co., Ltd., 1929.) 15*s*. net.

(3) *The Devil: an Historical, Critical and Medical Study*. By Maurice Garçon and Jean Vinchon. Translated by Stephen Haden Guest from the sixth French edition. Pp. 288. (London: Victor Gollancz, Ltd., 1929.) 12*s*. 6*d*. net.

THESE three books on witchcraft and cognate matters afford an interesting contrast in method. The first deals objectively with facts, and thereby adds much to our knowledge; the third analyses familiar material from an original point of view as a psychological study; while the second may enlarge the reader's ideas as to the extent of human credulity even in these days.

(1) Mr. Ewen's book is a mine of information for the student. A patient examination of documents in the Record Office has resurrected a large number of cases never previously noted, either by Hutchinson or by other writers on witchcraft. Prof. Notestein's list of 100 cases in the home counties is swelled to five hundred individuals and seven hundred indictments. To these is added an appendix containing a list of further cases mentioned in contemporary documents, but not in the records of the courts. Mr. Ewen has also provided his readers with a complete apparatus for the study of the subject.

In his lengthy introduction to the abstracts of indictments which forms the main section of the book, Mr. Ewen surveys the whole machinery of witchcraft persecution, including the legislation from the earliest times, the courts in which trials might be held, and the procedure from information to trial. The abstracts themselves are a valuable survey of the essential features of English witchcraft, and of the ends which the witch was supposed to have in view. It is interesting to note that one witch was accused of digging up the skull of a dead man, an allegation also made in the Lancashire witch trial of 1612. One point of significance to emerge is that, so far as the home counties are concerned, the witchcraft persecution reached its highest under Elizabeth, and not under the Commonwealth, as is usually stated; another is the exceptional prominence of Essex as the home of the witch.

(2) In "The Vampire in Europe", Dr. Summers follows up his previous volume on the vampire by a collection of relations arranged under countries. It affords plentiful material for students of the supernatural; but the author has had to interpret the vampire belief rather liberally to bring some of his data within the bounds of his subject. Outside eastern Europe there is practically no evidence of the real vampire. In ancient Greece and Rome, and still more in England and Ireland, until the literary efforts of modern times, the cases noted by Dr. Summers are those of ordinary ghosts, often malignant, rather than of vampires. The place of the vampire was taken by the were wolf. In this volume Dr. Summers appears to have abandoned his earlier methods entirely and to accept all stories at their face value as evidence—even fiction!

(3) "The Devil" is a useful corrective to Dr. Summers. It is also an answer, on one hand, to those who regard witchcraft as a surviving primitive religion, and on the other, to those who dismiss the evidence as due to, vaguely, hysteria. As regards the first point, the authors hold that, beyond a few very general ideas, there is little of primitive magic in the witchcraft doctrine, except in so far as Innocent VIII. gathered up much popular folklore in his famous Bull. Nor was the devil a primitive concept. Many hold that the concept of the devil was built up by the medieval church, just as the whole of the machinery of the witchcraft organisation was evolved by the Inquisition and judges through the medium of their examinations, which

were directed to elicit certain information. Belief in the devil, on the other hand, is no evidence of delusion either in medieval or modern times. It is an article of faith in the Roman Church, and before the explanation of hysteria can be applied to the facts, the border line of delusion must be fixed.

The cases studied in the medico-legal section of the book throws light on many manifestations of occultism. They should be studied in conjunction with some of the cases of vampirism quoted by Dr. Summers. It must, however, be urged that the authors have paid too little attention to the survival of a strong element of real primitive belief among the people. Can we fix a limit to the extent they were prepared to go in putting it into operation ?

The Trend of Applied Optics.

Applied Optics and Optical Design. By Prof. A. E. Conrady. Part 1. Pp. ix + 518. (London : Oxford University Press, 1929.) 50*s.* net.

APPLIED optics, once a languishing subject, has now largely emerged from the phase of semi-stagnation on one hand, and exploitation on the other, in which the outbreak of the War found it, and this book, contrasted with the predecessors of its class, emphasises the decided present-day trend of the science. In his endeavour to confine his attention to ' real optics ', Prof. Conrady has been influenced by some well-known criticisms of Prof. Silvanus Thompson. What was known as ' geometrical optics ' has, indeed, in more recent years, barely held its own against its critics, for it had certainly encroached to an unjustifiable extent upon neighbouring fields, at a period when unscrutinised criteria and false generalisations entered largely into its practical application. The optical designer, examining his problems by the aid of such imperfect theoretical means, saw as through a glass darkly, quite unperceiving the imperfect nature and inadequacy for his purposes of the methods currently adopted and the shadow of fact which they revealed. In later years the working of an ampler conception of the subject has removed the old inconsistencies and indicated fresh avenues of considerable possible development of the older plain theory.

Broadly speaking, Prof. Conrady proceeds by the conservative adoption of a type of semi-analytical method independently developed, and aims at providing a text-book suitable for the use of students of the subject, in whom some rudimentary preliminary knowledge can be assumed. The book opens with a chapter on " Fundamental Equations ", in which some of the simple, first order geometrical properties of symmetrical optical systems are considered and the old familiar computing formulæ for the tracing of an axial ray attributed to Bessel are given. Some further account of the simple Gaussian theory is given afterwards in Chapter ix. on the general theory. The student who realises at the outset the importance of a thorough knowledge of the correct manipulation of the instrument of numerical calculation will find useful guidance in the various practical hints and examples.

Chapters follow in which spherical and chromatic aberration are considered upon the basis of trigonometrical calculation and leading up to the design of simple forms of achromatic object glasses, approximate algebraical expressions for these aberrations to facilitate the preliminary design being deduced from the fundamental equations and graphical methods being employed to advantage. The chapter on spherical aberration is followed by a discussion on the physical aspect of optical images from an elementary point of view and the foundation of a system of optical aberrational tolerances, based upon the so-called ' Rayleigh limit ', is laid, in readiness for application in succeeding chapters.

Up to this stage, the student must be supposed ignorant of the aberrations and circumstances affecting extra-axial image formation, and the following three chapters are devoted to this subject, which is approached by way of an application and extension of the previous algebraical third order treatment of axial spherical aberration of ray intersections applied to single surfaces. Expressions similar to the aberration sums of von Seidel are thus obtained and employed as the basis of discussion with application to practice, the case of a system of ' thin ' components being especially considered. Keeping in sight the appropriate needs of students, Prof. Conrady clearly distinguishes three " Fundamental Laws ", these being generalisations of practical importance drawn from the third order theory of oblique pencils. Direct computational experience of oblique aberration is postponed to a much later stage, where formulæ are given for the tracing of an oblique beam through any given axially symmetrical system. Here it is sought to fortify the method by taking advantage of the foregoing analytical work in the interpretation of the results of computation.

For the purposes of this first part, the third order analytical treatment does not seem to offer any outstanding intrinsic advantages over the

available alternative systems, or to exemplify how the subject, although not allowed to "become drowned in a vast mass of complicated algebra", may be presented to the student with any gain in clarity and perspicuity. While so much remains to be done in the subject, it is a most lamentable fact that even upon common ground there should be no trace of an underlying unity in treatment or even in the notation employed by different writers. This is in striking contrast to other progressive branches of applied mathematics, and as a result thereof, talented energies attracted to the subject in the past have been largely expended merely in independently evolving, in special notations, fresh metamorphoses of essentially the same theory, which have for the most part entered upon the world still-born, destined to remain buried in the obscurer recesses of literature.

The general form of Prof. Conrady's algebraical theory must accordingly be familiar to the average reader. Considered more in detail, the formulation is of the class in which the third order aberrations are regarded as depending upon the trigonometrical data specifying the passage of rays within the paraxial region in analogy to the simple ray tracing scheme for finite aperture; it is distinguished throughout by a decided practical bias, and also, however, by a somewhat laboured notation, which, apart from being a source of printing errors, is an obstacle to thought and progress. It would be premature, on account of the apparently complementary nature of the forthcoming Part 2, to judge from the general point of view as to the comparative merit and utility of the system put forward.

In an appropriate chapter the sine theorem is developed by extension out of the theorem of Lagrange. The method has some didactic advantages. Convenient formulæ for subsequent practical application are derived and proper emphasis is laid upon their inherent limitations; but considering the purpose of the work, the method would seem to be appropriate rather as a practical supplementation of a deduction in closer correlation with the physical aspect. The book concludes with a chapter on the design of ordinary eyepieces as a fitting sequel to the foregoing theory, which pertains largely to telescope objectives.

The general impression that remains is that the book would be of proportionately greater value, having regard for its intended purpose and audience, if the matter dealt with had been considerably compressed; for the work cannot be regarded as succinct. Some other features cannot fail to impress themselves. There is a noticeable tendency to looseness of expression. The references to historical or contemporary work are few and far between and are merely of a cursory nature. Differing favourably from most previous books on this subject, the ultimate workshop production is retained steadily in sight as an important factor influencing the course of the theoretical design of optical work. The 'memoranda' following each chapter form a useful feature, but do not amply serve their purpose. The book, as such, is well got up and appears at a time when there is a need for just this class of work. In the present state of the literature, Prof. Conrady's work will certainly form a noteworthy contribution.

Big Game Hunting and Collecting.

Big Game Hunting and Collecting in East Africa, 1903–1926. By Kálmán Kittenberger. Translated from Hungarian. Pp. xix + 348 + 127 plates. (London: Edward Arnold and Co., 1929.) 25*s.* net.

NUMBERS of men, first-class old sportsmen, have lived long years and shot many lions in the bush regions of Central Africa, but unfortunately few of them have ventured or been able to put down their experiences on paper. As often as not it is the man with more imagination than experience who ventures into print. Mr. Kittenberger, however, is one of the few. During ten years in the lion country, shooting and trapping wild animals almost continuously, he killed thirty or more lions, suffered one severe mauling, and has survived to set down his experiences in a book of more than usual interest, adding as it does to our knowledge of the habits of Africa's great game. His account, occupying the first third of the book, of his many adventures with the so-called "King of Beasts" is, we think, one of the best and least coloured that has been written. In reading some of his descriptions of hunts and exciting incidents, one may almost smell the pungent odour of the great night-prowler after meat.

Besides the author's own nearly fatal mishap, one or other of his men on various occasions was mauled by a lion or tossed by a buffalo; he is, therefore, in a position to say exactly what happens on these occasions. Many authors describing the charge of a lion seem unable to avoid mention of great bounds and a mighty spring. In reality, whatever the action at the commencement of the approach to a man or standing animal—whether creeping, galloping, or bounding according to circumstances, with head down and tail stiffened—

the final charge, in the present writer's experience, which agrees more or less with the author's, is a very quick and terrible rush, ending in the lion standing up with the great fore-limbs widely extended, claws exposed, and mouth open. All happens in a moment, in a cloud of dust if in dry weather, the fearful right or left sideways blow with the huge paw, which does all the damage, coming almost too swiftly for the eye to follow.

The author, who made four expeditions in eastern equatorial regions before being interned for the duration of the War, also recounts his experiences with elephants in Uganda, but his knowledge of the greatest of beasts is not equal to what it is of the lion and the plains fauna, and, moreover, in this section he suffers apparently at the hands of his interpreter, the book being a translation from the Hungarian. His chapters, which are profusely illustrated with his own photographs dealing with most of the bush fauna and the birds, are very good reading. His final chapter contains useful directions on hunting equipment and the treatment of trophies.

The author's main interests throughout have been apparently the capturing and rearing of young animals, at which he seems to have become an expert. The majority of his antelopes were caught by driving the herds into loop nets, hung in eight or ten parallel rows, the young animals being afterwards turned loose in paddocks and fed, if very young, on milk from bottles fitted with rubber suckers. When tame enough, they were allowed out to graze with zebu cows herded in the same paddock and from which they never attempted to stray. In this way he was eventually able to drive a mixed herd of cows, antelopes and other animals, and ostriches down to the Victoria Nyanza or to the coast for shipment.

Life and Mechanism.

The Sceptical Biologist (*Ten Essays*). By Joseph Needham. Pp. v+288. (London: Chatto and Windus, 1929.) 7*s.* 6*d.* net.

OF these ten essays, seven deal with different aspects of a single topic, the character of the biological sciences and their status among the other sciences. Arising out of this question the relations between science and philosophy and other human activities are considered. Dr. Needham writes in a gay and even frivolous manner, but the subjects he deals with are serious and what he has to say is important. He does not claim that his main thesis is new, but he might justly claim that it has never been better stated.

The gist of the matter may be put in a few sentences. "The biologist is not committed to any opinion as to what his animals are in themselves, but he is committed to the opinion that the scientific method is one way of describing them, and that it is best to apply that method in its fullest rigour if it is to be applied at all" (p. 253). "The mechanistic conception of living organisms is necessitated by the fact that science is, above all, a system of measurement. What can be weighed or made measurable is susceptible of scientific treatment; elements of experience which cannot be so discussed are left on one side until they can" (p. 136). "The neo-mechanistic position, therefore, at one and the same time asserting the universal dominion of the mechanical sort of explanation over all nature, living and non-living, and admitting the inadequate nature of this sort of explanation as a full account of the world, resembles the old mechanisticism in maintaining the heuristic need for the machine, and differs from it in seeing nothing solely ultimate about the machine. It thus recognises itself as the way the scientific mind goes to work, and not the manner of thinking in philosophy, theology, and art" (p. 204). Everybody, in fact, who works in a laboratory has to be a mechanist while he is at work. Outside he may think what he likes. The mechanistic theory is like army discipline—necessary for the soldier on duty but intolerable otherwise.

While each individual essay can be unreservedly recommended, read together they do not make a good book. They resemble too much having to eat a succession of teas instead of a dinner.

The three other essays in the book are of a biographical character, but are not unconnected with the main theme of the others. One is on a forgotten biological essay by Coleridge; one on de la Mettrie, the author of "Man a Machine"; the third on the seventeenth century trials for witchcraft and Harvey's connexion with them. Unfortunately, it appears that Harvey never divulged his views on witchcraft, but the nature of his evidence at the trials combined with this very reticence seems to leave a presumption that he was sceptical. The essay is a very interesting little historical sketch.

The author displays a disconcertingly wide knowledge of scientific and philosophical literature and has a happy knack of quotation from unexpected sources. For this reason it is specially disappointing to find the bibliography incomplete. A. D. R.

Our Bookshelf.

Ethnography.

The Corridors of Time. By Harold Peake and Herbert John Fleure. Vol. 5: *The Steppe and the Sown.* Pp. 160. Vol. 6: *The Way of the Sea.* Pp. viii + 168. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 5*s.* net each.

In these two volumes the authors of the "Corridors of Time" pass definitely to that phase of archæological studies in which the comparative method on broad lines must at the very least take equal place with the intensive study of local conditions.

Each of these two volumes has, in a sense, a dramatic unity and a central theme, better expressed perhaps in the title of the first than the second. In "The Steppe and the Sown" the nomads of the plains of southern Russia, who, as it has been suggested, may have been the earliest Aryans, made more mobile by the domination of the horse, overrun and conquer the agricultural peoples, settling as overlords in eastern and central Europe, and ultimately reaching or affecting Mesopotamia, the Troad, the Balkans and Greece, Crete, and even Egypt, possibly giving rise to the Hittite Empire at a date later than that to which this volume extends. "The Way of the Sea", which carries the story down to about 2000 B.C., deals not so much with the migrations of peoples as the great movements of cultures, world-wide and more or less lasting in their effects on indigenous civilisation, whether due to actual racial contact or to trade, not only by sea but also by land routes. The range and character of the megalith, the spread of a knowledge of the use of metal, and the distribution of the 'beaker' are interpreted in terms of a widely extending continuity of contact.

The authors have analysed the evidence with no little ingenuity in attacking some crucial difficulties. In particular their view that the spread of the beaker must be regarded as a westward movement from eastern Europe seems more in accord with probabilities than that which regards it as an eastward spread from Spain. Their treatment of the history of the great centres of civilisation, Mesopotamia, Babylon under Hammurabi, the beginnings of the Hittite Empire, Crete and the eastern Mediterranean and Egypt, is necessarily summary in character and can touch only on the evidence for the main trend of events.

The Heroic Age of India: a Comparative Study. By Prof. N. K. Sidhanta. (The History of Civilization Series.) Pp. viii + 232. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1929.) 12*s.* 6*d.* net.

An account of the heroic age of India fittingly finds a place in a series which aims at covering the history of civilisation. Regarded integrally in its effect on the life of the peoples of India, the heroic age, as a phase of culture, must rank as an epoch of fundamental importance; but it has also to be recognised that in all probability it is, in mythical form, a record of one of a number of racial movements in world history which, having certain features in common, are mutually illuminative, and even in some cases may be interrelated. Prof. Sidhanta, throughout his study of the heroic age of India, points out again and again the similarities in the epic stories contained in the Mahabharata, the Puranas, and the Ramayana, and those of the Iliad and Odyssey, Beowulf, and the Serbian cycle of Marko, the hero of the battle of Kossovo.

Study of the Indian epic cycle presents grave difficulties to the student who is not also an expert in the interpretation of Indian literature. The religious and philosophic interest of a later age has remoulded these stories, thrusting the more purely heroic theme into the background. Prof. Sidhanta has done a valuable service in extracting from the poems the material which serves to throw light upon the chronology, the social system, and the religion enshrined in the tangled story of the heroes in the great struggle between Kauravas and Pandavas.

As has been said, the author refers frequently to the other great heroic sagas in the world's history. In seeking to explain the genesis of the heroic epic and the conditions of society which the heroic epic depicts, his method is literary rather than sociological. Had he carried his analysis a little further and on sociological lines, it would have been apparent that the resemblances represent a racial reaction—the reaction of Nordic peoples—to analogous conditions.

(1) *People of the Small Arrow.* By J. H. Driberg. Pp. v + 338. (London: George Routledge and Sons, Ltd., 1930.) 10*s.* 6*d.* net.

(2) *Jungle Gods.* By Carl von Hoffman. Edited by Eugene Löhrke. Pp. xxiv + 286 + 20 plates. (London: Constable and Co., Ltd., 1929.) 10*s.* net.

(1) Mr. Driberg's "People of the Small Arrow" is a graphic description of characteristic events in the life of the Didinga of the hill country of the Sudan bordering upon Abyssinia. The name here used is derived from the miniature arrow with which they bleed their cattle. Mr. Driberg was the first European to visit them, and a residence of some years among them has given him an intimate knowledge upon which he has been able to base these sketches of the normal course of their daily life. Drought, warfare, cattle tending, agriculture, love, marriage, birth and death, are all described graphically as we would look to a novelist or descriptive writer to deal with the life of a community in a western civilisation. Mr. Driberg's special, and it may be said difficult, task has been to make intelligible the springs of action in custom and belief which determine the conduct of the individuals as individuals and as members of the social organism.

(2) In "Jungle Gods", Capt. v. Hoffman is

dealing with a people still primitive in idea but no longer untouched by European culture. These are the Lala, a people of north-eastern Rhodesia. His method of treatment is comparable with that of Mr. Driberg. It is that of the graphic sketch of concrete incident and the record of ideas on specific points of belief and custom of the people themselves. Here again it is possible to grasp the significance of magical ideas in their effect in action. Particularly interesting is the way in which the author has brought out the psychology of the native attitude towards the missionary and other white activities.

Taken together, the two books are of special interest in showing how graphic studies of this type may be made to supplement the scientific record of observations in the field. They demonstrate how the beliefs, customs, and institutions described by the ethnographer function in the events and relations of everyday life.

Le royaume d'Arda et son évangélisation au XVII^e siècle. Par Prof. Henri Labouret et Prof. Paul Rivet. (Université de Paris: Travaux et mémoires de l'Institut d'Ethnologie, Tome 7.) Pp. iv + 63 + 20 planches. (Paris: Institut d'Ethnologie, 1929.) 30 francs.

THIS, the latest issue of the interesting series published by the Institut d'Ethnographie of Paris, deals with an intriguing problem in ethnography and geography. It turns upon a small octavo book in the library of San Isidro in Madrid which came from the Imperial Jesuit College, and contains a vocabulary and exposition of the Christian doctrine in the 'Arda Language'. It is dated 1658. The language was identified in 1858 by Ludewig as being that of an Indian tribe of the upper waters of the Amazon, and akin to the Yamio whom the Jesuits attempted to evangelise from 1727 to 1768. An examination of a photographic reproduction of the vocabulary, however, as well as the discrepancy in the date and the fact that it was the work of Capucins and not Jesuits, led the authors to doubt this attribution. Certain words in the vocabulary were undoubtedly African. They accordingly now identify it as the language of Allada on the Slave Coast, the cradle of the dynasty of Dahomey before it was made subject to the kingdom of Abomey in 1724. The title-page of this interesting volume and the vocabulary are reproduced photographically with other interesting plates from early voyages.

Psychology.

The Morality of Punishment: with some Suggestions for a General Theory of Ethics. By Dr. A. C. Ewing. Pp. xiv + 233. (London: Kegan Paul and Co., Ltd., 1929.) 10*s.* 6*d.* net.

BOOKS upon the subject of punishment are usually written by humanitarians, cranks, or persons with some sort of a doctrinal axe to grind—theological or psychological. Dr. Ewing, however, contributes a thoroughly well-thought-out and well-informed dissertation, which will be read with profit by magistrates, schoolmasters, and clergymen, as well as with sustained delight by philosophers and students of ethics.

Since Dr. Rashdall wrote his well-known chapter, "Punishment and Forgiveness", in his "Theory of Good and Evil", there has been nothing written in Great Britain of serious import on the subject, as Dr. W. D. Ross points out in his foreword. The author aims at reconciling the retributive and the deterrent theories of punishment in such a way as to do justice to the elements of value in both. Such elements, indeed, do exist; and Dr. Ewing, though repudiating the more savagely logical of retributive theories, has no difficulty in showing that the deterrent theory may be held and put into practice in such a way as to presuppose no visible moral point of view at all. For the deterrent theory (logically applied) presupposes in the criminal only a capacity for feeling pain, not of any moral sense as such.

Dr. Ewing deals further with educative ideas of punishment, and also with the complementary theory of reward. He adds a long chapter on the bearing of moral theory upon practice—that is, on the question how we are to decide in particular cases of conduct; a problem too much left by moral philosophers to the casuists whose inspiration has often been theological rather than humane. Dr. Ewing's work is of great value, and deserves careful study, not only by theorists but also by men of affairs. It is commendably readable—not a common quality in treatises on ethics.

The Foundations of Experimental Psychology. By H. Banister, Philip Bard, W. B. Cannon, W. J. Crozier, Alexander Forbes, Shepherd Ivory Franz, Frank N. Freeman, Arnold Gesell, H. Hartridge, Selig Hecht, James Quinter Holsopple, Walter S. Hunter, Truman L. Kelley, Carney Landis, K. S. Lashley, Mark A. May, T. H. Morgan, John Paul Nafe, George H. Parker, Rudolf Pintner, Eugene Shen, L. T. Troland, Clark Wissler. Edited by Carl Murchison. (The International University Series in Psychology.) Pp. x + 907. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1929.) 27*s.* net.

THE purpose of this large and comprehensive volume, issued from Clark University, one of the recognised homes of psychological research, is to indicate just where we stand at the present time in regard to the experimental method of inquiry in this field. To review such a book in detail would be a rather hopeless task, since it consists of no fewer than twenty-three independent studies of the subjects finally selected for treatment. But many of our readers will be glad to have an indication of the contents of the volume.

Chapters on heredity, the study of living organisms, and the mechanism of reaction, are followed by several chapters on the senses, two on emotion, and two on the psychology of learning. Then follow studies on the individual in infancy and in school, the adult in the community, and the conflict and survival of cultures. The last two chapters deal with statistical principles, of course with special

reference to their application to psychological problems. Care has been taken to exclude problems which promise little reward for experimental inquiry, and to avoid saying over again what has been said many times before.

The whole book may be regarded as an authoritative report on the present state of its subject, and we are promised that it shall be kept up-to-date by frequent revision. The book represents a big enterprise worthily accomplished.

Biology.

Die Binnengewässer: Einzeldarstellungen aus der Limnologie und ihren Nachbargebieten. Unter Mitwirkung von Dr. Einar Naumann und anderen Fachgenossen herausgegeben von Prof. Dr. August Thienemann. Band 7: *Die Biologie der Moore.* Von Dr. Otto Harnisch. Pp. iv + 146. 16 marks. Band 8: *Der Hochgebirgsee der Alpen (Versuch einer limnologischen Charakteristik).* Von Dr. Otto Pesta. Pp. xi + 156 + 8 Tafeln. 17·50 gold marks. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1929.)

Following Dr. Einar Naumann's excellent introduction to experimental fresh-water plankton investigations in Vol. 6 of the present work, we are now given treatises on the biology of the moor by Dr. O. Harnisch (Vol. 7), and on the high-mountain lakes of the Alps by Dr. Otto Pesta (Vol. 8). Both of these are highly interesting, and the student of fresh-water biology will find much to help him, whichever region he wishes to investigate. The plan of the volumes is similar, although naturally differing to a large extent in matter. The first part treats of the geographical and geological features with the chemical constituents of the soil and water, and following this are descriptions of the fauna and flora of these distinctive regions.

Dr. Harnisch begins with certain necessary definitions and proceeds to describe the moor in all its aspects, including its development and history, the chemical and physical nature of the soil and the moorland waters—stream, lake, and bog, the trees and turf; finally, the plant and animal life. The importance of *Sphagnum* to the Rhizopoda and other small creatures, always well known, is emphasised. Special stress is laid on animal communities and their environment; the whole forming an excellent basis for further work.

Dr. Pesta, who has himself investigated many of the high Alpine lakes, gives a valuable account of them. Most of these lakes have little or no vegetation round them, being situated chiefly between the mountains and surrounded by rocks and stones. The hydrophysics, including colour and transparency, temperature and winds, are here of great importance. The flora and fauna are mostly made up of cosmopolitan species with a small group of cold-water forms of restricted distribution. The lists given include a large variety of plants and animals, and special problems arise out of these, such as the restriction of food in the winter and consequent hunger-forms, the presence of red coloration in many species, and other suggestive points.

A Manual of External Parasites. By Dr. H. E. Ewing. Pp. xiv + 225. (London: Baillière, Tindall and Cox, 1929.) 20*s.* net.

This attractively printed manual, notwithstanding its title, is not a general book on ectoparasites, but a guide to the study of certain economically important groups. Its author, Dr. H. E. Ewing, is a well-known member of the United States Bureau of Entomology, and in preparing this book he has been able to draw upon the extremely complete collections of the creatures he deals with that are contained in the National Museum at Washington. The first five chapters are devoted respectively to mites, ticks, biting lice, sucking lice, and fleas. Each of these sections contains keys to the families and genera, together with some considerations of the external anatomy, economy, and control measures, while representative species are shown in the illustrations. At the end of each chapter is a list of the more important literature on the subject concerned: the references are well chosen, and by no means confined to American writers. The sixth and final chapter takes the form of an appendix containing descriptions of a number of new genera of ectoparasites. The wisdom of this procedure is disputable, but, it may be added, the new genera described are included in the keys given in the foregoing sections.

It is a matter of regret that the book is not larger, and its utility is limited in consequence. Its chief value is that it provides a guide to the identification of the groups of ectoparasites dealt with, and we know of no other single work wherein there are to be found diagnostic keys of a similarly comprehensive character. Museum workers, general entomologists, and veterinarians will find the book of real assistance in this respect. From the general point of view, however, the information on structure and biology is not given in the detail which might reasonably be expected in a specialised book of this description, and the same applies to the accounts of control measures.

Tabulæ Biologicæ. Ed.: W. Junk, Herausgegeben von C. Oppenheimer und L. Pincussen. Supplement 1 (Band 5): *Botanik; Biologie der Algen; Bakteriologie; Hefen- und Schimmel-Pilze; Geschlechter-Verteilung; Kern-Plasma-Relations; Keimung; Wachstum; Allgemeine Physiologie; Assimilation; Periodizität; Experimentelle Ökologie.* Pp. vi + 821. (Berlin: W. Junk, 1929.) 90 gold marks.

This volume is supplementary to the original four. It deals entirely with botanical data and is to be followed by a zoological volume. A variety of matters relating to the biology of plants are tabulated. Beginning with a list of all the species of algæ which have been cultured, many other facts which are amenable to tabulation concerning algal cultures are given. In similar fashion, many facts concerning bacterial and fungal culture and media are tabulated. Sections follow dealing with such subjects as sex in plants, germination, growth, and many other physiological topics in tabular form. Another section is ecological, and the volume ends

with an appendix on enzymes and an index of all botanical references in the five volumes.

References to the literature are given at the beginning of each table and at intervals in each section. Much out-of-the-way information is conveyed, which will be useful for reference. But in some cases the tables would be more useful if the method of computing the results was given. Thus in the table giving the nucleoplasmic ratio in embryonic organs, reference to the original paper would be necessary to determine how the volumes were computed. Numerous graphs and four plates of figures of yeasts and moulds add to the value of a volume which should be of use both to morphologists and physiologists.

Handbuch der biologischen Arbeitsmethoden. Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 293. Abt. 9: *Methoden der Erforschung der Leistungen des tierischen Organismus*, Teil 4, Heft 3. *Methoden der Erforschung bestimmter Funktionen bei einzelnen Tierarten. Methoden und Technik der Nerven- und Muskelphysiologie bei wirbellosen Tieren.* Von H. J. Jordan und P. J. van der Feen. Pp. 295-438. (Berlin und Wien: Urban und Schwarzenberg, 1929.) 8 gold marks.

THE present sub-section of this comprehensive undertaking will be found especially useful to workers in marine and in general physiology, as well as to those devoting themselves to the study of muscle and nerve phenomena. General methods for the investigation of the tone of smooth muscle are described, as well as special details of technique for dealing with the representative types of invertebrates.

What Darwin Really Said: connected Extracts from the "Origin of Species". With an Introduction by Prof. Julian Huxley. (Routledge Introductions to Modern Knowledge. No. 8.) Pp. 80. (London: George Routledge and Sons, Ltd., 1929.) 6*d.* net.

BY a judicious selection of extracts, Prof. Huxley here presents the pith of Darwin's argument in support of the theory of natural selection, and in such a way that the layman in biology should have no difficulty either in grasping the essentials or in avoiding misconceptions. The introduction, after showing the far-reaching effect of the appearance of "The Origin of Species", contains a valuable discussion of the present position in the light of recent advances in biological knowledge, especially of Mendelism; while occasional footnotes direct attention to facts not known to Darwin. A short bibliography of modern works relating to evolution, and a glossary, are included.

Insect Pests and their Control in South Africa. By Dr. Charles K. Brain. Pp. xii+468+viii. (Cape Town: Die Nasionale Pers Beperk, 1929.) n.p.

IN view of the enormous losses occasioned by insect pests to the farmers of South Africa, we welcome this first attempt to provide them with a manual of the subject, with methods of control. Dr. Brain has brought to his task wide experience of his subject and has succeeded in producing a thoroughly sound, well-illustrated book which is both practical and scientifically accurate. Within a compass of rather more than 460 pages, he discusses every pest of importance to the grower and stock-raiser in South Africa, besides providing chapters on bee-keeping, the relations of insects to human and animal diseases, and the general principles of control methods.

English Wild Life. By Eric Parker. (The English Heritage Series.) Pp. xi+180. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 3*s.* 6*d.* net.

THAT the old order changeth is sadly true of the English countryside to those whose memories extend back to the last century. It is thus good to have this record of what the wild life, both animal and plant, of England has meant and means to an all-round naturalist and (*quondam*) sportsman who has a knowledge of the fauna and flora of moors and fields, woods and forests, foreshores, rivers, lakes, and mountain peaks. May his pleasant little volume achieve some measure of preservation of our heritage before it is too late.

Animals Looking at You. By Paul Eipper. Translated by Patrick Kirwan. Pp. vi+187+32 plates. (London and New York: G. P. Putnam's Sons, 1929.) 10*s.* 6*d.* net.

THIS remarkable work should be read by all zoologists and others interested in animal life. It consists of what can best be described as a series of vivid verbal vignettes of incidents observed at Hagenbech's Stellingen zoo and elsewhere, and reveals much of the characters and temperaments of the great beasts and birds lodged in such establishments. The thirty-two magnificent photographic illustrations are as striking as the text itself. The translation is very well done.

Geography.

Practical Hints to Scientific Travellers. Edited by Prof. H. A. Brouwer. Vol. 6. Pp. v+177+12 plates. (The Hague: Martinus Nijhoff, 1929.) 5 guilders; 8*s.* 6*d.*

THE sixth volume of this useful work, which now appears in a handier form than that of the first two volumes, treats of travel in Canada, the Argentine, Madagascar, tropical West Africa, and Oceania. The articles vary in scope and treatment, as is obviously desirable in such diverse regions, but all are of an entirely practical character and should be very helpful to the scientific traveller. No attempt is made to compete with volumes on various aspects of the countries or to furnish guides or handbooks. Attention is concentrated on methods of travel, equipment, maps, food, and manners and customs that might affect the traveller. The articles on the Argentine and West Africa are specially valuable, but all are useful and are written by men of practical experience.

Greenland: its Nature, Inhabitants and History. By Th. N. Krabbe. Translated from the Danish by Annie I. Fausbøll. Pp. xvi + 129 + ix + 170 plates. (Copenhagen: Levin and Munksgarrd; London: Oxford University Press, 1930.) Paper, 33*s.* net; cloth, 40*s.* net.

Dr. Krabbe spent the best part of twenty years as a physician in Greenland, during which time he visited most of the inhabited parts. He is thus exceptionally well qualified to give a general account of the country, and particularly its inhabitants and their social conditions. The book, which is printed in parallel columns in Danish and English, gives an admirable survey of the present state of the country and a sketch of its history. It is of interest to note that the native population, under the care of the Danes, has increased from 10,000 in 1886 to more than 14,000 in 1926.

The chief value of the volume, however, lies in its beautiful illustrations. The numerous plates, which are provided with full descriptions, give a pictorial survey of Greenland on a scale that no other volume has attempted. Many of the settlements are illustrated and the inhabitants receive special attention. There are also fifty portraits of men who have been closely connected with the exploration of the country. A full index and a good map add to the value of the volume.

R. N. R. B.

Shipways to the Sea: our Inland and Coastal Waterways. By Ernest S. Clowes. Pp. viii + 196 + 6 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1929.) 20*s.* net.

The author of this excellent survey of the waterways of the United States, and, in part, Canada, believes that the development of inland navigation is needed to solve many of the problems of cheap and efficient transport in America. He develops this idea particularly in regard to the Mississippi basin and the interior plains of the United States. The book, however, is not merely a piece of propaganda. It embraces a historical, geographical, and economic survey of all the existing navigable rivers, canals, and lakes with a wealth of useful statistics. Projects in hand and dreams of the future are also discussed. The consideration of the proposed St. Lawrence waterway for ocean-going vessels is particularly valuable, because it appears to be free from the political bias which affects most discussions of this subject. The volume contains a few maps, but they should have been clearer and more numerous.

Open-Air Studies in Australia. By Frederick Chapman. Pp. xx + 170 + 23 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1929.) 10*s.* 6*d.* net.

For full appreciation of this series of essays, personal acquaintance with the soil and scenery of Australia are necessary. Nevertheless, the fundamental principles involved are of such universal application, and the allusions to features within the British Isles so frequent, that the reader who has a taste for open-air geology can be assured of interest in every chapter. Incidentally, attention may be directed to the chapter "The Problem of the Coral Island", and the discussion of the results of the Funafuti Expedition. Most of the illustrations are excellent, but a few are inconveniently small.

Mathematics.

Mathematics Preparatory to Statistics and Finance. By George N. Bauer. Pp. vii + 337. (New York: The Macmillan Co., 1929.) 8*s.* 6*d.* net.

The flood of elementary treatises dealing with statistics continues unabated; nearly all seem to be designed to aid students whose subjects are known or believed to require statistical methods, but who have already decided that they have neither the time nor the mathematical training to make themselves masters of the simple principles on which competent methods are founded. The authors of these heroic stopgaps cannot fairly be blamed for this situation; so long as the large portion of the population which will need statistics in its practical business does not imbibe the fundamental ideas in their school mathematics, so long will university students require such courses as that under review. The author shows a just perspective in saying (Preface, p. v):

"This is not a book dealing with the subject of statistics; neither does it attempt to present the subject of the mathematics of finance. It is a study of the simpler mathematical methods and principles that occur frequently in elementary courses in these subjects. But many of the principles and methods included are applicable to the study of phenomena in other fields. They have a wide range of usefulness."

The range of usefulness would certainly be greater if care had been taken to use common expressions in the sense which they bear in more advanced work. On p. 252 the 'standard error of an estimate' is spoken of as a test of 'goodness of fit'. This it certainly is not. The confusion which here lies in wait for those adventurous souls who ultimately win through to real tests of goodness of fit, is made worse by the fact that the standard error under discussion is not the standard error of the estimated regression, but a rather unsatisfactory estimate of the standard deviation from a regression formula.

Within its own limits, however, the book makes the subject easy. Explanations and examples are careful and abundant. R. A. Fisher.

Mathematical Tables and Formulas. By Prof. Percey F. Smith and Prof. William Raymond Longley. Pp. v + 66. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 8*s.* net.

This collection of tables, mostly to four figures, contains logarithms, square and cubes, square and cube roots, reciprocals, Napierian logarithms and trigonometrical tables. No differences are given. In addition, there is a three-figure radian table giving the six natural trigonometrical functions for arguments up to 3·20. This and the corresponding table of exponentials and hyperbolic functions are

definitely useful. It is therefore a pity that they were not made more extensive instead of being cramped into four pages. The formulæ, which occupy 25 pages, are not so well chosen. There are no formulæ of spherical trigonometry, nor are the derivatives of hyperbolic functions and their inverses given. Taylor's and Maclaurin's series should include a remainder term. The table of integrals is, however, welcome. The book is well bound and has a thumb-nail index, but the price is rather high.

The Adjustment of Errors in Practical Science. By R. W. M. Gibbs. Pp. 112. (London: Oxford University Press, 1929.) 5*s.* net.

THIS little volume is "the result of an attempt to simplify and condense into a readable form the gist of the Theory of Errors". It deals with the elements of probability, normal curves of error, distribution of errors, lines of closest fit, correlation coefficients and ratios, observational errors, and so on. The text is clearly and simply written, and is well illustrated by graphical diagrams. The chief mathematical theorems upon which the theory of error depend are not given in the text, but are established separately in an appendix at the end. Here the author has wisely aimed at giving clear and simple demonstrations in order that the mathematical treatment may be within the range of the non-specialist. In this he has in general succeeded; nevertheless, a fair amount of mathematical knowledge is necessary to appreciate fully some of the proofs, especially those dealing with the fundamental integrals.

Lists of common symbols and special formulæ used throughout the book are given at the end, and an excellent system of cross-reference has been adopted.

Elementary Differential Equations. By Dr. Thornton C. Fry. Pp. x + 255. (London: Macmillan and Co., Ltd., 1929.) 10*s.* 6*d.* net.

THIS volume is intended primarily for students of engineering, and is the outcome of 'out-of-hour' courses given at the Bell Telephone Laboratories. It embraces the significance and origin of differential equations, linear equations of the first and higher orders, systems of linear equations and other equations of a higher order than the first. The treatment is mainly practical, but a little elementary theory is included.

The author recognises the danger of dealing solely with technical applications and has made a commendable attempt to develop sound mathematical principles so far as is possible in such a treatise. Thus, there are sections devoted to brief elementary discussions on existence theorems, continuity, singular solutions, boundary conditions, essential conditions of convergence in series solutions, etc. There is a good chapter on the geometrical interpretation of a first order equation, and the book is full of excellent examples bearing on a variety of important applications.

The text is well arranged and printed, and the few necessary diagrams are very clearly drawn.

Physics and Chemistry.

(1) *Molecular Spectra and Molecular Structure: a General Discussion held by the Faraday Society, September 1929.* Pp. iii + 611-954. (London: The Faraday Society, 1929.) 15*s.* 6*d.* net.

(2) *Bandenspektra und ihre Bedeutung für die Chemie.* Von Prof. Dr. R. Mecke. (Fortschritte der Chemie, Physik und physikalischen Chemie, herausgegeben von Prof. Dr. A. Eucken, Band 20, Heft 3.) Pp. iii + 87. (Berlin: Gebrüder Borntraeger, 1929.) 7·60 gold marks.

(1) THE Faraday Society's General Discussion on Molecular Spectra and Molecular Structure, held at Bristol on Sept. 24–25, 1929, has already been reported in these columns (Oct. 12, 1929). The full report, which has now been issued as a separate publication, is remarkable in that it contains not less than forty original papers, together with verbal and written contributions to the discussion. It is, therefore, unsurpassed as a comprehensive survey of the important subject with which it deals, and has the special merit of being many months in advance of any volume that could be written by the most experienced author, since it discloses for the first time new facts and new opinions that can only gradually find their way into even the most up-to-date text-books.

(2) One of the most welcome visitors to the Bristol meeting was Prof. Mecke, of Bonn, the joint author of a paper on "The Absorption Spectrum of Ammonia Gas in the Near Infra-red". Prof. Mecke is also the author of a monograph on "Band-spectra and their Significance for Chemistry", published in a well-known series of *Fortschritte*, or progress-reports, on chemistry, physics, and physical chemistry. A recent monograph of this series, on the valency-number and its relation to the structure of the atom, was reviewed at length in these columns nearly a year ago (NATURE, April 13, 1929). Since the logical sequel to the study of line spectra of atoms is obviously that of the band spectra of molecules, those chemists who have read the former monograph in order to secure some knowledge of atomic physics will obviously be well advised to extend their studies to the latter monograph, which records the spectroscopic behaviour of chemical compounds and therefore presents a much wider field for the consideration of chemical problems. In particular, those who wish to appreciate the technicalities of the Bristol report will find in Prof. Mecke's monograph an excellent introduction to a very modern and somewhat difficult subject.

Physikalisch-chemisches Praktikum. Von Prof. Dr. K. Fajans and Dr. J. Wüst. Pp. xvi + 217. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 13·50 gold marks.

THE "Physikalisch-chemisches Praktikum" of Prof. Fajans and Dr. Wüst had its origin in instructions for experiments in physical chemistry which were prepared in 1910 by Prof. Bredig and his colleagues for use in his laboratory at Karlsruhe. Ten years of continuous service in Munich resulted in so many modifications that finally a plan was

developed whereby the experience gained there was united with that of Prof. Grimm at Würzburg and of Prof. Schiebe in Erlangen and used to produce a book which would meet the requirements of the four laboratories mentioned above.

The principal purpose of such a book is to lighten the burden which rests upon demonstrators who may now be required to cope with very large classes, as a result of the introduction of compulsory courses in practical physical chemistry. Its value can only be tested adequately by use in the country of origin, and English teachers will probably find it necessary to base their courses on instruction sheets or laboratory text-books in their own language; but they will find it of interest to compare notes with their German colleagues, and in some cases (for example, the experiments illustrating radio-active transformations) they may find material for developments in directions not hitherto exploited in undergraduate courses. The practical instructions are accompanied by theoretical sections, and references are given to German text-books in which the points at issue can be studied more fully.

Stereoscopic Photographs of Crystal Models. Edited by Sir William and Prof. W. L. Bragg in order to illustrate the results of X-ray Crystallography. Second series: *The Silicates.* (London: Adam Hilger, Ltd., 1929.) Set of 23 photographs complete in box with folding stereoscope, 24*s.* 9*d.*

This second series of stereoscopic photographs represents models of the structures of important members belonging to the silicate family. The original models were built up from results based on X-ray investigations, and they have been constructed with such simple materials that the student may be tempted to reproduce the simplest ones from the data printed on the back of each photograph. Seeing that the atoms in these structures make up nearly the whole of the earth's crust, this simple presentation of the results of a difficult physical research will be of great interest in many fields.

The key to each model is the regular grouping of the large oxygen atoms, the silicon and metal atoms being widely dispersed throughout the structure and adding, as it were, more complex harmonies to the central oxygen 'motif'. Both the close-packed and open structures of oxygen atoms are well represented. These examples of complex co-ordination are made up of simple units, notably tetrahedral groups of oxygen atoms around silicon, and octahedral groups of oxygen atoms around aluminium. The units are repeated rhythmically, often in chain or ring formation when they share one oxygen atom. The variable co-ordination number of aluminium is of particular interest to the chemist: andalusite provides an example of this atom being situated between five oxygen atoms.

It is to be hoped that photographs of models of the felspars, micas, and zeolites will form a nucleus for a third series. To the mineralogist remains the formidable task of finding how closely these ideal models represent the structure of all the members of a mineral species, within which the chemical composition often varies widely. F. A. B.

Das Fermentproblem (*zugleich Einführung in die Chemie der Lebenserscheinungen*). Von Prof. Dr. Andor Fodor. Zweite, völlig umgearbeitete Auflage. Pp. xi+283. (Dresden und Leipzig: Theodor Steinkopff, 1929.) 20 gold marks.

The author's aim in the present edition of his book has been to prepare a concise treatise on fermentation phenomena, embodying the more recent discoveries, without attempting to treat the subject exhaustively. The difficulties of dealing, within a limited compass, with a subject having so profuse a literature, are frankly admitted by Prof. Fodor.

The book is divided into five sections, each of which is subdivided. A short account is given in the opening section of the history of fermentation. The physiology of digestion is next dealt with, and a detailed account is given of the products resulting from the action of enzymes. Some of the text in this part of the book is inclined to be one-sided; thus, that concerned with starch hydrolysis is almost exclusively confined to the work of German chemists. A useful summary is given of the enzymes of animal organs and of prophylactic ferments. The section on assimilation and dissimilation is a long one, describing photosynthesis, respiration—aerobic and anaerobic—and setting forth the views of Bach and Chodat, Warburg, Wieland, and others. Here also the final excretion products of animal metabolism are dealt with. There is a section on the physical chemistry of enzymes, whilst the subject matter of the concluding section of the work is concerned with colloidal chemistry in its relation to the activity of enzymes. A subject matter index is provided.

Whilst regarding the book as a useful addition to the literature, after reading the sections the feeling can scarcely be avoided that it lacks that personal touch so desirable in a work intended for didactic purposes. A. R. L.

Analytical Processes: a Physico-Chemical Interpretation. By T. B. Smith. Pp. viii+373. (London: Edward Arnold and Co., 1929.) 12*s.* 6*d.* net.

Dr. T. B. Smith has written a book of a very unusual type, since it is neither a text-book of analysis nor a text-book of physical chemistry, but a review of the processes of analysis in the light of modern knowledge and of physico-chemical laws. For this purpose he has considered a series of analytical operations, such as the precipitation of barium sulphate, lead sulphate, ferric hydroxide, and silver halides, the titration of chlorides against silver nitrate, of acids against alkalis, and of oxidising against reducing agents, and the methods of electro-analysis, and has brought to bear on them a wealth of physico-chemical experience which may win the admiration even of a well-read student of physical chemistry.

The book also includes chapters dealing with the ignition of precipitates, analytical separations, super saturation and crystallisation, colloidal phenomena

and complex ions, each of which contains a satisfying review of current knowledge. The author has, in fact, first become a keen student of the science (as distinct from the art) of analysis, and has then set himself the more difficult task of passing on to others the scientific equipment and critical skill which he has himself acquired. The volume in which this has been done is a noteworthy production, and may be commended heartily to all those who are responsible for teaching analysis, as well as to those who may value it for the additional interest which it may give to analytical practice.

Miscellany.

The Evolution of Earth and Man. By Lorande Loss Woodruff, George Howard Parker, Richard Swann Lull, Charles Schuchert, Harry Burr Ferris, Joseph Barrell, Albert Galloway Keller, George Grant MacCurdy, Ellsworth Huntington, James Rowland Angell, Edwin Grant Conklin, Wesley Roswell Coe. Edited, with a Preface, by Prof. George Alfred Baitsell. Pp. xv + 476 + 32 plates. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1929.) 22*s.* 6*d.* net.

THIS volume consists of a reprint of two volumes of elementary lectures, "The Evolution of the Earth and its Inhabitants" (1918), and "The Evolution of Man" (1922), delivered at Yale University, with the addition of a chapter entitled "Cultural Evolution" by Prof. G. G. MacCurdy, and another on "The Mechanism of Evolution", by Prof. W. R. Coe. Most of the chapters are reprinted without any (or with only slight) alteration. Hence the review that appeared in NATURE (June 2, 1923, p. 735) still gives an accurate idea of the new impression, and the criticism of the titles of the individual lectures and of the whole volume is still relevant.

The new chapters are summaries of well-known evidence, which omit a good deal of modern research. For example, the beginning of the Bronze Age is given (p. 285) as 3000 B.C.; although it is now generally admitted that the alloy was not invented before 2500 (or perhaps even 2000) B.C., and some time must be allowed for the building up and diffusion of the culture-complex which in western Europe was called 'The Bronze Age'. The beginning of the Neolithic Period is assigned to 12,000 B.C., which is about nine or ten millennia too early.

Nature: Cosmic, Human and Divine. By James Young Simpson. (The Terry Lectures, Yale University, 1929.) Pp. ix + 157. (London: Oxford University Press, 1929.) 6*s.* net.

PROF. J. Y. SIMPSON'S three Terry Lectures delivered at Yale last year will interest those students of science who are not indifferent to the speculative and religious bearings of their subject. The first lecture summarises the results of recent astronomical and physical science. The second lecture, which is anthropological, takes an optimistic view of human nature, accepting Elliot Smith's view that 'savagery' is not natural to man, and expressing the opinion that "human nature not merely can be, but is being changed", and (what seems too good to be true) that "we stand on the threshold of an Age of Reason".

The final lecture essays to present us with some sort of a philosophic synthesis in terms of trends and tendencies. "The association of mind with the energy at work in the world-process is forced on us in contemplation of the sustained and broadly progressive character of the process as a whole, with its present *dénouement* in man." The Christian theologian will discover in this last chapter a point of view indistinguishable from the *Logos* doctrine of the Fourth Gospel; nor would Dante feel that his view of love as the motive power of the world had been neglected. Prof. Simpson may be congratulated on a very useful piece of work.

The Scientific Examination of Pictures: an Investigation of the Pigments used by the Dutch and Flemish Masters from the Brothers Van Eyck to the Middle of the 19th Century. By Dr. A. Martin de Wild. Translated from the Dutch by Dr. L. C. Jackson. Pp. xv + 106 + 46 plates. (London: G. Bell and Sons, Ltd., 1929.) 15*s.* net.

DR. DE WILD has made an examination of the pigments used in painting Dutch pictures from the fifteenth to the nineteenth century inclusive, by micro-chemical methods, thus enabling him to use tiny samples without injury to the pictures, and carrying on the work done by former chemists such as Raehlmann and Laurie. The work, on the whole, confirms the conclusion formerly arrived at as to the pigments used at different periods in painting, but adds much detailed information on the pigments of the Dutch school during this period. The beautiful photomicrographs of actual examples are well worth looking at.

There are other chapters on the cleaning and preservation of pictures, the examination of them by means of X-ray photographs, and by means of ultra-violet light.

The work is a solid and useful contribution to a subject of growing importance and should find a place both on the bookshelf of the chemist and the picture expert. A. P. LAURIE.

Isis: or the Future of Oxford. By W. J. K. Diplock. (To-day and To-morrow Series.) Pp. 95. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1929.) 2*s.* 6*d.* net.

DISSATISFIED with Mr. Julian Hall's "Alma Mater", recently published in the same series, on the future of the two older universities of England, Mr. Diplock has produced a sparkling and thoughtful essay on Oxford as it appeared to him during the past five years, when spending laborious days in chemical laboratories, and nights in discussing 'life' and topics of wider intellectual interest with non-scientific friends. He not unnaturally prefers the Oxford of his leisure hours, and points out how the 'old academic tradition' may be in danger, if women become too numerous, or if benefactors

prove too commercially-minded, or if 'job-hunters' increase. At the same time, he notes the absence of heads of colleges who have had a scientific training, whereas Cambridge has often benefited by their ability. We hope that Mr. Diplock will enlarge further on his theme.

Are we Civilized? Human Culture in Perspective. By Robert H. Lowie. Pp. xiii + 306. (London: George Routledge and Sons, Ltd., 1929.) 12*s.* 6*d.* net.

In this amusing and witty book, Prof. Lowie has made a survey of human culture with the view of analysing the permanent and impermanent elements in the line of progress. His thesis is that man, like the chimpanzee, must fight against the forces of destruction; but he has forged ahead of the ape by passing on his experience to his descendants of the next generation. Prof. Lowie aims at showing that in so doing he has passed on dross as well as gold. In his time and space survey, he shows that identity in difference leads to the conclusion that we ourselves, however much we may differ from our ancestors and the so-called 'lower races', retain much in our own make-up, 'inherited' in the looser sense, which justifies the interrogative which forms the title of his book. Prof. Lowie holds no brief for the popular theory of Nordic superiority, because, as he says, he does not recognise that a Nordic race exists to-day. Like everything he writes, the book is stimulating. Though scientific in method and outlook, it is written in a style which avoids technicalities and will appeal to the least instructed of readers.

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Exhibition in 1872 and was labelled prophetically "A Young Engineer". The headmaster of his first school, Cargilfield, Edinburgh, encouraged his mechanical tastes. When at this school he gave exhibitions with a magic lantern and became skilled in taking photographs. In 1877 he took a good photograph of Prof. T. H. Huxley which, with other portraits, is included in a book entitled "Autobiographical and other Writings", which was in the press when he died. In 1878 he was sent to Fettes College, but as he hated games he found the school life very uncongenial. In his opinion the way Latin and Greek were taught in public schools, especially the unnecessary stress laid on grammar, took away all the romance from the wonderful stories of Greece and Rome. He also considered that compulsory games had a tendency to damp out any originality a boy might possess. He, however, enjoyed the work in the carpenter's shop at Fettes.

In 1879, after reading the description of the working of a telephone given by Prof. Dolbear, Campbell Swinton constructed a pair of telephones which functioned excellently. As the telephone had only been invented some two years previously, this would have been a good piece of work for a scientific worker; for a boy of fifteen it was admirable. His house master, thinking that his scientific absorption interfered with his classical studies, made him send the telephones home.

In the easter of 1881, Alan was sent at his own request to Havre, where he had lessons in mathematics and French, but he seems to have spent much of his time in taking snap photographs of ships and fishing boats. He also visited the lighthouse on several occasions and studied how the electric arc was fed by a de Meritens dynamo which had permanent steel magnets. He was puzzled by the fact that the current seemed to have no effect on a little compass needle brought near it, the reason being that it was alternating current.

Campbell Swinton was a great believer in self-education. The passing of advanced examinations he regarded as pure waste of time. He attributed his success to cultivating scientific friends and to attending lectures at institutions like the Royal Institution and the Royal Society of Arts.

In 1881, Campbell Swinton visited the Paris Exhibition and was most impressed by the wonderful electrical inventions he saw. In 1882 he was apprenticed to Lord Armstrong in the works at Elswick. During this period he fitted a Chilian battleship with electric gun-firing control which enabled any number of guns to be fired simultaneously. In 1887 he left Elswick and set up in London as an electrical contractor and consulting engineer. He installed the electric light in many town and country mansions.

Early in January 1896, after reading an account in the morning paper of Prof. W. C. Röntgen's discovery of X-rays, Swinton was successful in obtaining a shadow photograph by means of a Crookes tube which he happened to possess. A few days later he obtained a shadow photograph of the bones in his own hand. The present writer remembers him showing this at the Camera Club, which was then in Charing Cross Road. This was the first photograph produced by Röntgen rays in Great Britain. It was reproduced in NATURE of Jan. 23, 1896. On Feb. 4, 1898, he showed many interesting experiments with cathode and X-rays at the Royal Institution. In conjunction with Sir Charles Parsons, he converted diamond into coke by heating it in a vacuum by cathode rays. As the diamond became carbonised, it split up and frothed and became much larger in size. The temperature at which this conversion took place was 1890° C.

In 1904, Campbell Swinton gave up contracting work and became exclusively a consulting engineer. He was specially interested in radio work. When the Marchese Marconi first came to England he called on Swinton, who introduced him to Sir William Preece and rapid developments in radio telegraphy soon ensued. When in Copenhagen in 1910, Swinton first heard articulate speech by radio when listening to tests with the Poulsen system. He was associated with the development of the Parsons turbine and was a director of the Parsons Marine Steam Turbine Co., Ltd. He went out on many of the trials of the pioneer turbine boat, the *Turbinia*, which created a sensation at the Naval Review in 1897 by going at the record speed (at that time) of 33½ knots. Swinton was one of the pioneers of motoring in England.

Campbell Swinton was associated with many electrical works and supply stations. He was a director of Crompton, Parkinson, Ltd., and of W. T. Henley's Telegraph Works, Ltd. In 1911 he was president of the Röntgen Society and in 1913 of the Radio Society. For several years he was chairman of the council of the Royal Society of Arts. In 1915 he was elected a fellow of the Royal Society and twice served on the council. In 1926 he presented the Royal Society with £1000 to form the nucleus of a general purposes fund. He undertook to defray the costs of the charter which was recently granted to the British Association. He had been a member of the general board and of the executive committee of the National Physical Laboratory. He was well known at the Athenæum Club, of which he had been a member for nearly thirty years; he was unmarried.

Campbell Swinton was a member of the three professional engineering institutions—the Civils, the Mechanicals, and the Electricals. He had been a vice-president of the Electricals for four years and had served energetically on many committees. In his home in Chester Square he was most hospitable, and enjoyed showing to his guests the photographs he had taken of many eminent scientific workers and demonstrating the latest developments in radio communication. He will be missed by many, and especially by his old assistants, with whom he maintained a warm friendship.

A. R.

News and Views.

NEARLY everyone agrees that radio telephone services with the Dominions and distant foreign countries should be opened up whenever it is economically practical. Last August, Imperial and International Communications, Ltd., wrote to the present Postmaster-General, Mr. Lees Smith, inviting the Government to work its radio telephone services through the company's stations, beginning with four services to Canada, Australia, South Africa, and India. Whilst negotiations were going forward and before the special committee had reported, statements appeared in the Press giving an *ex parte* presentation of the case coupled with a series of charges against the Post Office. Mr. Lees Smith very properly did not reply until the committee had reported. The evidence showed that both the Marconi system and the Post Office Rugby system are capable of providing long-distance services to the Dominions and foreign countries. Owing to its invaluable pioneer work on short-wave systems, our sympathies are with the company, but we think that the Government has acted rightly in putting the matter into the hands of the Post Office. There is no intention of duplicating the Marconi stations, and there are many advantages in concentrating the plant and buildings at Rugby. To work the four services to India and the Dominions through stations belonging to Imperial and International Communications, Ltd., would require 4190 miles of high grade telephone circuits connected with London as compared with 786 miles to connect with the P.O. stations at Baldock and Rugby. In South Africa, also, it would be more economical to erect a station at Johannesburg than to connect with the Company's terminal beam station at Cape Town. We do not see that there was any necessity to make a comparative experimental test between the systems before coming to a decision.

SCIENTIFIC and industrial research in the British Empire was the subject of a paper read by Dr. A. W. Hill, director of the Royal Botanic Gardens, Kew, before the Dominions and Colonies section of the Royal Society of Arts on Feb. 25. The rapid growth of research in all branches of biological science during the last few years throughout the Dominions and Colonies has created a demand for trained men which it is at present very difficult to meet. Dr. Hill referred to developments in the West Indies and West Africa. In the former, the Imperial College of Tropical Agriculture has been evolved and is recognised as a research station for the study of the many pressing problems which confront tropical agriculture. It is also a training centre for agricultural officers for the various agricultural departments throughout the Colonial Empire. Botanic stations have been established in West Africa to serve generally for the growth of indigenous trees and plants of marketable value as demonstrations to the natives, for the introduction and propagation of alien plants of economic and commercial importance, and as practical agricultural schools for training the natives. The stations have expanded into agricultural departments, that in Nigeria having, in addition to the director, a staff of forty-four scientific officers besides native assistants. The research station at Amani, Tanganyika Territory, which was founded by the Germans, has been reorganised as a station for the East African Colonies.

DR. HILL emphasised the importance of an intensive taxonomic and ecologic study of the vegetation of the overseas portion of the British Empire, and referred to the important services of Kew, especially in the issue of a series of Colonial floras, and indicated similar works in preparation or projected which would deal in detail with smaller areas. The work in progress and in contemplation in connexion with scientific research on the vegetation of the Empire calls for a great increase in the numbers of well-trained botanists both at home and overseas, especially in the domains of taxonomy and ecology, and for the investigation of plants yielding economic products. Workers in the field of genetics are also required for the study of staple products, to produce and select true-breeding types which will give a maximum yield. There are also the many problems in plant pathology, so closely linked with progress or failure in intensive agriculture. Have we the scientific staffs properly equipped throughout the Empire for the great tasks that confront us ? In conclusion, Dr. Hill quoted from the Norman Lockyer lecture delivered by Sir Walter Morley Fletcher before the British Science Guild in November last and stated that his remarks on the inadequate remuneration and status of those engaged in medical research are equally true with regard to botany and agriculture.

THE Young Kikuyu movement is again a cause of grave anxiety to the Kenya Government. Further, it is stated, attempts are being made to spread unrest to the peaceful Akamba. The causes of the present disquiet are reviewed in an article which appeared in the *Times* of Feb. 27. In that article the gravity of the situation is by no means exaggerated. The Young Kikuyu movement, which has now taken on the form and title of a 'Kikuyu Central Association', is composed largely of younger members of the people who are impatient of the control of the elders and have thrown off tribal restraints. In the present situation, however, it is probable that to some considerable extent they will have the support of the elders. When it is remembered that the Kikuyu number some 800,000, it is clear that the situation requires statesmanlike handling. The chief point now at issue is not one on which conflict is directly with the Government; but the danger is that the Government may be implicated. The question is one of missionary control and the conditions on which converts will be admitted to, or allowed to remain in, the Christian churches. For some time past, attempts have been made to abolish the practice of clitoridectomy on young girls on the ground that it is a cause of disease and of infant mortality. This operation is an essential part of the female initiation ceremonies. The missions have made it a rule that no convert or candidate for admission to their churches shall take part in or be a party to female initiation.

The real bearing of this regulation on the situation in Kenya only becomes apparent when it is realised that without undergoing the operation as a part of the initiatory rite no girl can take her place among the marriageable women of the tribe. She ceases to be a valuable asset; no man will seek her in marriage, and the bride-price she would have earned is lost to her family group. Hence the missionary prohibition strikes at the roots of tribal organisation and the rights of property and the family. The question of the so-called 'obscene' dances and scurrilous songs about persons in authority which the chiefs are trying to suppress on behalf of the Government stand on a different footing. The missions are under a serious responsibility in having brought into the political field an issue of such gravity to the whole Kikuyu people. However desirable the elimination of the initiatory operation may be, it is not one with which the Government should interfere, at any rate at the present stage of Kikuyu development. Would it ever be considered tolerable that any civilised government should interfere with, or place a ban upon, any one participating in the Jewish rite of circumcision?

The Archbishop of York scarcely showed Christian spirit in his reference to science students in the newer universities, when speaking on behalf of the Student Christian Movement at York on Feb. 27. On account of the large number of students taking science subjects in these universities, the Archbishop is reported in the *Yorkshire Post* to have said, "We are shortly going to be confronted with the peril of a purely scientific education", and he regarded the Student Christian Movement as "the main corrective we have at present to cope with the worst tendency of our contemporary education". He also suggested that students of science as a body are irreligious and without any knowledge of social values, so that "when they come to talk about anything that cannot be measured, anything of civic interest, they talk like children in the nursery". It would be interesting to know the evidence upon which Dr. Temple bases his perverted conceptions of science students and of the influence of scientific teaching. We have no hesitation in saying that a truly spiritual frame of mind is just as often found among students of science in our universities as it is among arts students; and we can assert with the same confidence that nothing in the teaching of science subverts the highest religious thought or noblest social endeavour. The attitude of a student towards these things is largely determined by the influences of his home and school before he proceeds to a university; and the main subjects taken up by him have little to do with it. We suggest indeed that, in these days, a purely literary education is a greater peril to progressive life than is the "purely scientific education" which the Archbishop of York regards so fearfully. After all, a student of science is not necessarily limited in his reading to technical treatises or in his interests to the laboratory. He often takes an active part in spiritual and social movements in spite of what Dr. Temple says; and he might reasonably ask for just regard to be shown towards his scientific studies as factors even in a religious life.

At the annual general meeting of the Institution of Mechanical Engineers on Feb. 21, the report for 1929 was presented. From this it appears that there has been an increase of 279 in the total number of members, which now is 10,745, this being inclusive of 1401 students and 1238 graduates. Eighteen papers were presented during the year, and reference is made in the report to the work done by the provincial branches. The value of the national certificates granted on the examinations held throughout Great Britain was shown by the increased appreciation of them both by their holders and by employers. During the year more than 1200 certificates were issued. The council has conferred honorary life memberships upon Dr. H. S. Hele-Shaw, who has been a member of the Institution since 1879, and served as president in 1922, and upon Baron Shiba of Tokyo, who has long been associated with the mechanical engineering industry in Japan and took a leading part in the recent World Engineering Congress at Tokyo. Mr. Loughnan St. L. Pendred was installed as president of the Institution in succession to Dr. D. Adamson. Born in 1870, Mr. Pendred was educated at Finsbury Technical College, and gained practical engineering experience not only in important British works, but also in others in Belgium and France, and in 1896 joined the staff of *The Engineer*, of which his father, Vaughan Pendred (1836–1912), had been editor since 1865. On his father's retirement, in 1905, Mr. Pendred succeeded to the editorship, which has thus been held in the same family for no less than sixty-five years.

At the same meeting of the Institution of Mechanical Engineers, the sixth report of the Steam-nozzles Research Committee was read and discussed. The Committee, which was formed in 1914, has for its objects the measurement of the efficiency of nozzles of practical form, and the investigation of the manner in which the efficiency is affected by changes in the shape of the nozzle and by the pressure, velocity, and temperature of the steam passing through it. Though delay was occasioned by the War, the work has been carried on continuously since 1921, and the results have been applied with good effect to the design of turbines. The sixth report is the final one and is virtually a clearing up of all that has been done, which includes the construction of a testing apparatus for any usual form of steam-nozzle with steam flowing at speeds from 300 ft. to 2000 ft. per second, the measurement of efflux angles, tests of built-up impulse nozzles, tests of reaction nozzles, and determinations of the effects of roughness and other points connected with nozzle design. The investigations have been carried out in conjunction with the British Electrical and Allied Industries Research Association. The results which have been obtained should be of great value to turbine builders.

In a paper on "Pioneer Ships of the Atlantic Ferry", read on Feb. 19 to the Newcomen Society by Engr. Capt. E. C. Smith, many hitherto unpublished particulars were given of the vessels by which trans-Atlantic steam navigation was inaugurated. By 1838,

three companies had been formed for the purpose of establishing regular communication between England and America by steam, and in that year the *Sirius*, *Great Western*, *Royal William*, and the *Liverpool* were placed on the route. To these vessels were added in 1839 and 1840 the *British Queen* and the *President*, which, like the others, ran to New York, and then came the formation of the Cunard Company and the dispatch of the *Britannia* and her sister ships to Halifax and Boston. Of all these vessels, the *Great Western* was the most remarkable, and she continued to run until 1846, making 74 passages in all. Tables were given of the voyages of each ship, with particulars of the ships and their machinery and of the relative times taken by the sailing liners and the steamships. The *Sirius* and *Royal William* were not built for work in the Atlantic and were soon withdrawn. During 1839, however, the *Great Western*, *Liverpool*, and *British Queen* made regular passages and, whereas the outward voyages by sail averaged 33 days, the average time taken by the three steam vessels was only 17 days. Of the four pioneer ships built for trans-Atlantic work, the *Liverpool* was sold to the P. and O. Co., the *British Queen* to Belgian owners, the *Great Western* to the West Indian Royal Mail Co., and the *President* in 1841 foundered at sea without anything being heard of her.

THE February issue of *Scribner's Magazine* contains the address entitled "Alleged Sins of Science", delivered by Dr. Robert A. Millikan at the recent meeting at Des Moines of the American Association for the Advancement of Science. The address rebuts the charges brought against science by Mr. Raymond Fosdick in a recent volume, "The Old Savage in the New Civilisation". "Have we spiritual assets enough to counterbalance the new forces?" and "Can the old savage be trusted with the new civilisation which he has created?" are the challenging questions to which Dr. Millikan replies. Speaking of the sinister possibilities latent in molecular physics envisaged by Prof. F. Soddy, whereby the equivalent of 150 tons of dynamite could be carried, like a flask of contraband whisky, in the hip pocket of every American citizen, Dr. Millikan is able to reassure us that subatomic energy is not likely to be available in dangerous quantities. Science, he points out, concerns itself with fertilisers quite as much as with explosives, though as "a horror makes better news than a wheat crop", we hear more about the latter than the former. Indeed, science is likely to be effective in abolishing war by doing away with its primary cause, which is a lack of balance between population and food supply. "That, in the last analysis, is mankind's greatest problem." Dr. Millikan is prepared to admit that in some respects the rapid process of scientific knowledge has created an undesirable mentality in the public. Novelties have fostered an omnivorous and quite undiscriminating appetite for what is new, which displays itself in literature in the works of what Mr. Stuart Sherman has aptly called the emetic school, and in the experimentalist school in ethics. But Dr. Millikan has made out a good case for the comparative beneficence of science.

THE Imperial Geophysical Experimental Survey, which has been operating in Australia for nearly two years, under an arrangement between the Empire Marketing Board and the Commonwealth Government, is now finishing its work. The leaders of the various sections are at present engaged in Melbourne upon the drafting of their reports, under the direction of Mr. A. Broughton Edge, leader of the Survey, and Prof. T. H. Laby. Electric, gravimetric, seismic, and magnetic methods have been adopted, the object being to test their applicability under Australian field conditions. For the most part British instruments have been used. The areas examined include Anembo, Captain's Flat, Leadville, and Gulgong in New South Wales; Cooper's Creek, the Mallee, Laverton, Gelliondale and Lakes Entrance in Victoria; Chillagoe in Queensland; Zeehan and Renison Bell in Tasmania; Moonta-Wallaroo and Port Lincoln in South Australia; and Northampton in Western Australia. The governments in all the States have undertaken to test promising indications by drilling and, though there have been delays in certain areas, it is hoped that the results will be available in time for inclusion in the final report.

THE areas in Australia selected for the geophysical survey provided opportunity for testing geophysical methods for the location of sulphide ores (lead, copper, and iron), gold deep-leads, brown coal, stanniferous pyrrhotites, graphite, and also water horizons (in the Mallee). The results on the whole are decidedly interesting, and are regarded in Australia as thoroughly justifying the survey. One outstanding point of interest is the complication introduced by the saline waters which are present at comparatively shallow depths over large portions of the continent. In places, electrical methods are of very little value for this reason: but the members of the survey have been successful in effecting useful modifications of apparatus by means of which it has been possible to gain results over areas where at first there seemed little chance of success. The report will be in two portions, one dealing with the objectives and field results and the other giving much more detailed accounts of theory, apparatus, and field procedure. A draft will be submitted to the British Geophysical Committee and the final report will probably be printed and published in England.

SIR HUBERT WILKINS, on his return to Montevideo from Deception Island, sent an account to the *Times* of his flight to the south early in February, when he searched in vain for a suitable starting-point for a flight to the Ross Sea. Travelling south-west in the *William Scoresby*, lent by the Falkland Islands government, he met the pack ice about thirty miles south of Peter Island. Weather conditions were bad, but the seaplane was launched on Feb. 1 in about lat. 70° S., long. 100° W. (the figure of long. 145° given in the report is clearly a mistake). The weather became worse; visibility was very bad. In lat. 71° S. it was noted that the edge of the pack spread westward. In a position which Sir Hubert believes was about lat. 73° S., long. 101° W., he saw no indication of land or

barrier ice, but a number of large bergs, and much pack ice. From there the flight was directed back to the ship, which then set a course for Deception Island, sounding and trawling on the way. These observations will amplify the work done by the *Belgica* in those seas in 1898–99 on a course slightly farther in the north. Sir Hubert Wilkins believes that a meteorological station might be established in about long. 100° W. by seaplane, but it would be difficult. He does not think a sea-going ship could hope to reach land and land-ice in that area, but suggests that a submarine might well be utilised.

THE occurrence of a spell of summer-like warmth over the eastern parts of the United States was reported on Feb. 25 last in the daily Press. Among the more notable maximum temperatures quoted were one of nearly 84° on Feb. 24 at Washington, and of 75° at New York on the same day. The weather charts for the northern hemisphere published daily by the Meteorological Office, based on observations made at 8 P.M. (American time) at the official stations of the U.S. Weather Bureau, confirmed the occurrence of very exceptional conditions, and an examination of successive charts give some idea as to their immediate cause. Over the temperate latitudes generally, the slope of temperature from south to north is sufficiently steep to make the occurrence of unseasonable warmth at a time of the year when the direct heating by the sun is small merely a matter of transport of air from low to relatively high latitudes. This must happen when the run of the isobars is from south to north over a wide area for several days in succession, as was the case over the eastern part of the United States for several days before Feb. 25, for the general drift of the wind in the lower layers of the atmosphere is in accordance with the direction of the isobars.

A MAXIMUM of 75° has not occurred at New York in February during at least forty-eight years, the previous highest having been 69°. The exceptional feature on the weather charts during this 'heat-wave' in the United States was the length of the trough of low pressure that provided the southerly winds; there are not sufficient observations to show whether it extended as far as the equator, but the northern shores of the Gulf of Mexico experienced such winds for several days, with a rising temperature that yielded at least one 8 P.M. reading so high as 80°, and this is scarcely likely to have happened unless the winds extended a long way farther south. In the opposite direction, the same air stream appears to have continued without a break to the neighbourhood of southern Greenland and Iceland, where it was deflected into the south-westerly wind characteristic of those regions.

THE Air Ministry announces that in consequence of the rapid development of the international organisation for the collection of weather reports, it has been possible for some months past to prepare each day in the Meteorological Office, London, a chart showing the weather for the greater part of the earth's surface north of latitude 40° N. At first, copies of this chart were prepared by a cyclostyle process for use in the Meteorological Office, but demands for copies became so large that it was necessary to arrange for them to be lithographed; this chart has, however, never been made generally available to the public. The importance of this chart to everyone interested in the weather is so great that it has been decided to issue it daily as part of the *Daily Weather Report*. This has necessitated a rearrangement of the matter printed in the *Report* and an increase in the size of the sheet, which now becomes 13 in. × 12½ in. When the new *Report* is opened out, the left-hand half shows a weather chart of the British Isles with forecasts, general inference and further outlook. This page also contains the data from health resort stations. The right-hand half shows the new chart of the northern hemisphere with the north pole slightly displaced from the centre of the sheet, thus allowing North America, Europe, North Africa, and northern Asia to be included. The two back pages contain the complete set of observations made at the telegraphic reporting stations in the British Isles four times each day, namely, 1 A.M., 7 A.M., 1 P.M., and 6 P.M., with a large amount of miscellaneous information and full explanation of the symbols used. The opportunity has been taken of improving the general appearance of the *Report*, the land areas now being printed in buff colour, and the weather information overprinted in black. The new *Daily Weather Report* came into use on Mar. 1, and may be obtained from the Meteorological Office, Air Ministry, Kingsway, London, the price being 1½*d.* for single copies, or 6*s.* 6*d.* a quarter, or 25*s.* a year, post free.

PROF. G. I. TAYLOR'S Friday evening discourse at the Royal Institution on Feb. 28 took the form of an account of his tour in the East Indies after attending, as a British delegate, the Pacific Science Congress held in Java last year. During and after the Congress the Government of the Netherlands Indies provided every possible kind of hospitality and opportunity for seeing their countries. The journeys described were illustrated by means of films taken by a small cinema camera. The first film showed a visit which some members of the congress paid to Krakatau. In 1883 this island was the scene of the greatest volcanic disturbance ever recorded. Extensive researches have shown that all animal and vegetable life was then completely destroyed, and the successive stages of their gradual reappearance have been of great interest to botanists and zoologists. At the present time, quite large trees have established themselves and the film showed a stage in which the *Casuarina* trees are already being suffocated by huge creepers. A visit to a small island called Suak Krakatau which appeared mostly in 1928 was of interest, because a few weeks after the film was taken the island disappeared. Two further films illustrated a journey in Borneo by river and jungle from Dutch territory to Sarawak. This journey was undertaken by Prof. Taylor and his wife, by the kind and efficient help of H.H. the Rajah of Sarawak and of Dutch officials. The film showed the journey up the Kapoewas River, the trek through the jungle with a party of Dyaks, and an

impromptu dance by one of them at a resting-place in the jungle. The end of the film showed the descent down the Lupar River in a long dug-out canoe paddled by Dyak boatmen and a visit to a Dyak kampong.

MEMBERS and friends of the Manchester Microscopical Society, which was founded in 1880, met for a jubilee reunion on Feb. 20 at the rooms of the Literary and Philosophical Society. An address by Prof. S. J. Hickson, who was unavoidably prevented through illness from attending, was read by the president, Dr. John Walton, lecturer in botany at the University of Manchester. Prof. Hickson chose for his subject "Biology and Beauty", and developed the idea that, in opposition to the older classical view of education, there is in the study of biology, and especially in the intricacies of the technique required, a distinct cultural and æsthetic value which has a refining influence and is a strong incentive to further work and research; while the utility of biology is every day becoming more apparent. Of four living past-presidents only one, Prof. Weiss, was able to be present. The Society, the largest of its kind outside London, can look back with satisfaction on its unbroken half-century's work; from its beginning it has counted in its ranks those who might find themselves in everyday life classified as employers and employed, but who meet on terms of equality united by a common interest in biology and microscopical science. The Society includes among its members professional scientific workers as well as those to whom science affords a recreation after their usual daily occupations. It has also had strong support from members of the University, in the laboratories of which many of its exhibitions have been held. In these days, with so many applications of the microscope in industry, the Manchester Society can look forward with confidence to a new era of usefulness.

THE Kampala correspondent of the *Times* announced recently (Feb. 20) that a gorilla sanctuary has been proclaimed in the south-west corner of Uganda in the neighbourhood of the Sabinio mountain and the Belgian Congo border. This rounds off the gorilla territory, of which a portion had already been proclaimed a sanctuary by the Belgian Government, and, if adequately watched, should afford a safe retreat for many generations to come for one of the closest of man's surviving relatives.

SIR THOMAS H. HOLLAND, Vice-Chancellor of the University of Edinburgh, has been awarded the Gold Medal of the Institution of Mining and Metallurgy "in recognition of his eminent services to Geological Science and to the mineral industries during his tenure of high public appointments—notably those of Director of the Geological Survey of India and of Rector of the Imperial College of Science and Technology—and of his researches and publications upon the mineral resources of the British Empire and their relationship to national and international problems".

AT a general meeting of the members of the Royal Institution, held on Mar. 3, it was announced that the managers have elected Mr. J. B. S. Haldane Fullerian Professor of Physiology in succession to Prof. J. S. Huxley. The Friday evening discourses after Easter will commence on May 2, when Mr. H. E. Wimperis will give a discourse on "A Study of the Phenomenon of Spin in Airplanes". Successive discourses will probably be given by Prof. J. Garstang, Dr. C. M. Yonge, Mr. R. S. Whipple, Sir Harold Carpenter, and Prof. H. Clay.

AT the ninth annual dinner of the London section of the British Association of Chemists, held on Mar. 1, Sir Arnold Wilson outlined a scheme which is now under consideration for a building to house the principal societies and institutions in London concerned with chemistry and chemical industry or related to them. The societies interested are the Institution of Mining and Metallurgy, the Institution of Mining Engineers, the Chemical Society, the Society of Chemical Industry, the Institution of Chemical Engineers, the Institution of Rubber Industry, the Institution of Petroleum Technologists, the Institute of Fuel, the Institute of Metals, the Iron and Steel Institute, the Faraday Society, and the Physical Society. It is proposed that all these societies should be housed under one roof and their libraries pooled for the common use of their members. As Sir Arnold pointed out, the scheme has the advantage that each society would retain its own individuality while giving its members facilities for informal meeting with members of related societies. It would thus be an important step towards the co-operation and co-ordination so necessary to-day in allied branches of science and technology. It was stated that £100,000 has already been promised in furtherance of the scheme.

AT a meeting of the Royal Society of Edinburgh, held on Mar. 3, the following were elected fellows of the Society: Prof. William Annan, Edinburgh; Mr. D. R. R. Burt, Colombo; Lieut.-Col. John Cunningham, Edinburgh; Lieut.-Col. L. M. Davies, Edinburgh; Dr. A. E. M. Geddes, Aberdeen; Dr. Douglas Guthrie, Edinburgh; Sir Thomas Holland, Edinburgh; Dr. David Jack, St. Andrews; Dr. S. G. Jones, Glasgow; Prof. P. S. Lelean, Edinburgh; Dr. J. W. Low, Bristol; Dr. A. C. M'Candlish, Sorbie; Mr. W. C. Miller, Edinburgh; Dr. J. M. W. Morison, Edinburgh; Mr. James Morton, Edinburgh; Prof. Wm. Oliver, Edinburgh; Principal G. F. O'Riordan, London; Mr. A. W. Ritchie, Edinburgh; Dr. David Russell, Leven; Dr. F. W. Sansome, London; Mr. E. C. Shankland, London; Dr. R. H. Slater, Edinburgh; Mr. J. W. Struthers, Edinburgh; Prof. C. W. Stump, Sydney; Dr. J. D. Sutherland, Edinburgh; Dr. C. I. B. Voge, Edinburgh; and Dr. A. C. White, Beckenham.

THE Empire Marketing Board has made a grant to the New Zealand Department of Scientific and Industrial Research for research on fruit production and storage to be carried out in New Zealand. Investigations will be pursued into cool storage, transport, disease and insect control, nutrition, physiological disturbances, and rootstock propagation of New Zealand fruit. Valuable results have been obtained in the past, as the quality of fruit imported into Great Britain shows, but the work has suffered from lack

of continuity and field experiments. At a conference held recently at Wellington between representatives of the fruit-growers, the Department of Agriculture, the Department of Scientific and Industrial Research, and the Cawthron Institute, it was decided to form a fruit research organisation for New Zealand. Arrangements have been made to purchase an orchard, a research programme has been planned, and the Cawthron Institute and the Department of Agriculture have agreed to lend the members of their staff who are mainly engaged on fruit research. A horticulturist is to be appointed to work on root-stock improvement and introduction, and it is probable that he may first study methods and results achieved in Great Britain at the East Malling Research Station, where Mr. R. G. Hatton is engaged on root-stock improvement and other activities with Empire Marketing Board funds. New Zealand fruit-growers are contributing substantially to the expenses of the scheme, and the remainder of the cost is being met by the New Zealand Government.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An engineer at the Building Research Station, Garston, near Watford, for work mainly in connexion with research on steel structures—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Mar. 10). A public analyst for the City of London (Food and Drugs (Adulteration) Act, 1928) and agricultural analyst for the City and Port of London (Fertilisers and Feeding Stuffs Act, 1926)—The Town Clerk, Public Health Department, Guildhall, E.C.2 (Mar. 10). A lecturer in chemistry at the Widnes Municipal Technical College—The Clerk to the Governors, Municipal Technical College, Town Hall, Widnes (Mar. 17). A woman sanitary inspector and health visitor for the Royal Borough of Kensington—The Medical Officer of Health, Town Hall, Kensington, W.8 (Mar. 18). A resident lecturer in geography at the Diocesan Training College for Women Teachers, Derby—The Principal, Diocesan Training College for Women Teachers, Derby (Mar. 21). An assistant on the higher technical staff of the Library in the Science Museum, South Kensington—The Director and Secretary, Science Museum, South Kensington, S.W.7 (Mar. 22). An organiser of agricultural education under the Administrative County of Cambridge—The Clerk of the County Council, County Hall, Cambridge (Mar. 22). A lecturer in metallurgy at the University College of Swansea—The Registrar, University College, Singleton Park, Swansea (Mar. 28). An assistant to the Chief Officer of the Imperial Bureau of Fruit Production—The Chief Officer, Imperial Bureau of Fruit Production, East Malling Research Station, East Malling, Kent (Mar. 31). An assistant lecturer in geography in the University of Birmingham—The Secretary, The University, Birmingham (April 26). A professor of zoology in the University College of North Wales—The Registrar, University College of North Wales, Bangor (May 5). A secretary to the Lagos Executive Development Board, Nigeria—The Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1 (quoting M/2029). A sanitary inspector under the Sudan Medical Service—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1.

Our Astronomical Column.

Report of the Paris Observatory for 1928.—This report contains an interesting summary of the recent comparison of longitudes of various observatories by wireless signals, which was organised by M. B. Baillaud and General Ferrié.

The following are three arcs girdling the world :

Algiers to San Diégo .	8^h	0^m	$56{\cdot}900^s \pm 0{\cdot}002^s$
San Diégo to Zi-Ka-Wei	8	5	$28{\cdot}731 \pm 0{\cdot}006$
Zi-ka-Wei to Algiers .	7	54	$34{\cdot}362 \pm 0{\cdot}006$

The sum of the three shows an error of only 0·007 sec.

The difference Paris-Greenwich comes out $9^m\,20{\cdot}914^s$, which is less than the "Nautical Almanac" value by only $0{\cdot}016^s$. There was formerly an appreciable difference between the English and the French determinations of this arc, but they have now been brought into satisfactory accord.

The catalogue of 10656 "étoiles de repère" for the Astrographic Catalogue is on the point of being issued.

Dark Objects in Barnard's Photographic Atlas.—In a fifth note on the dark objects in Barnard's Photographic Atlas, published in the *Atti della Pontificia Accademia della Scienze* (*Nuovi Lincei*) for 1929, Prof. G. Hagen of the Vatican Observatory points out that the last ten plates in Barnard's Atlas confirm the suggestion of the preceding forty plates, that not a single one of the dark objects selected by Barnard for his two lists differs in any way from W. Herschel's fifty-two extensive nebulosities. Moreover, all of those within reach of the Vatican refractor could be estimated in density on the numerical scale with which all Herschel's regions were examined. It may safely be concluded that all the dark markings represented on the fifty plates of the Atlas, whether selected or passed over by Barnard, correspond with the Herschel regions.

Distribution of Stars of Different Spectral Types.—Dr. Otto Seydl of Prague has published a series of maps which give the distribution of stars of the different spectral types referred to galactic co-ordinates. The stars of types *B*0 to *B*5 are confined to a narrow belt along the galaxy. Those of *B*8 to *A*3 are in a wider belt, with a few islands in higher latitudes ; in the next map, *A*5 to *F*2, the galaxy is still discernible as a richer region, but there is a strong minority in higher latitudes ; the same description applies to the next two maps, *F*5 to *G*0 and *G*5 to *K*2. For *K*5 to *M*c, galactic concentration is again strongly in evidence, but less so than in *B*0 to *B*5. There is a final map showing all types combined ; naturally the whole map is fairly full, but the galaxy is by far the richest region. Star density is indicated by depth of shading in the manner adopted to show ocean depths. The Henry Draper Catalogue was used in preparing the maps, which include stars of magnitude 7.0 and brighter. There is a description (in English) of the maps, together with tables ; the whole forms Cis. 6 of the *Publications* of the National Observatory of Prague.

Research Items.

Pictographs on European Prehistoric Pottery.—We have received from Dr. L. A. Waddell a questionary on the Sumerian markings upon prehistoric pottery found in the Danube and associated valleys of Middle Europe. In an explanatory note Dr. Waddell appeals to archæologists and historians in middle and south-eastern and northern Europe, and particularly to prehistorians in the British Isles, to examine all examples of prehistoric pottery from the area mentioned to which they have access for markings, apart from the decorative element, in the nature of owner's or maker's marks. The object of the search, it is explained, is to demonstrate that these markings are analogous to the 'owner's marks' inscribed on the pottery of the Predynastic and First Dynastic periods in ancient Egypt. The latter, Dr. Waddell maintains, can be shown to be Sumerian pictographic writing and presumably bear their phonetic values. By means of a comparative table of marks, Dr. Waddell seeks to demonstrate their identity in Sumerian, Egyptian, and Danubian pottery marks, giving their phonetic equivalent in each case. Dr. Waddell also holds that he has demonstrated that all the ancient civilisations of the world—Mesopotamian and Elamite, Egyptian, Minoan, Hittite, Græco-Roman, Indo-Persian, and presumably also Chinese, were derived from Sumeria. By a synchronism of ancient Egypt and Mesopotamia, Menes is identified as a son of Sargon of Akkad and his date fixed at about 2703 B.C., while for the Danubian pottery from the prehistoric strata at Vinča, a date of about 3300 to 2700 B.C. is suggested on palæographic grounds.

Sacred Trees in Egypt.—In *Man* for January, Mr. G. D. Hornblower describes with photographs a sacred grove at Nezlet Batrân in Egypt, which differs from most sacred groves in that country in that it is not connected with any holy personage. Sacred trees, mostly sycamore, are common in Egypt, normally in association with sheikhs or their tombs. On them rags from the clothing of their devotees are frequently hung. The Virgin's Tree at Matarieh, near Cairo, is a well-known example and has been the object of pious pilgrimage for Christians for centuries. Under it the Virgin is said to have rested with the Holy Babe, and here only was true balm grown, originating in water from the Infant's clothes which the Mother washed out in a neighbouring pool. The grove at Nezlet Batrân is known as *Dahr es-Sunt*, "The Back of the Acacias". The fact that it is not associated with a Moslem or Christian saint suggests that here the belief has survived from very early times in considerable purity. It is sacred to the *Sukkan es-Sunt*, "The Inhabitants of the Acacias"—supernatural beings who live underground. It is visited on Friday mornings, and its leaves dried and powdered are burned as incense for the healing of the sick. No man may use its wood for fuel under penalty that evil, such as fire, will strike his house or he may lose his cattle through sickness. It shares with other sacred trees two features. Lighted lanterns are hung on the branches, and iron nails are driven into the trunk as offerings for sick people. These must be fresh from the forge.

Biological Control of the Gipsy Moth.—In *Technical Bulletin* No. 86 of the United States Department of Agriculture (1929) Messrs. A. F. Burgess and S. S. Crossman discuss the results of twenty-four years of work with reference to this problem. Both the gipsy moth and the brown-tail moth are well known introduced pests of the United States and the present report reviews the work done in controlling these insects by the introduction of their natural enemies from Europe. It is claimed that by introducing insect parasites against the gipsy moth, the forests of New England have been saved from destruction. From 1905 to 1916 defoliation showed no reduction in intensity, but, from 1920 to 1924, the acreage defoliated gradually decreased, until in the latter year few completely defoliated areas remained. The total percentage parasitism resulting from the activities of beneficial insects gradually increased until the maximum was attained in 1923. Since then, the parasitism has steadily declined until 1927, when some revival was noticed. The authors state that unless the parasites increase again more rapidly, the westward spread of the gipsy moth will have greatly reduced chances of being checked. During the decline of the parasitism the gipsy moth has greatly increased again and, in eastern Massachusetts, it regained its former severity. In forest areas, where artificial control methods, other than the elimination of favoured food plants, are not applicable, the sole chance of repression, without undue expense, lies in biological means. Much work still remains to be done on the latter procedure, and investigations being made in the native countries of the gipsy moth lend support to the possibility that improved methods and results will follow. In towns and cities, on the other hand, artificial control, although expensive, can be employed and yields good results. A combination of both methods of campaign, according to the type of country in question, requires continued rigorous prosecution.

Pliocene and Pleistocene Fossils from Sakhalin.—The northern half of the island of Karafto, or Sakhalin, has long been known to yield rock-oil in the regions bordering on its eastern coast. During the occupation of the island by the Japanese, regular surveys of these districts were made and fossils collected, many of which, however, were destroyed in the fire following the great Tokyo earthquake of 1923. The remainder, with some additional material and specimens collected farther south, where oil does not occur, have now been described by Prof. Matajiro Yokoyama (*Jour. Fac. Sci., Imp. Univ. Tokyo*, sect. 2, vol. 2). Forty-two species of marine mollusca are described and referred to the Pliocene, while a few from the southern locality are ascribed to the Pleistocene. From a study of these the author is led to infer that whereas in similar deposits in Japan proper and in Formosa the evidence, as pointed out in previous papers, indicates a colder climate then existed than at the present day, no such difference seems to have occurred in Sakhalin. Further studies on this point are nevertheless necessary.

After-Shocks of the Tango (Japan) Earthquake of Mar. 7, 1927.—Mr. N. Nasu, of the Tokyo Seismological Institute, has recently made an exhaustive study of the after-shocks of the Tango earthquake *Jour. Fac. Sci., Tokyo Imp. Univ.*, vol. 3, pp. 29-129; 1929). These shocks were so numerous that at one station 1307 shocks were recorded up to the end of June 1928. Of these it was found possible to determine the surface-position and depth of focus of 482 shocks. The sites of the shocks changed from time to time within a limited area near the two new faults, the most active zones lying to the west of the Gomura fault, and to the south of the Yamada fault. From the distribution of the epicentres, it is inferred that the Gomura fault may extend under the Japan

Sea to a distance of 18 miles from the coast, so that its total length may be more than 30 miles, while that of the Yamada fault may be 18 miles. Plotting the positions of the foci on horizontal and vertical planes, Mr. Nasu shows that they lie on series of parallel planes from one to three miles apart, the sensible shocks being caused by the formation of large cracks, and the insensible shocks as a rule by the growth of small secondary cracks that were very numerous near the principal faults. A clinograph, erected near the central region of the earthquake, showed that the ground tilted for a few days before each after-shock of moderate strength, the tilting being towards or from the epicentre according as it lay in a region of subsidence or elevation during the principal earthquake.

Samarskite from New Mexico.—A detailed study of the samarskite from a mica-pegmatite near Petaca in the north-central part of New Mexico has been made by F. L. Hess and R. C. Wells, and their results are published in the January number of the *Amer. Jour. Sci.*, 1930. The mineral is shown to be composed of two parts: one approximating to $2Y_2O_3 . 3Cb_2O_5$ and the other to $Y_2O_3 . Cb_2O_3$. Detailed analyses are given from which the following data are quoted:

	I.	II.
U	10·66	4·85 per cent
Th	1·39	0·97 ,,
Pb	0·40	0·10 ,,
$\frac{\text{Pb}}{\text{U} + 0{\cdot}38\ \text{Th}}$	0·038	0·019
Age	280	140 millions of years.

Radiographs show that I is an older mineral which was partly replaced by II by later solutions flowing along cracks. The results indicate that the variable results in age calculations on minerals from the same pegmatite are due to successive periods of mineralisation. The evidence supports the thesis of Hess that many pegmatites are the product of successive replacements, and it further explains satisfactorily the puzzling fact already recognised by Holmes, Ellsworth, and Kirsch, that minerals from the same petrographic province may show very different ages as tested by their lead-ratios. It is suggested that the radial cracking of pegmatite around minerals may be due to the growth of new minerals being faster than the replacement of the older material.

The Behm Limno-Sounder.—A useful echo-sounding machine for use in shallow water from small craft, such as motor-boats and rowing-boats, is described in the *Hydrographic Review*, vol. 6, No. 2. The Behm Limno-Sounder is operated with 12 volts, and power is supplied from dry cells or a storage battery. It is made of light metal, and has a range up to 200 metres, and shows the depths in metres. When the vessel is stopped, the range is greater than when the vessel is under way. Soundings may be repeated at intervals of a little less than one second. The transmitter and receiver may be permanently fixed to the vessel's side or bottom, or, if more convenient, may be slung over the side by a rope when required. The depth is shown by the reflection of light. A point of light moves along the scale, and the length of the line of light is the measure of depth. The same apparatus mounted on a tripod is adaptable to soundings from an ice-covered sea or lake. Its operation is uninfluenced by low temperatures. A special form of this sounder lowered by a cable and provided with floats could, it is claimed, be used from an airship.

Surface Tension and Temperature.—In the issue of the *Physikalische Zeitschrift* for Jan. 1, Dr. N. Barbulescu, of the Physical Chemistry Laboratory of the University of Klausenburg, Rumania, sums up and extends his endeavours to express by a satisfactory formula the variation of the surface tension α of a liquid with temperature. He introduces the idea of a surface tension of the gas or vapour above the liquid and makes the observed surface tension the difference between the true surface tensions of liquid and gas or vapour. It is also assumed that it varies as exp. $- a/(T_c - T)$ where a is a constant and T_c the critical temperature of the liquid. On these assumptions, he arrives at the relation $\alpha\ V^{2/3}$ proportional to $(T_c - T)$ exp. $- a/(T_c - T)$, which he shows fits the observed values very well for a number of normal liquids, except close to their critical points. For abnormal liquids he makes a a linear function of $T_c - T$ and states that a still more accurate expression $\alpha\ V^{2/3} = (A + BT + CT^2)(1 - p/P)$ where A, B, and C are constants, p the saturation vapour pressure at T and P at T_c, may be used up to the critical point.

Range of Electromagnetic Waves.—Mr. V. T. Saunders has prepared a chart, based upon one exhibited by the Royal Society at the British Empire Exhibition at Wembley, showing the range of electromagnetic waves (size 6 ft. × 1 ft. 10 in. (London: John Murray, 1930.) Unmounted, 4*s.* 6*d.* net; mounted on linen, 8*s.* 6*d.* net; mounted on linen, folded, 10*s.* 6*d.* net; mounted on linen, varnished, on rollers, 12*s.* 6*d.* net). The chart covers the whole range of the electromagnetic spectrum between the cosmic rays and the waves produced by mechanical movement of a coil in a magnetic field. Wavelengths are shown both in centimetres and in Ångström units, together with the corresponding frequencies, and summaries are given of how the waves in each range are generated and detected. There are two errors under the head of the detection of X-rays. It is not necessary for a body to be heated for it to emit electrons under their action (*e*), and it is at least misleading to state without further detail that X-rays show no ordinary reflection or refraction (*f*). Apart from these two points, the chart is accurate, and is likely to find a home on the walls of most elementary laboratories.

Rapid Chemical Changes.—The February number of the *Proceedings of the Royal Society* contains two papers by Dr. F. J. W. Roughton on heat effects in rapid chemical changes. The time required for completion of a reaction is often a very small fraction of a second, if the reacting materials are in good contact, and the measurement of this time, or the setting of an upper limit to it, especially if coupled with a determination of the thermal effect, calls for a special technique. Dr. Roughton has applied for this purpose a modification of the method used by him and Dr. H. Hartridge for studying the velocity of rapid reactions; the reagents are mixed whilst travelling at high speed through an observation tube, and the temperature of the mixture read at various points by delicate thermocouples, time intervals being deduced from the speed of flow of the fluid. After an exhaustive inquiry into the possible sources of error, Dr. Roughton concludes that it is possible to measure absolute temperatures in the mixture to an accuracy of 10^{-3} deg. C., and temperature differences to somewhat less. The order of magnitude of the time intervals involved is indicated by his result that the total heat of neutralisation of most acids and bases is liberated within a period of less than one hundredth of a second. Attempts are now being made to extend the accuracy of the temperature measurements to 10^{-4} deg. C., which will permit of the study of some reactions of considerable physiological importance.

Gramophone Records of Acoustic Analyses.

AT a meeting of the Physical Society of Sheffield held at the University of Sheffield on Feb. 11, a number of special gramophone records prepared in the Bell Telephone Laboratories, New York, to illustrate certain phenomena of hearing, were demonstrated by Dr. W. H. George. In the preparation of the original records the usual electrical process was used to convert the sound-waves by means of a microphone and amplifier into fluctuating electrical currents which, in passing through an electromagnetic recorder, operate the stylus cutting the 'wax'. In addition, electric filters could be switched into the circuit so as to eliminate effectively known frequency ranges.

Three of the records demonstrate the striking discovery of Fletcher (*Phys. Rev.*, **23**, p. 427; 1924) that, contrary to the usual conception, the pitch of a musical sound is *not* necessarily that of the lowest component vibration. A single note (C = 256 vib. per sec.) is played successively upon a piano, a 'cello, and a French horn, and then the notes are repeated with the filters adjusted to eliminate the fundamental tone, then the fundamental and the first two overtones, and later all below the sixth or eleventh overtones. Although great differences in quality and intensity are apparent, the pitch of the notes heard remains the same. Quality differences sometimes make it difficult to decide if the pitch is middle C or one of its octaves. The experiments and results are repeated with the sung vowel Ah, with an organ pipe and with a clarinet, in which latter instrument the lower even overtones are very weak.

Low pass filters are used in another record to illustrate the effect on tone quality of removing the upper partials from the tones of a single note played upon a piano, 'cello, or French horn. The filters are adjusted to give successively the fundamental, and then no overtones above the first, fourth, ninth, and seventeenth. Notable changes of quality and loudness are observed depending upon the relative intensity of the various overtones for each instrument. When the fundamental only is recorded the instruments are almost indistinguishable, but the slight difference which remains when allowance has been made for the intensity differences and for a certain difficulty of the horn player getting the correct note, suggests that the quality of a musical note depends also upon the rate of growth and decay, and it would be interesting to hear the effect of various amplitude changes imposed upon a tone which when sustained was pure and of single frequency.

The remaining records deal with the quality changes produced in much more complex sounds consisting of a short musical passage played by a number of instruments and with a passage spoken by the normal voice. The original sounds cover a normal range of frequencies, and the filters introduced pass only the frequency ranges 375-2500 or 750-1250, below 1250 or 2500 or above 375 or 1250 vibrations per second. The effects of an overloaded amplifier with and without a middle pass filter are illustrated and the characteristic high hissing sound appears well in the spoken passage. Filters are not used in two of the records which demonstrate the effects of reductions in the general intensity of the same complex sounds. The intensity level is lower by steps of 1, 3, 5, 10, 20, and 30 transmission units (or decibels). Incidentally, these two records enable the hearer to obtain an idea of the scale of this unit which is being generally adopted.

Apart from the general interest of the records, it would appear that, provided we regard a good gramophone as fairly common, then the three records illustrating Fletcher's work on perception of pitch form the first example of a research worker in acoustics presenting results originally obtained with complex and expensive apparatus in such a form that the actual phenomena involved can be experienced by others not so equipped. The records may then be regarded as the analogues of the spectrum or X-ray photographs presented in papers dealing with other branches of physics.

Common Commercial Timbers of India and their Uses.

THE technical publications of research institutes have rarely much attraction for the layman, nor are they commonly read by members of trades to whom they would prove useful. With this truism in mind, Mr. H. Trotter, forest economist at the Forest Research Institute at Dehra Dun, has recently prepared a brochure entitled "The Common Commercial Timbers of India and their Uses" (Calcutta: Government of India Central Publication Branch, 1929), designed for the use of timber merchants and other users of Indian timbers.

This booklet is based, as the author admits, on one drawn up in 1912 by his predecessor, Mr. R. S. Pearson, entitled "A Commercial Guide to the Forest Products of India". Mr. Trotter's work shows the great advance in knowledge in these matters which has been made since 1912. In the preface the author states: "A great deal has been written of late years concerning the 'vast forest wealth' of India. The fact remains, however, that except for teak and a few parcels of other timbers from Burma, Madras, and the Andamans, there is practically no export of timber from the country. In the same way, the Indian markets concentrate on teak, sal, deodar and a few other well-known woods, while local craftsmen content themselves with the cheapest timber available, whether suitable for the purpose for which it is intended or not."

Two factors are bringing about a change in the conservative ideas which have so long persisted throughout India. The first is the prohibitive prices to which the more commonly used valuable timbers have risen; the second, the valuable work carried out at the Research Institute during the past eighteen years. As is obvious from his work, Mr. Trotter regards the forest wealth of India from the purely timber point of view. Writers with perhaps a wider experience when alluding to the "vast forest wealth" of the country have not been so limited. If some of the most valuable timbers of the country were eliminated from the account, the value of India's forest wealth, regarded from the point of view of the requirements of the greater bulk of its population, would still be enormous; and to this may be added an increasing number of minor products of the forest the potential value of which is at present not computable.

The author divides his work into several chapters, dealing with the storage of logs in log ponds (the method being described and illustrated); air-seasoning—a section which will well repay careful study—kiln-seasoning; preservation of timber by impregnation, and a chapter describing various common Indian woods. This latter chapter is of importance, since, from the experience gained at Dehra Dun, it has proved possible to modify some of the descriptions

in old text-books of Indian timbers, for example, Gamble's "Manual of Indian Timbers".

The practical user of timber, as also the forest officer, will probably find Chap. vi., "Woods recommended for Special Uses", of the highest interest. It is certain that this chapter best illustrates the remarkable progress in our knowledge in these respects which has resulted from the work of the research institute at Dehra Dun. The author points out that there is a wide range between the cork-like wood of *Erythrina* and the iron-like hardness of 'pyinkado', and that only research and trial will enable each timber to be allotted to its best purpose; this is the work the economic side of the Institute has been engaged upon. "As the work of research proceeds, it becomes more and more evident that India possesses timbers which are unsurpassed by any other country, but the practical utilisation of the lesser known timbers has been hindered by a curious circumstance. This circumstance can be summed up in the one word 'teak'. For years past, teak has been the watchword in India. It is what one might call a fool-proof wood, and its durability and adaptability soon made it famous throughout the world. With such a timber available in good quantities, Indian users looked no further for possible substitutes, until the inevitable began to happen, and supplies became more restricted, resulting in a very rapid rise of price. Then, at last, India began to look to the rest of her timbers, and although considerable progress has been made to date, it will be some years yet before she knows exactly what her resources in this direction are, and still more time will be required before the industrial world is satisfied that these other timbers will answer the purpose for which they are required. In addition to teak, such timbers as sal (*Shorea robusta*), deodar, chir (*Pinus longifolia*), sissoo (*Dalbergia sissoo*), and a few others, were used fairly extensively in those parts where they occurred, but beyond these, the commercial exploitation of the many hundreds of other so-called Indian 'junglewoods' was a thing unknown."

The author divides this section into constructional woods, woods used in contact with the ground, woods used in contact with water, in boat- and ship-building (the best Burma teak known as 'Admiralty Teak' still reigns supreme), joinery and cabinet-making (a number of species are enumerated); cart- and carriage-making; cooperage, packing cases, and various miscellaneous articles. A perusal of this chapter renders it evident that India could, and probably will, become entirely self-supporting in articles the raw material of which is timber, and that in the future the people will be weaned from the old ideas which confined utilisation to teak, sal, deodar, and one or two others; for this chapter shows that already a variety of other Indian timbers are being brought into use.

Mr. Trotter is to be congratulated on a very valuable and useful piece of practical work which, *du reste*, is suitably illustrated.

Larval Crabs.

AN important addition to our knowledge of development in the Brachyura is contained in Hiroaki Aikawa's recent work "On Larval Forms of some Brachyura" (*Records of Oceanographical Works in Japan*, vol. 2, No. 1; 1929). The author has hatched out the young of twenty-four species of Japanese crabs, and from these first zoeas each genus can be quite easily recognised.

Previous writers have used mainly the form of telson, presence or absence of spines on carapace, and the antennæ, as diagnostic characters of crab zoeæ, and those hitherto known can be classified by such characters, together with a knowledge of the number of zoeal stages. The present author gives prominence also to the chromatophores, giving them a foremost place. There is no doubt that these chromatophores are of importance; the disadvantage in using them is their comparatively fleeting nature. Although Mr. Aikawa states that the primary chromatophores (which alone are used) remain for a long time in preserved material, they undoubtedly do disappear eventually. Taken together with the other characters, however, they are of considerable value.

The system of classification given, based on the first zoeas only, is good, and shows that the Japanese crabs studied fit well into the usual scheme of classification. It is to be hoped that further study will be made of the later stages and megalopæ. A knowledge of these, together with number of zoeal stages, is much wanted. The Oxyrhyncha having been shown in all known forms (with a few doubtful exceptions) to have only two zoeal stages, necessarily develop much more quickly than the Brachyrhyncha, and even in the first zoea this difference can be seen.

The crabs described belong to various groups and families, most of the larvæ being described for the first time, and the first zoea is in many cases compared with those from other countries, fitting in well with previous observations. If such a study were to be made in all parts of the world, we should have a real foundation on which to work in order to form a scheme of classification which would undoubtedly help the systematist, for no systematic work can be complete without the thorough knowledge of all larval stages. The paper is very well illustrated and is a welcome contribution to the literature on crustacean larvæ.

University and Educational Intelligence.

BIRMINGHAM.—Dr. J. G. Emanuel is to be invited to fill the vacancy in the joint professorship of medicine from the beginning of the summer term 1930.

The following gifts have been received: £350 from the Distillers Company, Ltd., for a post-graduate research investigation in oil engineering; £100 from the Anglo-Persian Oil Company and £100 from the Institute of Automobile Engineers, for research in oil engineering; mine rescue apparatus to the value of £210, from Messrs. Siebe, Gorman and Co.; and a collection of modern safety lamps, to the approximate value of £77, from several firms, for the Mining Department. Mrs. Frankland has presented to the Chemistry Department a bronze relief portrait of Prof. P. F. Frankland, first professor of chemistry in the University.

The following resignations have been received: Mr. T. H. Turner (lecturer in metallurgy), Mr. L. P. Timmins (oil engineering), and Dr. W. C. O. Hill (anatomy). An additional assistant lecturer (Grade III.) is to be appointed in the Department of Geography.

EDINBURGH.—The Court has agreed to subscribe to the Students' Hostel at Benmore, Argyllshire. This Hostel, which was formerly the Mansion House of Benmore, has been presented to the Forestry Commission (Scotland) by Mr. Harry Younger, who had previously given the whole estate to the Commission. The house will be open to visiting students and members of scientific societies interested in sylviculture and botany from April 1 to Sept. 30 in each year. The policies, extending to 115 acres, including the gardens and arboretum, will be open to authorised visitors. In addition, the adjoining and neighbouring estates

of the Forestry Commission, extending to 36,000 acres, will be available of access for educational purposes.

LEEDS.—The University Council has recorded "its profound regret in the loss sustained by the death of Arthur Greenhow Lupton, the first Pro-Chancellor of the University. His long and continuous association with the Yorkshire College and University—a connexion unbroken for 55 years—lent to his counsel a supreme value, and to his advice the wisdom born of experience. He had followed and accompanied every step in the growth of the Yorkshire College, and its gradual development to University status. He presided over the board of Governors of the College from 1889 till 1904, and over the University Council from 1904 till 1920. . . . The University acknowledges with pride that the distinguished place and high standing which it now occupies in the public opinion of Yorkshire and the country are in large measure due to the character and ideals of its first Pro-Chancellor. . . ."

LONDON.—Dr. H. A. Harris has been awarded the William Julius Mickle Fellowship for 1930 in respect of research work (radiographic and histological) during the past five years in connexion with problems of growth in man and animals.

Dr. Francis Davies has been appointed, as from Aug. 1, to the University readership in anatomy tenable at King's College. Dr. Davies was educated at University College, Cardiff, and continued his medical studies at University College Hospital, London. From 1924 until 1927 he was demonstrator, and since 1927 he has been senior demonstrator in anatomy at University College.

Prof. L. T. Hogben has been appointed as from Aug. 1 to the University chair of social biology tenable at the London School of Economics. In 1912, Prof. Hogben entered Trinity College, Cambridge, with a major entrance scholarship, and in 1915 he obtained the Frank Smart Prize in zoology. From 1919 until 1920 he was lecturer in zoology at Birkbeck College, and from 1920 until 1922 lecturer in the Department of Zoology and Huxleyan Curator at the Imperial College of Science. In 1922 he was Mackinnon Student of the Royal Society. He was at the University of Edinburgh from 1923 until 1925 as lecturer in experimental physiology, and at McGill University from 1925 until 1927 as assistant professor of zoology. Since 1927 he has been professor of zoology in the University of Cape Town.

SOME attractive cinematograph displays of Empire films are being given at the Imperial Institute. During the present month, films dealing with various aspects of life in Africa, the West Indies, the Antarctic, Australia, and India, and a natural history film are being shown for successive periods. There are four sessions daily, except on Sundays, when there are two sessions. Admission is free but seats are reserved on application in writing to the secretary of the Institute.

THE Foreign Work Committee of Leplay House is arranging to send a group of members and others to North Africa during the coming Easter vacation, under the leadership of Mr. E. M. Keith Ellerton, of the University of Liverpool. The route covered is Algiers to Biskra and Touggourt, then to Tunis via Timgad and Constantine. Another group will go to Brittany, making Carnac its centre, for archæological studies, and another to Holland. Those interested in field studies from the point of view of architecture, history, geography, and sociology should apply to Miss Margaret Tatton, Director, Foreign Work Committee, Leplay House, 65 Belgrave Road, S.W.1.

Historic Natural Events.

Mar. 11, 1669. Eruption of Etna.—One of the greatest eruptions of Etna, preceded by violent earthquakes for three days, began by the opening of a fissure nearly 12 miles long on the south side of the mountain. A new crater opened 8 miles west of Acireale, the ashes from which formed the double cone now known as the Monti Rossi. The lava stream from the crater covered an area of about 40 sq. miles. It destroyed 14 villages, including Belpasso and Mascalucia, invaded Catania, mounting over the wall 60 ft. high, and finally reached the sea in a stream 600 yards wide and 40 feet deep.

Mar. 11, 1912. Darkness and Black Rain.—In the afternoon of Mar. 11 a severe thunderstorm took place in the east of Hampshire and the west of Sussex. A peculiar feature was the intense darkness that occurred near the centre of the storm. The sky was described as of inky blackness; in other places the cloud was greenish yellow and dense fog was experienced. The rain which fell from this cloud was black like ink, and smelt slightly of tar. There seems little doubt that the blackness was actually due to London fog which drifted southwards before a light wind until it reached the thunderstorm area.

Mar. 11-14, 1888. 'The Great March Blizzard'.—This was the worst storm in the history of the eastern United States. An elliptical trough of low pressure moved eastward, with two intense centres; the northern centre passed out over the Atlantic on Mar. 11, while the southern centre turned north-eastward and remained in the neighbourhood of Cape Cod from Mar. 12 to 14, gradually becoming less intense. On the western side of these two depressions intensely cold northerly winds blew with great force, the temperature being little above 0° F. in the interior of Connecticut and New York, and the wind up to 70 miles per hour. West of 72° W. the snowfall was excessive, and piled up in immense drifts. The average depth of undrifted snow exceeded four feet in parts of New York State, and caused almost complete cessation for several days of railway traffic entering New York City.

Mar. 13, 1252. Drought and Disease.—This great drought was associated with persistent north, north-east, or east winds. "On the 13th day of March there began a sore drought, continuing a long time. . . . The grass was so burned up in pastures and meadows that if a man took some of it in his hands it straight fell to powder, and so cattle were starved for lack of meat. And because of the exceeding hot nights there was such abundance of fleas, flies, and gnats that people were vexed and brought in case to be weary of their lives. And herewith chanced many diseases, as sweats, agues, and other. In the harvest time fell there a great death and murrain amongst cattle, and especially in Norfolk, in the Fens, and other parts of the south. This infection was such that dogs and ravens feeding on the dead carrion, swelled straightway and died, so that the people durst eat no beef lest the flesh haply might be infected."

Mar. 13, 1523. Storm and Flood.—A severe thunderstorm accompanied by violent winds broke over Holland; hailstones the size of hen's eggs fell. A dam burst at Schalkwyk, causing great floods on the Leck from Schalkwyk to Leyden. There were many thunderstorms throughout the following summer.

Mar. 13, 1924. Sun Pillar.—A fine sun pillar was widely observed over southern and eastern England, including London, and also in Ireland. At Turnham Green it was first seen at 5.45 P.M., when it formed

a whitish vertical streak equal in width to the sun and reaching up to 5° above it. The sun's disc was strangely distorted before it disappeared at 5.49, and the pillar remained visible until 6.9. At Golders Green at 5.30 it came out of the sun's disc like a tree trunk, red-orange in colour, turning to gold and then becoming whiter. Other observers described it as blood-red, apricot, or rose pink streaked with primrose yellow, but all agreed on its extreme beauty. Some experienced observers estimated the height as 30°, though sun pillars exceeding 15° are exceedingly rare.

Mar. 15, 1889. Hurricane at Samoa.—On Mar. 15 the harbour of Apia, Samoa, was crowded by seven warships, one British, three American and three German, all of which had been sent there because of the strained political situation, as well as two merchant ships and two schooners. On the afternoon of that day the island was struck by a violent hurricane from north-north-east (the harbour opens to the north), and all the vessels were either sunk or driven ashore with the exception of H.M.S. *Calliope*, which was able to steam out of the harbour.

Mar. 15, 1929. Floods in Alabama.—As a result of heavy rain at the end of February and early in March, the valleys of the Choctawhatchee and Escambra Rivers in Alabama were already saturated with water, when on Mar. 13–15 further heavy rains fell over the district, reaching 29·6 inches in three days at Elba, of which 20 inches fell on Mar. 15. (This amount is partly estimated, as the rain-gauge was carried away by the floods after 14 inches had been recorded.) The towns of Elba and Brewton, at the junctions of rivers, were flooded to a depth of more than 10 feet in places, and great damage was done, estimated at nearly five million dollars. Owing to the flood warnings, no lives were lost.

Societies and Academies.

CAMBRIDGE.

Philosophical Society, Jan. 27.—**A. F. H. Ward**: A microcalorimeter. A microcalorimeter was described accurate to 0·0005 cal. The system liberating the heat fits closely inside a copper tube contained in a Dewar flask. A series of iron-constantan thermo-couples has one set of junctions making good thermal contact with the tube and the others in a brass ring outside, kept in a thermostat. They are connected to a sensitive moving-coil galvanometer. The Tian multiple walled thermostat is used—three concentric thick copper cylinders, insulated with kapok, the inner containing water. The temperature of the outer cylinder is controlled with a mercury regulator, and the insulating layers cut down temperature variations so that the inner vessel is constant to less than 1/500,000 C°.

PARIS.

Academy of Sciences, Jan. 27.—The president announced the death of General Sebert.—**L. Cayeux**: The existence of two groups of Algæ with the structure preserved in the 'schisto-limestone system' of the French Congo. There is ground for supposing that, in the oolitic complex of the limestone schists of the French Congo, certain limestones of oolitic appearance are petrified Algæ.—**Charles Nicolle, Paul Durand, and Ernest Conseil**: Preventive vaccination against plague pneumonia by the respiratory tract. In addition to the usual injection of dead plague bacilli, a method of inhaling a suspension of the serum as a spray was tried. 866 cases were treated, and less than 1 per cent died of the plague.—**Serge Bernstein**: A class of polynomials of minimum deviation.—**Louis Roy**: The fundamental equation of shock waves on elastic surfaces.—**G. Friedel and R. Weil**: The influence of the symmetry of the medium on the symmetry of the crystalline forms.—**Auguste Lumière and Mlle. Anna Malespine**: The impeding influence of gestation on the Arthus phenomenon.—**Alexandre Ostrowski**: Some generalisations of the Euler product $\prod_{\nu=0}^{\infty}(1 + x^{2\nu})$.—**S. Stoilov**: The topological character of a theorem on the meromorph functions.—**W. Břečka and J. Gueronimus**: An inequality for monotone polynomials.—**Henri Eyraud**: The summation of divergent integrals in the theory of spectra.—**M. A. Andronow and A. Witt**: The mathematical theory of auto-oscillations.—**F. Campus**: The mean fibre of large hyperstatic arches.—**Maurice Lambrey**: The influence of foreign gases on the absorption spectrum of nitric oxide.—**Félix Ehrenhaft**: Magnetophotophoresis and electro-photophoresis. A description of the phenomena observed when submicroscopic particles are examined under the microscope in a powerful magnetic field and in an electric field.—**J. J. Trillat**: The structure of gelatine. The results of an X-ray study of films of gelatine.—**Jean Dalsace, M. Gory, and Nemours-Auguste**: An attempt on the radiographic visibility of the kidney. Intra-arterial injection of lipiodol, which is not toxic to the animal, brings out anatomical details in radiographs, especially in the kidney and suprarenal capsules.—**J. Décombe**: The passage from the β-ketonic esters to the β-amino esters. The reduction of the azines or oximes of the β-ketonic esters by the usual reducing agents does not give the amino esters, as might have been expected: the reduction of the acetylhydrazones or benzoylhydrazones of these esters, however, gives the amino esters with fair yields.—**L. Haskelberg**: Researches on the preparation of the glycerol esters of the amino acids.—**Augustin Boutaric and Mlle. Madeleine Roy**: Researches on the sedimentation of suspensions of clay. The results described are in general agreement with those obtained by Dubrisay.—**H. Besaire and Mlle. E. Basse**: New stratigraphical and palæontological observations on the upper Cretaceous of the province of Maintirano (west of Madagascar).—**Ch. Brioux and Edg. Jouis**: The correlation between the fineness and the solubility in carbonic acid of powdered limestones, and their neutralising action on acid soils. The availability for agricultural purposes of powdered limestone is shown to depend on its state of division. The neutralising action in the soil is in direct relation with the rate of solution in solutions of carbon dioxide. A commercial method of valuation based on these facts is suggested.—**P. Chevey**: Various rhythms other than thermal rhythms capable of marking the scales of fishes of the intertropical zone.—**E. Kohn-Abrest, Mlle. Hélène Villard, and L. Capus**: The presence of thiocyanates in the human organism. The post-mortem transformation of veronal, dial, gardenal into cyanogen compounds. Consequences in toxicology. It is known that hydrocyanic acid under the influence of putrefaction can be partially converted into thiocyanic acid, and the presence of the latter is frequently the only proof of poisoning by a cyanogen compound. Human viscera, even after much putrefaction, are normally free from thiocyanates, but after the administration of veronal, dial, or gardenal, appreciable quantities of thiocyanates can be found. These new facts must be taken into account by toxicologists.

COPENHAGEN.

Royal Danish Academy of Science and Letters, Nov. 15.—**Elis Strömgren**: Continued researches on the restricted problem of three bodies. Continued

researches on asymptotic solutions in the restricted problem of three bodies have led to the discovery of a whole system of hitherto unknown classes of periodic orbits.

Nov. 29.—**Harald Bohr**: (1) On integral functions. General solution of a problem proposed by Borel.—(2) On analytic, almost periodic, functions.—**C. Wesenberg-Lund**: Contributions to the biology of the Rotifera (2). Deals mainly with the sexual biology of the Rotifera, studied for several years in a series of ponds in the northern part of Seeland.—**Ojvind Winge**: Sex-determination in the Cyprinodont *Lebistes reticulatus*. In *Lebistes*, individuals with two X-chromosomes are generally females and XY-individuals are males. As an exception XX-males are produced, owing to genes, outside the Y-chromosome, pulling in male direction. This observation explains to a certain degree the peculiar disagreement between the sex-determination in *Lebistes* and the closely allied genus *Platypœcilus*, where the males have XX and the females XY chromosomes.

ROME.

Royal National Academy of the Lincei, Nov. 3.—**C. Foà** and **A. Peroni**: First attempts to register action currents of the acoustic nerve.—**P. Tortorici**: The principle of the arithmetic mean.—**A. M. Bedarida**: The theory of ideals of a finite algebraic body (4).—**I. Todros**: Projective-differential investigations on pairs of plane lines or of surfaces.—**E. Gugino**: The validity and extension of the theory of maximum effort.—**G. Supino**: Certain integral properties of cubic expansion. For certain investigations to be published shortly, use has been made of the following integral relations concerning the cubic expansion Θ of an elastic solid S subjected to external forces in equilibrium acting only on its surface σ:

$$(1)\qquad \int_S \Theta dS = \frac{mE}{m-2}\int_\sigma (xP_x + yP_y + zP_z)d\sigma, \text{ and}$$

$$(2)\qquad \int_S y\Theta dS = \frac{mE}{m-2}\int_\sigma \left(xyP_x + \frac{y^2 - x^2 - z^2}{2}P_y + yzP_z\right)d\sigma.$$

With these as starting-point, it is shown that, if a system of forces in equilibrium (with components P_x, P_y, P_z) acts on a single plane zone σ, of an elastic solid, the total cubic expansion caused in the solid by these forces is zero.—**E. Raimondi**: The dynamic effect of a translatory-circulatory current investing a thin cylinder in the neighbourhood of an indefinite plane wall.—**G. Wataghin**: An application of relativity to quantum mechanics. The principal differential equations used in quantum mechanics and in the theory of relativity may be derived from a single variational principle.—**M. Merola**: The variability of Y Canes Venatici.—**P. Tortorici**: New determination of the local deviation in latitude and in longitude at the Astronomical Observatory of Palermo.—**F. Scandone**: The Hall effect with extended electrodes (3).—**L. Mascarelli** and **D. Gatti**: Contribution to the knowledge of diphenyl and of its derivatives (5). To obtain derivatives of diphenyl, use has been made of various methods which serve to prepare the corresponding derivatives of benzene.—**O. Cantoni**: Investigations on the supposed existence of pulmonary lipo-dieresis. Experimental results, obtained under various conditions, fail to confirm the hypothesis of pulmonary lipo-dieresis.

VIENNA.

Academy of Sciences, Nov. 28.—**M. Beier**: Zoological expedition to the Ionian Islands and the Peloponnesus (6). Fishes worked out by **M. Holly**.—**E. Schweidler**: The disintegration constant of radium D.—**H. Hornich**: The complete independence of Menger's axioms of dimension.—**F. Morton**: Measurements of brightness with grey-wedge photometers on a sea voyage from Europe to Guatemala and in Guatemala, 1928–29. The exposed strips of photometer paper wrapped in tinfoil were sent back every four weeks to the observatory at Davos-Platz for development. The values found for insolation were less than those at Davos.

Dec. 5.—**A. Köhler**: Geological and petrographical investigations into the deeper rocks of the Lower Austrian Waldviertel and its boundary regions (1).—**A. Köhler**: Chemical analysis of the hornstone rock of Niederndorf near Erlauf, Lower Austria.—**M. Beier**: Zoological expedition to the Ionian Islands and the Peloponnesus (7). Ixides worked out by P. Schulze.—**A. Zinke** and **R. Wengen**: Perylene and its derivatives (28).—**K. Ehrenberg**: A remarkable bear's skull from the Bärenhöhle near Winden in Burgenland.—**G. T. Whyburn**: The sum of regular curves.

Dec. 12.—**F. Becke**: The systematics and nomenclature of the 32 symmetry classes of crystals. The German mineralogical society discussed this matter in Duisburg in 1926 and in Breslau in 1927. F. Becke, E. Schiebold, and F. Rinne expressed themselves in lectures at Breslau, and F. Rinne has put his proposals in final form in 1929 in Vol. 50 of the *Abhandlungen* of the Saxon Academy.—**W. Schmidt** and **P. Lehmann**: Experiments on the 'breathing' of soil. Under oscillations of atmospheric pressure the air in the soil is movable.—**A. Dadieu** and **K. W. F. Kohlrausch**: The Raman spectrum of organic substances. Various substances were tried, esters and salts of acetic acid, derivatives of benzol. The acetone line λ3008 was not verified.—**K. Przibram**: Remarks on natural blue rock-salt. There may be layers in the crystals corresponding to cubic and other layers corresponding to rhombic-dodecahedral surfaces. Secondary recrystallisation is a possibility.—**G. Schaum**: Communication of the Radium Institute No. 245a. Action of β- and γ-rays on electrolytic solutions. A capillary tube with 30 mgm. radium was submerged in a concentrated solution of silver nitrate for two months. A grey precipitate formed.

Jan. 16.—**L. Moser**, **K. Neumayer**, and **K. Winter**: Determination and separation of rare metals from other metals (19). New methods for the separation of titanium from other elements. Tetravalent titanium can be precipitated in sulphuric acid solution by means of tannic acid and antipyrine.—**A. Kailan** and **A. Ostermann**: Velocity of esterification with ethyl-alcoholic, ethylene-glycolic, and glyceric-hydrochloric acid.—**H. R. v. Gaertner**: Geology of the Central Carnic Alps. A great number of new fossil finds in Silurian, Devonian, and Carboniferous strata, including graptoliths and trilobites in upper Silurian and cephalopods in upper Devonian.—**J. Schaffer**: Change of function in gland organs of the skin. The shrew-mouse has skin-glands commonly called sweat-glands but secreting fat and albumen with a characteristic smell; more probably these are scent or trail glands. The water-shrew has glands that swell in the breeding season, so also the sebaceous glands of the gemse. The secretion in the gland-bag of the badger seems to change from youth to age.—**M. Glaessner**: The danic stage in the Gosau basin. Conglomerates in the Salzkammergut.—**R. Ebner** and colleagues: Hymenoptera from Palestine and Syria (Zoological expedition, 1928).—**P. Esben-Petersen**: Neuroptera (F. Werner's zoological expedition to the Anglo-Egyptian Sudan, 1914).—**F. Werner**: Scientific results of a zoological expedition to western Algeria and Morocco (3).—**J. Hoffmann**: Communication of the Radium Institute (246). Behaviour of ultramarine and of some natural and artificial silicates towards radium rays.—**K. Menger**: Sketch of a new theory of measure. Axioms of dimension and measure.

Official Publications Received.

BRITISH.

Paleontologiese Navorsing van die Nasionale Museum, Bloemfontein. Deel 1, Eerste Stuk: Die Krytfauna van Soeloeland. 1: Trigoniidae. Deur Dr. Ir. E. C. N. Van Hoepen. Pp. 38+7 plates. (Bloemfontein.)

Ministry of Agriculture and Fisheries. Miscellaneous Publications. No. 70: Report on the Occurrence of Fungus, Bacterial and Allied Diseases of Crops in England and Wales for the Years 1925, 1926 and 1927. Pp. 75+2 plates. (London: H.M. Stationery Office.) 3s. 6d. net.

The University of Manchester: The Manchester Museum. Museum Publication 97: Report for the Year 1928-29. Pp. 26+2 plates. (Manchester.) 6d. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1250: Reports and Memoranda of the Aeronautical Research Committee published between 1st August 1928 and 31st August 1929. Pp. 7. 6d. net. No. 1222 (M. 62): High Frequency Fatigue. By G. F. Jenkin and G. D. Lehmann. (E.F. 219.) Pp. 34. 1s. 6d. net. (London: H.M. Stationery Office.)

Leeds University. Report to the Worshipful Company of Clothworkers of the City of London of the Advisory Committee on the Departments of Textile Industries and Colour Chemistry and Dyeing, during the Session 1928-29. Pp. 14. (Leeds.)

University of Leeds: Clothworkers' Departments. Report of the Work done under the Research Scheme established in 1928 with the aid of a Special Grant from the Worshipful Company of Clothworkers, Session 1928-29. Pp. 16. (Leeds.)

The Dioptric Review: the Transactions of the British Optical Association. Edited by John H. Sutcliffe. Vol. 32, No. 2, February. Pp. 36-83. (London.)

Report on the Second Imperial Mycological Conference, 1929. Pp. 42. (London: H.M. Stationery Office.) 1s. 6d. net.

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Experiments to test the Yield and other Properties of various Species and Strains of Herbage Plants under Different Methods of Management. By R. G. Stapledon and William Davies. (Series H, No. 10, Seasons 1923-28.) Pp. 42. (Aberystwyth.) 3s. 6d.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1251: Some Early Model Experiments on Devices for Improving Lateral Control near the Stall. By H. B. Irving and A. S. Batson. Pp. 5+7 plates. (London: H.M. Stationery Office.) 1s. net.

The National Institute of Agricultural Botany. Tenth Report and Accounts, 1928-29. Pp. 22. (Cambridge.)

The Journal of the Royal Horticultural Society. Edited by F. J. Chittenden. Vol. 55, Part 1, January. Pp. 167+lxxv+43 plates. (London.) 7s. 6d.

FOREIGN.

Publications of the Kapteyn Astronomical Laboratory at Groningen. No. 43: Distribution of Stars according to Apparent Magnitude, Galactic Latitude and Galactic Longitude. By Prof. Dr. P. J. Van Rhijn. Pp. ii+104. No. 44: Photovisual Magnitudes for the Selected Areas at $\delta = +75°$, derived from Plates taken at the Leander McCormick Observatory by H. L. Alden and P. van de Kamp. Discussed by Prof. Dr. P. J. Van Rhijn and B. J. Bok. Pp. ii+19. (Groningen: Hoitsema Bros.)

Ministero dell' Aeronautico, Aviazione civile e Traffico aereo. Annali dell' Ufficio presagi. Vol. 2. Pp. 202+4 tavole. (Roma.)

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 1, Janvier. Pp. 61. (Prague: Regia Societas Scientiarum Bohemica.)

Statens Skogsförsöksanstalt. Meddelanden, Häfte 25. Pp. iii+317. 7.00 kr. Exkursionsledare, 13a: Führer der Exkursionen des Internationalen Kongresses Forstlicher Versuchsanstalten, Stockholm, 1929. Pp. 97+59. Flygblad, No. 39: Skogsträdens Fruktsättning år 1928. Av L. Tirén. Pp. 19. (Stockholm: Centraltryckeriet.)

Agricultural Experiment Station of the Rhode Island State College. Bulletin 222: The Production of Gas by *Salmonella pullorum*, II. By John C. Weldin and Helen J. Weaver. Pp. 25. (Kingston, R.I.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1612: Propagation of Aquatic Game Birds. By W. L. McAtee. Pp. ii+41. 10 cents. Farmers' Bulletin No. 1613: Propagation of Upland Game Birds. By W. L. McAtee. Pp. ii+61. 10 cents. (Washington, D.C.: Government Printing Office.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 18, No. 4. Pp. 419-579. (Tokyo and Sendai: Maruzen Co., Ltd.)

CATALOGUES.

Catalogue of Second-hand Books, including the Libraries of the late H. V. Macnaghten and R. D. Hicks; with Books from other Libraries recently Purchased. (No. 341.) Pp. 90. (Cambridge: W. Heffer and Sons, Ltd.)

Scarce and Interesting Old Books: First Editions, Americana, Old Novels, Early Law Books. (No. 28.) Pp. 90. (Newcastle-on-Tyne: William H. Robinson.)

Catalogue de livres anciens et modernes, rares ou curieux, relatifs à l'Orient. (No. 12.) Pp. 277-362. (Paris: Libr. Adrien-Maisonneuve.)

Diary of Societies.

FRIDAY, MARCH 7.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—G. J. Jenkins, Dr. J. S. Fraser, and E. B. Barnes: Discussion on Malignant Disease of the Ear.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 2.45.—T. B. Layton: Demonstration of The Rhinological Anatomy of the Naso-frontal Duct and the Hiatus Semilunaris.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.—Dr. Cumming: Lignin.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.—The History of Mountains. Opener: Dr. Harold Jeffreys.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—L. W. Schuster: The Strength and Design of Fusion Welds for Unfired Pressure Vessels.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.—Dr. F. L. Pyman: Fine Chemicals.

INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.—A. E. Moore and W. T. Slater: An Investigation of the Frequency Variations in Induction Watt-hour Meters.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Annual General Meeting), at 7.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Informal Meeting) (at Bolbec Hall, Newcastle-upon-Tyne), at 7.15.—W. D. Horsley and others: Discussion on The Effect of the Use of Electricity in Workshops on Efficiency and Costs.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Lt.-Col. G. J. Hartley: Chile and Engineering in Chile.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—A. Coad Pryor: The Manufacture of Glass and some of its more Interesting Properties.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.—Dr. A. E. Trueman: The Lower Lias (Bucklandi Zone) of Nash Point, Glamorgan.—A. A. Fitch: The Geology of Etchingham and Robertsbridge, Sussex.—G. S. Sweeting: The Geological Structure of the Ashburnham, Battle and Crowhurst Districts, Sussex, with Notes on the Wealden Iron Ore.

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Dr. C. Donald: Spinal Analgesia with Spinocain.—Dr. H. Jones: Percain 'Ciba', a New Regional and Spinal Analgesic, with Special Reference to High Thoracic Nerve-root (Splanchnic) Block.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. C. Tate Regan: Angler Fishes.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Glasgow Section) (at Institution of Engineers and Shipbuilders, Glasgow).—J. S. F. Gard and R. F. Robinson: The Insulation of Heated and Cooled Surfaces.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Prof. C. E. Ingles: The Construction of a Great Suspension Bridge.

SATURDAY, MARCH 8.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Annual District Meeting) (at Lecture Hall, Taunton) at 11 A.M.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure (1).

BRITISH PSYCHOLOGICAL SOCIETY (General Meeting) (at Bedford College), at 3.30.—Dr. V. Hazlitt: Children's Thought.—Miss A. M. Jenkin: Imagery and Learning.

BRITISH ASSOCIATION OF MANAGERS OF TEXTILE WORKS (at Manchester Athenæum), at 6.30.—F. Nasmith: The Increasing Use of Cotton Fabrics for Industrial Purposes.

MONDAY, MARCH 10.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Demonstration of Affections of Joints.

KING'S COLLEGE ENGINEERING SOCIETY, at 5.15.—A. H. S. Oddy: Pulverised Fuel.

ROYAL AERONAUTICAL SOCIETY (jointly with Institute of Transport) (at Royal Society of Arts), at 6.30.—Herr Wronsky: Air Transport.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—W. H. Goddard: The Mercedes-Benz Diesel Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—L. J. Fowler: Some District Heating Systems.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Annual General Meeting.

MEDICAL SOCIETY OF LONDON, at 8.—Dr. J. W. McNee and others: Discussion on Cardiac Infarction.

SURVEYORS' INSTITUTION, at 8.—Sir Harry Haward: Recent Developments in Electricity Supply in Great Britain, with Special Reference to Rural Electrification.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—F. Kingdon Ward: The Eastern Gate to India.

INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol).

TUESDAY, MARCH 11.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. Singer: The Passage from Mediæval to Modern Science (1): Science in the Middle Ages.

INSTITUTION OF CIVIL ENGINEERS, at 6.—H. D. Smith: Reconstruction of Liskeard Viaduct, and Scheme for Reconstruction of the Approach Spans of the Royal Albert Bridge, Saltash.—F. Gibbons: Reconstruction of Approach Spans, Royal Albert Bridge, Saltash.—J. Alexander: Reconstruction of Kent and Leven Viaducts, Furness Section of the London, Midland and Scottish Railway.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—A. T. Wall: The Advantages to the Shipowner of Closer Co-operation between the Naval Architect and the Marine Engineer.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.—Capt. P. P. Eckersley: Broadcasting by Electric Waves (Faraday Lecture).

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Annual General Meeting.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch—Burnley Section) (at Municipal College, Burnley), at 7.15.—A. Sutcliffe: Jobbing Castings.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Centre) (at King's Head Hotel, Coventry), at 7.30.—Capt. J. S. Irving: Problems Encountered in the Design of the *Golden Arrow*.

MANCHESTER COLLEGE OF TECHNOLOGY TEXTILE SOCIETY (at Manchester), at 7.30.—J. Innes: Artificial Silk Manufacture.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.—Prof. R. R. Gates: Vegetation and Man in the Canadian Arctic.
EUGENICS SOCIETY (at Linnean Society), at 8.—W. A. Appleton and others: Discussion on Unemployment.
LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at Museum, Leicester), at 8.—Discussion on The Profession of Chemistry.
ROYAL SOCIETY OF MEDICINE (Psychiatry Section) (jointly with British Psychological Society), at 8.30.—Discussion on The Rôle of Psychotherapy in the Treatment of Psychoses.
PHARMACEUTICAL SOCIETY, at 8.30.—Prof. R. V. Wheeler: The Chemistry of Coal.

WEDNESDAY, MARCH 12.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—R. W. Pocock: The Age of the Midland Basalts.—Dr. T. Robertson: The Origin of the "Etruria Marl".
INSTITUTION OF CIVIL ENGINEERS (Informal Meeting), at 6.—F. M. G. Du-Plat-Taylor: Land-Reclamation Work.
SOCIETY OF CHEMICAL INDUSTRY (Newcastle Section) (Annual Meeting) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—J. A. Reavell: Some New Aspects of Evaporation.
ROYAL SOCIETY OF ARTS, at 8.—Prof. G. Elliot Smith: The Human Brain.
OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB.—Dr. G. Wachsmuth: Cosmic Formative Forces in Earth and Man.

THURSDAY, MARCH 13.

ROYAL SOCIETY, at 4.30.—V. B. Wigglesworth: A Theory of Tracheal Respiration in Insects.—H. Raistrick and others: Studies in the Biochemistry of the Lower Fungi.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—W. N. Bailey: Some Classes of Functions which are their own Reciprocals in the Fourier-Bessel Integral Transform.—E. T. Davies: The Equations of Gauss and Codazzi for Spaces with Torsion.—D. E. Littlewood: (*a*) Algebras in which the Equation $px-xp=1$ has a Solution; (*b*) Identical Relations Satisfied in an Algebra.—Prof. L. J. Mordell: (*a*) The Zeta Functions Arising from Quadratic Forms of which the Real Parts are Definite or Indefinite Forms, and their Functional Equations; (*b*) Note on Kapteyn's and Bateman's Integrals Involving Bessel Functions.—V. Naylor: Euler's Method of Summation.
ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. B. S. Haldane: Some Problems of Genetics.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section, jointly with Institute of Chemistry—Liverpool and North-West Section), (at Liverpool University), at 6.—W. Doran: Odour and Chemical Constitution.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—R. A. Raven: The New Prospect for our Adolescents: Some Reflections.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—H. A. Humphrey, D. M. Buist, and J. W. Bansall: The Imperial Chemical Industries Limited's Steam and Electric Power Plant at Billingham.
INSTITUTE OF MARINE ENGINEERS (Junior Section), at 6.30.—Engr.-Lieut.-Comr. H. S. Humphreys: Marine Boilers: Their Troubles and Maintenance.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Colour Group—Annual General Meeting), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (Dundee Sub-Centre) (at University College, Dundee), at 7.30.
OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—T. Smith: Imagery Around a Skew Ray. Part I. Conjugate Points. Part II. Fourth Order Matrices for Skew Pencils. Part III. Sixth Order Matrices for Skew Pencils.—Prof. R. A. Sampson: The Purpose and Design of the New Equipment at the Royal Observatory, Edinburgh.—Adam Hilger, Ltd.: A Description of the Stellar Spectrograph for the 36″ Reflector at the Royal Observatory, Edinburgh.—Sir Howard Grubb, Parsons and Co.: A Description of the 36″ Reflector at the Royal Observatory, Edinburgh.
INSTITUTION OF AUTOMOBILE ENGINEERS (Plymouth Centre) (at Devonport Technical College), at 8.—Capt. L. W. Johnson: The Inspection of Metals and their Alloys.
ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Discussion on Injuries to the Brachial Plexus.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-side Branch).—A. Herbert, Ltd.: Films of The Age of Speed, and The 30th part of a Hair.

FRIDAY, MARCH 14.

BIOCHEMICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 3.—R. A. McCance and K. Madders: The Comparative Rates of Absorption of Certain Sugars from the Human Intestine.—A. Hunter and J. A. Dauphinee: The Rate of Liberation of Arginine in the Tryptic Digestion of Proteins.—Prof. A. Harden and M. G. Macfarlane: Fermentation by Yeast Preparations.—G. F. Marrian and P. F. Marrian: Micro-determinations of Hydroxyl Groups by Grignard's Reagent.—G. F. Marrian: (*a*) Further Observations on the Alcohol Isolated from the Urine of Pregnancy; (*b*) An Improved Method for the Preparation of Œstrin. The Isolation of Active Crystalline Material from Urine.—B. Ahmad and Dr. J. C. Drummond: Observations on the Relation of Carotene to Vitamin A.—L. F. Hewitt: Oxidation-reduction Potentials of Cultures of Hæmolytic Streptococci.—C. A. Ashford: The Phosphorus Distribution in Blood during Hypervitaminosis.—R. A. Morton, I. M. Heilbron, and A. Thompson: Some Further Observations on Vitamin A.—R. A. Morton and I. M. Heilbron: A Note on the Vitamin A of Butter.—T. Moore: The Conversion of Carotene to Vitamin A *in vivo*.—F. Dickens: The Preparation and Properties of an Active Principle from the Urine of Pregnancy.—K. H. Coward, K. M. Key, R. Morgan, and F. J. Dyer: Variation in Vitamin A Assay.
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Guy's Hospital), at 5.—Clinical Meeting.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Frank Colyer: Demonstration of John Hunter's Specimens of the Teeth.
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.
MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.
ROYAL METEOROLOGICAL SOCIETY (jointly with Royal Aeronautical Society) (at Institution of Electrical Engineers), at 6.30.—Dr. F. Nansen: The Aims and Objects of the Aeroarctic.
SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (Annual Business Meeting), at 6.45.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Exhibition of Industrial Kinematograph Films.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Sallis: An outline of Siemen's No. 50 Telephone Switching equipment.
INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—A. G. Lobley: Electric Heat Treatment Furnaces.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. Elliot Smith: New Light on Vision.
INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Ltd., Manchester).—G. F. Thomson: Colours used in the Rubber Industry.

SATURDAY, MARCH 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure (2).
PHYSIOLOGICAL SOCIETY (at University College).—Annual General Meeting.
ROYAL IRISH ACADEMY (Dublin).

PUBLIC LECTURES.

SATURDAY, MARCH 8.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: Casting Life in New Moulds.

MONDAY, MARCH 10.

BIRKBECK COLLEGE, at 5.30.—Prof. V. M. Goldschmidt: Chemical Geology. (Succeeding Lecture on Mar. 11.)
UNIVERSITY COLLEGE, at 5.30.—Prof. E. J. Salisbury: Concerning The Study of Plants.

TUESDAY, MARCH 11.

UNIVERSITY COLLEGE, at 5.—Prof. J. C. Brash: The Growth and Developmental Mechanics of Bone. (Succeeding Lecture on Mar. 13.)
KING'S COLLEGE, at 5.30—Prof. J. H. Muirhead: Prospect and Retrospect in British Philosophy.

WEDNESDAY, MARCH 12.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Portland Hall, Great Portland Street Extension of Regent Street Polytechnic), at 5.30.—Prof. J. L. Myres: The Early Use of Metals.
UNIVERSITY COLLEGE, at 5.30.—Prof. J. Steffensen: Some Recent Researches in the Theory of Statistics and Actuarial Science. (Succeeding Lectures on Mar. 13 and 14.)
BRITISH MEDICAL ASSOCIATION (Tavistock Square), at 8.—Sir Andrew Balfour: Health and Empire (Sir Charles Hastings Lecture).

THURSDAY, MARCH 13.

SIR JOHN CASS TECHNICAL INSTITUTE (Jewry Street, E.C.3), at 8.—Prof. T. P. Hilditch: The Structure of Fats and its Bearing on their Utilisation.

SATURDAY, MARCH 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Monsters of the Deep.

CONGRESS.

MARCH 12 AND 13.

INSTITUTE OF METALS (at Institution of Mechanical Engineers).

Wednesday, March 12, from 10 A.M. to 12.30 P.M.—Presidential Address.
Dr. D. Stockdale: The Composition of Eutectics.
Dr. T. A. Rickard: The Early Use of the Metals.
From 2 to 4.—N. P. Allen: Experiments on the Influence of Gases on the Soundness of Copper Ingots.
W. E. Prytherch: Gases in Copper and their Removal.
E. J. Daniels: Unsoundness in Bronze Castings.
R. Genders: Macrostructure of Cast Alloys. Effect of Turbulence Due to Gases.

Thursday, March 13, from 10 A.M. to 1 P.M.—Dr. D. Hanson, S. L. Archbutt, and Grace W. Ford: Investigation of the Effects of Impurities in Copper. Part VI. The Effect of Phosphorus in Copper.
R. Genders: The Aluminium Brasses.
Dr. C. F. Elam: The Diffusion of Zinc in Copper Crystals.
From 2 to 4.—L. Davies and L. Wright: Protective Value of Some Electro-Deposited Coatings.
R. Lancaster and J. G. Berry: A Note on Zinc-Base Die-Casting Alloys.
Prof. B. P. Haigh and B. Jones: Atmospheric Action in Relation to Fatigue in Lead.
W. R. D. Jones: A Note on Metallic Magnesium.

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