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University Training in Relation to Industry.

In an address delivered at Oxford during the annual meeting of the Association of Special Libraries and Information Bureaux, Prof. A. M. Carr-Saunders suggested that in the tendency for the modern university to give professional training we are returning to the old tradition, when the prime function of a university was to equip its members for life, even though life was to them represented at first by no more than the Law or the Church. In this view he is supported by Prof. S. Alexander, who recently suggested to a Manchester audience that the inclusion of technology is the distinctive feature of university work and the best key to the understanding of the real business of a university (*Political Quarterly*, July–September).

At first sight this attitude may appear sharply opposed to the view of J. S. Mill that "Universities are not intended to teach the knowledge required to fit men for some special mode of gaining their livelihood. Their object is not to make skilful lawyers or physicians or engineers, but capable and cultivated human beings." The contrast, however, is more apparent than real, for Prof. Alexander's assertion that "What the University seeks to provide is the command of a subject, afterwards to be applied, which will make the application worthy of a free man" is scarcely to be distinguished from Mill's conclusion: "What professional men should carry away with them from an University is not professional knowledge, but that which should direct the use of their professional knowledge and bring the light of general culture to illuminate the technicalities of a special pursuit". Essentially, however, Prof. Alexander, as much as J. S. Mill, is concerned that the graduate should acquire that sense of values which is essential to the intelligent use of knowledge. Sir J. J. Thomson, in his presidential address to Section A (Mathematical and Physical Sciences) of the British Association on Sept. 24, directed attention to the danger of over-specialisation in research courses, even in laboratories where the importance of mental training is fully realised, and asserted that the student often spends too much time in performing his experiments and too little time in thinking about them.

Sir J. J. Thomson's further remark, that methods of mass production cannot be applied to education without disaster, is of the greater interest in view of the attempts being made in Soviet Russia to provide the technicians required for the execution of the Five-Year Plan. The success or failure of this attempt at mass technical education is of intense

interest to the rest of the world. The difficult conditions which prevail in industry at the present time make it indisputable that the nation whose industry commands the best brains, the most efficiently trained recruits, and the highest degree of technical skill, will have an advantage of which no artificial economic barriers can deprive it. Perhaps nowhere outside Great Britain is it more certain that the efficient training of personnel for industry is an essential factor in the permanent recovery of industrial prosperity.

Through our ubiquitous examination system, the rapid growth of knowledge in certain branches of science, notably in chemistry and in physics, has reacted on the successful candidate in a way that frequently detracts from his usefulness in industry. The danger is seen clearly enough by some, at any rate, of our teachers of science, but most of them are powerless in the grip of the system, and industry finds that its recruits are commonly well acquainted with a mass of scientific facts and lacking in the knowledge of scientific methods and principles. It must be recognised that the early specialisation in the schools, which our competitive examination system encourages, and the defective and limited teaching of general science in elementary and secondary schools, are real difficulties to the university in teaching independence of mind.

The task of utilising the sciences as a medium for imparting a training in the methods of science and of the philosophy of science is indeed herculean, and is not assisted by the suggestion that teaching is but an interlude in the proper work of a professor. The relation of research to teaching and to the examinations, which, in some form or other, can scarcely be avoided, is a crucial problem, and part at least of the present unsatisfactory situation is due to the absence of great teachers like Hofmann. Schools of science are founded by more than research, and the technique, which Major F. A. Freeth has rightly pointed out as one of their characteristics, is acquired as a result of teaching the methods and principles of science and not the imparting of facts or the prosecution of a research so as to obtain rapid results.

Although the right relation between research and teaching is the key to the situation, in Great Britain difficulties arise from the fact that, while our universities are not yet sufficiently advanced to insist on the advancement of knowledge as a necessary part of their existence, there are many who regard the prime work of a professor as research, and his teaching functions as purely subordinate and secondary. It is true that no great school of organic chemistry, for example, can be developed at a university apart from a flourishing research school. What may easily escape notice is that able teaching in the methods and technique of science inevitably results in the production of brilliant research workers whose services are widely sought and valued; whereas a brilliant investigator who cannot teach frequently gathers round him students who are schooled only in a narrow technique, the independent application of which they are unable to attempt.

The closer relations which are developing between industry and the universities may ultimately lead to a solution. In the first place, industry already recognises the importance of fundamental research work and also that this is most fittingly carried out at the universities, although not now confined to them. Once this is definitely established as a principle, the universities will have won the required public recognition that advancement of knowledge is part of their work, and can consider the relation between teaching and research without fear of prejudicing the position of the latter.

There is, however, further point in the clarification of industry's own ideas about the standard of recruit it desires, which is equally important. It is more and more widely asserted that, given an adequate training in scientific methods and principles, the particular facts which are the medium of that training matter little. Given recruits who have learnt the use of knowledge, industry will rapidly teach them the facts and problems upon which their ability is to be exercised, and more rapidly than is possible outside. Important industrial firms frequently devote much care to the training of their recruits and to discovering the particular sphere for which they are most suited, and an exchange of personnel designed to counteract the mental staleness or narrowness of outlook which doubtless account for Mr. Ford's distrust of the expert is not uncommon. Sir J. J. Thomson referred to the general experience that new ideas about a subject come when one is not thinking about it, or at least when the thread of one's thought is broken, and Prof. Graham Wallas, in "The Art of Thought", makes the point that periods of incubation free from conscious thought on the particular problem are of vital importance to thinking. Undoubtedly, industry, no less than the university, is fully alive to the danger of mental sterility in the specialisation engendered in scientific research and to the importance of stimulating creative thought and originality.

This tendency is definitely opposed to that pre-

vailing in Russia under the Five-Year Plan, where the old ' polytechnics ' are steadily being converted into highly specialised ' monotechnics '. The latter policy may be unavoidable under the present exigencies ; but, although the authorities may be alive to the importance of a proper adjustment between quality and quantity in this mass production of technicians, it seems inevitable that something of quality must be sacrificed to quantity, and there are other dangers. Science, like industry, has now reached a stage when advances come not merely from the work of specialists but also from the co-operative work of different classes of scientific workers upon specific problems, and especially from the contribution of minds which can both specialise and generalise. In this co-operative work a wider technique and wider outlook are demanded of the specialist, and this cannot be acquired in the ' monotechnic '.

It is only one phase of this tendency that scientific research, whether prosecuted at the universities or in industry, is more and more concerned with the consequences of applying the new knowledge. More and more, a sense of values and of perspective is demanded of scientific as well as of industrial research, and the call for more attention to be paid to the social sciences is only one example. It should be noted that, as Flexner points out, in his recent work on " Universities : American, English, German " (see NATURE, Nov. 14, p. 811), this does not imply that the universities should be concerned directly with the conduct of business, politics, and industry ; but that they should select, as the material for their studies, problems of real value and bring to bear upon them a detached mind. In urging this, Flexner stresses that the business of a university is the advancement of knowledge, the study of problems from whatever source they come, and the training of men ; and he deprecates strongly the multiplication of subjects or even the prosecution of technical education at a university. The absence of values or proportion in so much of the so-called specialisation in American universities shows what a danger may lurk here. Perhaps, as already indicated, the best prospect for the application of scientific thought and method to national and world problems, enabling society to regain control over events, lies in this reflex action of industry on the universities. If society and industry look increasingly to the universities for the study of the fundamental problems of both the physical and social sciences and ensure adequate provision for the prosecution of such research, it should be easier for the universities to free themselves from the thraldom of an obsolete examination system and devote themselves to the production of graduates characterised not by their acquaintance with a multitude of unrelated and undigested facts, but by a sense of values and a judgment requiring only the ripening of experience to enable them to apply the methods and principles of science to the solution of any problem with which they may be confronted. The prime function of a university is to train intelligence, and industry cannot be satisfied with any education, university or not, which does not at least enable its possessors to attack new tasks or problems successfully.

Early Man in Kenya.

The Stone Age Cultures of Kenya Colony. By L. S. B. Leakey. With Appendices by J. D. Solomon, C. E. P. Brooks, A. T. Hopwood, H. C. Beck, and M. Connolly. Pp. xiii + 288. (Cambridge : At the University Press, 1931.) 25*s.* net.

LEAKEY here begins an account of a very marked advance of knowledge concerning early man. The luck of a good hunter and careful preparatory study along several lines have led to a great achievement. The text is commendably short, and Mrs. Burkitt has enriched it with large numbers of fine drawings. Solomon's studies of the deposits concerned add greatly to the value and interest of the book.

For beds near the Kariandusi river above Lake Elmenteita, and containing tools, Leakey and Solomon have adopted the name ' Kamasian ', given by Prof. J. W. Gregory to beds he included in a Miocene series. There is obviously matter here for further investigation on both sides. All that concerns the main argument is that certain beds contain, as original constituents, Chellian and Acheulian *coups de poing*, often of fine type, many of which are flakes rather than cores. There are also chisel-like cleavers, such as have now been described for the Stellenbosch culture in South Africa and the Acheulian in Europe and North Africa.

The beds concerned include large amounts of diatomite, and bear witness to a period when large areas in the Rift Valley were under water. At the end of the period there were earth movements and volcanic eruptions, and there are indications that these occurred in a dry period.

Leakey describes next a Nanyukian culture which, for him, shows evolution from the Kenya Acheulian to the Kenya Mousterian, and may

belong to the period of earth movements. This is a very tentative suggestion.

Then followed Leakey's Gamblian period, during which a lake in the Nakuru-Elmenteita region rose to 700 ft. above the present lakes, sank to below 300 ft. above them, so that parts of the lake floor became land surfaces, still recognisable by rootlet channels in the layers concerned, and then rose once more to 510 ft. (490-530 ft., for there was slight tilting later on). Above the Gamblian deposits are layers showing severe desert conditions.

During this long, but not uniform, wet period, cultures closely akin to European Mousterian and Aurignacian, but using mainly obsidian, existed side by side in Kenya, the former in the open, and over a very wide area from Kavirondo to Mombasa, as researches by Archdeacon Owen and by Mr Rickman are showing. The Kenya Aurignacian, on the other hand, belongs especially to caves. Though the Kenya Mousterian is, in Leakey's opinion, mainly a local evolution from the Nanyukian, it shows from the beginning the typical Mousterian points with faceted striking platform and secondary working. This culture develops into something akin to the South African Still-Bay phase with implements delicately worked on both faces. Burkitt thinks the Kenya Mousterians learned a lot from their Kenya Aurignacian contemporaries. Leakey apparently prefers the name Aurignacian to the name Capsian.

The Kenya Aurignacian culture lasted all through the wet period under discussion, but the evidence is chiefly from the time of the later maximum (the 510 ft. lake). Blunt-backed blades with Chatelperron points, and several types of burins, scrapers, and so on, occur. Leakey discusses specially long, thin flakes, triangular in section, often with one used edge and the opposite flake-surface showing a bulb of percussion. He thinks they are chipped-off worn edges of blocks that had been used for fine pressure-flaking. Some of these flakes were also used after being chipped away from the block; similar flakes had puzzled workers in other regions. Another type of implement has been named by Leakey a sinew-frayer; it has a rough and irregular edge used, he thinks, as are any jagged edges nowadays, by the natives. M. Breuil notes analogous tools in Europe. Leakey found some lunates in such a position as to leave no doubt that they had been mounted as barbs of a wooden arrow-head with their cutting edges forwards. Some burins were most useful tools for making grooves in wooden arrow-heads for insertion of lunates. At least two pieces of 'pottery' occurred definitely *in situ*; one was inclined to disintegrate when washed; the other was harder and patterned as if made by smearing clay inside a grass basket. Here, therefore, dies the venerable notion that agriculture antedates the invention of pottery, unless, indeed, this culture in Kenya is very late or the pottery is accidental. Other finds include ostrich egg-shell beads, some apparently deliberately stained. Human remains are more like those of ancient Europeans than of any peoples of torrid Africa, and they are to be described in a later volume.

After the intensely desertic period the lake redeveloped with diatomite deposits. This wet period, called by Leakey Makalian, is represented only by thin deposits containing a late and aberrant development of the Kenya Aurignacian culture with large quantities of pottery. To this culture Leakey gives the name Elmenteitan, and one may commend the care with which he has created separate names for cultures and for periods determined by climate. One site of this phase of culture yielded a number of non-African skeletons, some with very narrow noses.

Multitudes of microliths in Kenya, as in North Africa and Europe, end the palæolithic phase of culture. Leakey adopts for this industry the name of Kenya Wilton, because of resemblances to the Wilton industry in South Africa; there is a good deal of associated pottery.

The neolithic cultures of Kenya are briefly discussed, pending further work. They are named Gumban *A* (with pottery, lunates, scrapers, stone-bowls, etc.) and Gumban *B* (with stone-bowls, pottery, tools of obsidian, and bone and beads). These finds accompanied burials, and one cannot say which is earlier. The Njoroan culture yields burials which, unlike all earlier ones, are extended full length; one polished axe has been found in a burial and others occur casually. Obsidian flakes continued in use.

Absolute dates for this important series of cultures are a problem, and, with characteristic courage, Leakey, supported in large measure by Wayland, C. E. P. Brooks, and Miss Caton-Thompson, makes his chief pluvial periods contemporary with Pleistocene ice maxima in Europe. The Kamasian, containing Chellian and Acheulian tools, he associates with the older maxima, called, in the Alpine region, the Gunz and the Mindel. His succeeding dry interval would then be correlated with the long Mindel-Riss interglacial, a period, according to central European glaciologists, of climates warmer than the present one and fairly moist, as evidenced by the finds in the Hötting breccia. The

second long wet period, the Gamblian, would, on the same basis, be correlated with the Riss and Würm maxima of the Alpine glaciation. This scheme is broadly useful as a working hypothesis.

The slighter Makalian wet phase is correlated by Brooks, and by Leakey and Solomon, with what used to be called the Bühl re-advance during the post-Würmian ice retreat. Here we have some doubts. There seems little indication that between the Würm and the Bühl stadia in the Alps, or between stadia that have been supposed to be more or less their contemporaries in the Baltic, there was any really warm period; and, if the correlation of European and African stadia is maintained, the intense desertic conditions between Gamblian and Makalian in Kenya would suggest a very marked climatic oscillation in Europe between Würm and Bühl. It might, therefore, be well to keep in mind as an alternative hypothesis, if the correlation of climates has anything in it, that the Kenya Gamblian covers what in the Alps includes Riss, Würm, and Bühl. This makes it conceivable that the upper Aurignacian of Kenya may not be of quite such immense antiquity as it would otherwise be necessary to imagine. The Elmenteitan culture, of the Makalian wet phase, might on this view be contemporary with one of the minor and later regrowths of glaciers in Europe, for example, that described for the Alps as the Gschnitz. In any event, however, this study of climatic correlations is only in its infancy.

If the lower Aurignacian reached Europe across the Mediterranean from North Africa, and the middle Aurignacian reached our continent from the Palestinian region, we can picture a little of early culture spreads from both north and south sides of what is now the great zone of hot deserts in northern Africa and south-west Asia, but was less desertic then. The resemblances in implements, and to some extent in human types, suggest that the two spreads (north and south) may not have been separated by a long period of time.

The poverty of evidence of anything analogous to the Kenya finds farther west in Africa seems not entirely due to lack of investigation, and one recalls Falconer's interesting conclusion in Nigeria, that, in Pleistocene times, before the Sahara had become fully desertic, a desert belt lay farther south, as one would expect if there is anything in the hypothesis of climate correlations based on shifting of the main climatic zones. A desert belt would limit the spread of early man, but the Nile might well give him a way southwards into the east of Africa. Orographical changes in the later Pleistocene in the Red Sea region may have helped movements between Arabia and Africa and southward in East Africa.

Those interested in prehistoric man will have noted the important parallels between some of the early Kenya cultures and those of South Africa. This is a subject receiving new illumination from van Riet Lowe, Goodwin, and Breuil, and from Armstrong's results from Bambata, Rhodesia, and more may be expected from the joint work of Reck and Leakey in Tanganyika. South African cultures seem to be the drifted descendants, having also sometimes intermingled *en route*, of some of those of Kenya. The later volume on physical types of men will link itself with Broom's interesting studies in South Africa.

Leakey's work bristles with points of wide interest and invites discussion of big principles; there may be modifications of hypotheses in the future, but the hypotheses are at any rate very promising and serviceable, and the work done is first-rate.

The Development of Formal Logic.

A Treatise of Formal Logic: its Evolution and Main Branches, with its Relations to Mathematics and Philosophy. By Prof. Jørgen Jørgensen. Vol. 1. Pp. xv+266. Vol. 2. Pp. iv+273. Vol. 3. Pp. iv+321. (Copenhagen: Levin and Munksgaard; London: Oxford University Press, 1931.) 60*s*. net.

OF all the branches of philosophy, logic alone has had the distinction of being claimed by the exact sciences as one of them. The event is of recent occurrence; in fact, it has happened only since logic has taken to mathematical symbolism. So long as logic reigned over philosophical logomachies, it was scarcely differentiated from normative philosophy; and it has cost a great deal of hard thinking to bring it by degrees within the favours of the exact sciences. Why logic slumbered in the linguistic bliss devised by Aristotle's genius, and how it was awakened to a nobler destiny, is a story of great importance and interest for the student of mental sciences. It is this story which Prof. Jørgensen tells us in his present work, in which real scholarship is happily federated with the easier ways of education.

Prof. Jørgensen points out very adequately that formal logic now consists of three main branches, which mark the three principal stages of its historical development: classical logic, the algebra of logic, and logistics. In the first volume, he gives

a critical survey of the history of these three branches up to the present day: while he devotes the second volume to a systematic exposition of the principal parts of these branches, with critical observations on their relative advantages and defects. The third volume deals with the relations between formal logic and mathematics; it discusses the various methods of establishing the foundations of mathematics, and examines in particular the theory of logical types. Finally, the author investigates the relations between logic and philosophy, and certain aspects of psychology and linguistics, and indicates the grounds for the validity of formal logic.

A very useful background to the problems discussed is given by the historical development of logic, from the Greek works on mathematics which contain "the earliest known attempts at establishing rational, logically constructed, and abstract thought contexts", to the "Principia Mathematica" of Russell and Whitehead. What characterises this survey is the indication of the constant connexion between logic and mathematics. This, however, does not prevent the author from stigmatising classical logic as an "artificially restricted system, the fossilised form of a very early and imperfect stage in the evolution of the science", as "a mixture of faulty attempts at a formal deductive logic and the philosophy of formal logic".

On the basis of these drastic pronouncements—which, however, seem to us rather unfair in the light of history and of the services still rendered by classical logic—the author proposes to replace classical deductive logic by the algebra of logic and logistics, while the old philosophy of formal logic should give way to a more profound investigation and analysis of the real and ideal presuppositions of the sciences in question. Thus, he thinks that

"formal logic disappears from the ranks of the philosophical sciences, and becomes a special science, the foundations of which, however, may still be subjected to philosophical investigation. So that the 'philosophy of formal logic' remains a philosophical science occupying the place of 'logic' in the system of philosophy, and having for its principal objects the discovery, analysis and arrangement of logical forms, an adequate symbolization of the logical forms, and the investigation of the conditions governing validity of the logical forms. It will require here the support of linguistics and psychology, especially the psychology of thought" (vol. 3, p. 294).

The technical outline of the algebra of logic and of logistics or mathematical logic (vol. 2) is a most welcome contribution to these difficult subjects, as the source books and memoirs are not easily accessible to the general student who approaches them for the first time. The epitome of the theories of the earlier mathematical logicians, such as Schröder and Frege, which is given in vol. 1, introduces very aptly this part, as it illustrates the progress in the analysis of the elements of thought and in the ideography employed. The distinction between the algebra of logic and logistics is worth mentioning here. The former is considered as "an attempt to apply the algebraical method to the exposition of the doctrinal system of logic and to the solution of logical problems". Originally, the algebra of logic was considered as a kind of algebraical translation of classical logic, which assumed thus a more general character in its new dress. Its later development, however, turned it into an independent mathematical theory; so that now its relation to logic lies only in the fact that logic is one of its possible applications. As the algebra of logic, however, asserts nothing as to the existence of objects satisfying its axioms and theorems, it is entirely a hypothetical deductive system, and as such, it assumes previous knowledge of the logical constants and the validity of the logical principles of deduction.

On the other hand, the "chief aim of logistics is to reduce pure mathematics to formal logic, so that these two sciences are made to form a systematic whole". Logistics differs from all other deductive theories in utilising the principles of deduction themselves as its primitive propositions, which must be therefore materially true. If the whole of formal logic and pure mathematics could be deduced solely from these principles, all dispute as to their foundations and validity would be at an end. Prof. Jørgensen thinks, however, that logistics is not yet elaborated to completeness. It has been obliged to establish three additional principles—the axiom of reducibility, the multiplicative axiom, and the axiom of infinity—the material truth of which is not yet proved.

This serious defect, along with other difficulties, lead Prof. Jørgensen to suggest the most important problems to be solved before the foundations of formal logic and pure mathematics can be regarded as quite in order. These are as follows: (1) How many different logical forms and constants are there? (2) How far is it possible to reduce their number by means of nominal definitions? (3) How can they be most adequately symbolised? (4) What is the relation between formal and informal premises in the various deductive theories? (5) Are all compound objective forms truth-

functions ? (6) Can the principle of the excluded middle be applied to infinite manifolds ? (7) What are the conditions required to render a system of axioms complete in the sense that all problems concerning its objects can be solved unequivocally on the basis of its axioms ? (8) Are the axioms of reducibility, the multiplicative axiom, and the axiom of infinity necessary, or can they be replaced by more satisfactory axioms or perhaps dispensed with altogether ? (9) Wherein lies the paradoxical deception in the logical-mathematical paradoxes ?

These are very serious difficulties, though Wittgenstein, Chwistek, and Ramsey seemed to have cleared the theory of logical types of some of its blemishes, indeed, and suggest to one that the ideal of absolute deduction is only a pious hope. It will be probably experienced that attempts to dispense with any of these difficulties will only change the terms of the problem. If we make up our mind that no perfect human science is possible, then we do not see why, as Prof. Jørgensen suggests, it is futile to discuss the general problems as to the nature and relations of logic and mathematics, grammar, or psychology until the major difficulties of logistics are satisfactorily solved. Science and philosophy cannot mark time ; their greatness lies in their heroic uncertainty as to the ultimate nature of things.

THOMAS GREENWOOD.

The Works of Scheele.

The Collected Papers of Carl Wilhelm Scheele. Translated from the Swedish and German originals by Dr. Leonard Dobbin. Pp. xvi + 367. (London : G. Bell and Sons, Ltd., 1931.) 10*s*. net.

THERE has not previously been available an English account of the investigations of Scheele in a single volume. The present work supplies this defect, and, since it has been translated afresh from the original sources, it also has the character of a critical edition. The edition of Hermbstädt, in German, which has usually been considered authoritative, contains errors not present in the Swedish originals, this latter being the language in which Scheele wrote his memoirs. This is an important point, since it has often been considered that Scheele wrote in German and that the Swedish versions were translated from the German. Dr. Dobbin shows quite conclusively that the opposite course was, in fact, followed. The rugged style of the originals has been preserved in the translation, and although some modifications have been made in the punctuation and division of sentences, the text reproduces faithfully the individuality of the originals. This was a wise course of procedure and one which is much to be commended. The index is full, and there is a short but adequate appendix of modern equivalents of the chemical names used by Scheele.

The amount of chemical work done by Scheele in his spare time as a small retail tradesman in drugs in an insignificant Swedish town is amazing. His guiding theories were nearly all wrong and his contributions to chemical theory are as good as nothing. But it is very instructive to see him, guided step by step along the lines of a totally incorrect working hypothesis, reaching experimental results of the highest importance, and to perceive how it would have been possible to work back from these and to reach a different theoretical interpretation. His method of work was essentially qualitative, although he was very skilled in the use of the balance, and at some points, as when he was able to show that nitrogen was somewhat less dense than air, he turned this to advantage. He very often gives us the weights of the materials he employed and of the products obtained, but the data are usually given more from the point of view of preparative detail than from that of quantitative investigation.

Among the new substances discovered by Scheele, and his original investigations, may be mentioned the independent discovery of oxygen, the discovery of chlorine and of barium compounds, of the solubility of manganous carbonate in water containing dissolved carbon dioxide, of the formation of manganates and permanganates, of the action of the different parts of the solar spectrum on silver chloride, of the discovery of hydrocyanic acid and several cyanides, of glycerol and several organic acids, of manganous dithionate (see p. 18), of a new method of preparing benzoic acid, of arsenic hydride (of the poisonous properties of which, as well as those of hydrocyanic acid, he was not aware), of many analytical methods, of hydrofluoric acid, tungsten and molybdenum compounds, and a large number of improved methods of preparation of substances already known. All this work was carried out with the very simplest apparatus, such as glass and clay retorts, bottles, dishes, and bladders available in the pharmacist's shop. If Scheele had any fundamental philosophical guiding principle, it was probably that which he expresses as follows (p. 77) : " My practice with chemical statements is never to believe any of them until I have proved them by making experiments "—an attitude which was afterwards adopted by Dalton.

It is impossible to give in a few words any adequate appreciation of Scheele's scientific importance. "Really to know and appreciate Scheele," as Dr. Dobbin says, "it is necessary to read and study his papers attentively in detail." The translation includes the famous treatise "On Fire and Air", which laid the foundation of its author's reputation throughout Europe. This treatise and most of Scheele's other papers contain innumerable discoveries, announced in short and unpretentious statements, which reveal a master of experimental method.

Dr. Dobbin's translation is to be welcomed as a careful and authoritative work, and one which makes available to chemists a collection of memoirs of the greatest interest and importance. The printing and paper are excellent, and the book is one which chemists will read with interest and with a growing admiration for the great Swedish experimenter.

Coal and its Use.

(1) *Entstehung, Veredlung und Verwertung der Kohle.* Vorträge, gehalten an der Deutschen Technischen Hochschule in Prag von W. Petrascheck, H. Apfelbeck, H. Tropsch, R. Heinze, A. Czermak, E. Kothny, H. Löffler, A. Rozinek, J. C. Breinl. Herausgegeben im Auftrag des Professorenkollegiums von Prof. K. A. Redlich, Prof. J. C. Breinl und H. Tropsch. Pp. vii + 359. (Berlin: Gebrüder Borntraeger, 1930.) 30 gold marks.

(2) *Die Chemie der Kohle.* Von Dr. Walter Fuchs. Pp. viii + 510. (Berlin: Julius Springer, 1931.) 45 gold marks.

(1) THIS book is a reprint, in an enlarged and revised form, of several lectures, by different authors, having reference to the general subject of the origin, improvement, and utilisation of coal. Naturally, the whole subject could not be covered. The individual lectures vary greatly in range of subject and thoroughness of treatment, with the result that the book has a somewhat disjointed character.

Nearly half the available space is taken up by R. Heinze's dissertation on the drying and carbonisation of brown coal (157 pages and 49 illustrations). This might well have been printed separately, and gives much information not so conveniently available elsewhere. There are sections on the nature of the raw material and of the products, besides illustrations of most forms of drying and carbonising plants. The value of the book to a given reader must depend largely on this chapter.

H. Tropsch is responsible for two lectures, one on the origin and chemical structure of coal, and the other on syntheses from gases obtained from coal. The former is a useful summary of the views of the German school of coal research; the latter deals with the preparation of liquid fuels by the pyrolysis of methane and ethylene, besides the now familiar hydrogenation of carbon monoxide to give methyl alcohol, etc. The recent experiments, in which liquid paraffins were obtained by working at atmospheric pressure, are described in considerable detail.

Of the others, the most interesting lectures are perhaps those of W. Petraschek (on the geological aspect of coal formation) and H. Apfelbeck. The latter has many interesting graphs showing changes in composition during the coal-forming process, but the lecture would be improved by more references to previous work. The remaining lectures can only be mentioned—E. Kothny, on the economic and thermotechnical significance of coal; H. Löffler, on the burning of solid fuels; A. Rozinek, on the Szikla-Rozinek process of firing with producer gas from pulverised fuel; and J. C. Breinl, on theoretical principles of the mechanical regulation of firing.

(2) The chemistry of coal has not in the past attracted many first-rate chemists. Numerous investigations have nevertheless been carried out, shedding a good deal of light on this difficult problem, and indicating many promising lines of future progress. Further information is, however, badly needed, especially in connexion with the newer methods of coal treatment, such as the Bergius hydrogenation process. Any organic chemist lacking a subject for research may be recommended to read the book under review.

Fuchs's method is to start with the living plant. The first chapter gives an admirable summary of present knowledge of the chemistry of plant products, and goes on to discuss the processes of decay that take place in Nature. Then follow lengthy chapters on peat, brown coal, and bituminous coal. These chapters have the character of self-contained monographs. The information on peat and brown coal should be especially useful to English readers. The matter is very systematically arranged—definition, varieties, and mode of occurrence; petrographic, physical, and chemical properties; chemistry of the constituents; response to various chemical, physical, and biological treatments; discussion of the mode of origin.

The final chapter restores the continuity by

dealing with the comparative chemistry of the various fuels.

The author has succeeded in being comprehensive without undue prolixity. Every important piece of work seems to be mentioned, and references are given to the whole of the modern literature, both in German and other languages, up to the early part of the current year. Matters of purely historic interest are purposely omitted. One feature perhaps lending itself to criticism is the almost complete absence of graphs, which in many places might advantageously have been introduced to summarise experimental data.

The book is well printed and bound. The price is unfortunately high, but the coal chemist cannot afford to dispense with it. It is to be hoped that an English translation will be published.

R. WIGGINTON.

Short Reviews.

Handbuch der vergleichenden Stratigraphie Deutschlands. Herausgegeben von der Preussischen Geologischen Landesanstalt. *Alluvium.* Schriftleitung, J. Stoller. Unter Mitwirkung von K. von Bülow und W. Dienemann. Pp. xii + 424. (Berlin: Gebrüder Borntraeger, 1931.) 30 gold marks.

IN this "Handbuch", issued under the auspices of the Prussian Geological Survey in association with other German surveys, it is proposed to furnish a complete account of the German stratigraphical succession. The distribution, especially with regard to facies, the petrography, palæontology, tectonics, economics, and the whole genesis of each geological formation are to be described; where possible, geological maps are to accompany each volume. The "Handbuch" is to be completed in twelve volumes, of which this on alluvium is the first. The other volumes are to deal with Diluvium, Tertiary, Cretaceous, Jurassic, Trias, Zechstein, Rothliegendes, Carboniferous, Devonian, Silurian-Cambrian, and Crystalline Schists. The publication of a work of this scope is obviously an event of first-class importance in the study of European geology.

Fourteen authors have contributed to the present volume, "Alluvium"; their work has been collated by the late Prof. Jakob Stoller, with the help of K. v. Bülow and W. Dienemann. All deposits formed since the melting of the last ice-sheet come within the scope of this volume. The treatment is based upon the facies classification of v. Bülow—marine, freshwater, continental. The North Sea and Baltic marshes and coastal deposits form the first facies, lacustrine and fluviatile deposits the second, whilst in the third are grouped dunes, calc-sinters, peat, and landslips and related deposits. The origin, distribution, and petrography of each type are exhaustively discussed. The flora and fauna of 'Alluvium'—in the sense used in this work—are employed in the elucidation of the climate of the time. The volume ends with a summary of the products of economic value derived from the alluvium. Lengthy bibliographies are appended to each section.

A large folding table, by v. Bülow, gives the classification and correlation of the various types of deposits considered in this work, with their corresponding floral, faunistic, and archæological characteristics.

Paläoklimatologie. Von Dr. Fritz Kerner-Marilaun. Pp. viii + 512. (Berlin: Gebrüder Borntraeger, 1930.) 39 gold marks.

DR. KERNER-MARILAUN, an Austrian mining geologist, has since 1895 issued a long series of papers on former climates, and his contributions have been marked by recognition of the uncertainty of evidence on which reliance was once firmly placed, and by ingenuity in the application of many different lines of investigation. In the present work he has summarised the nature of the available evidence and discussed its value.

The book is divided into six parts, as follows: the various kinds of evidence as to former climates; the character of established ancient climates; their causes, including elevation above sea-level, distribution of land and water, the influence of latitude, the wandering of the poles and variations of latitude, fluctuations in solar radiation, and the influence of sunspots and volcanic dust; methods of estimation of climatic factors (or thermogeographical analysis); the evidence of palæogeography and geochronology; and finally, consideration of the various theories of former climatic changes. The work consists mainly of a statement and discussion of the principles of palæometeorology, and its chief value is as a summary of the conflicting hypotheses rather than an exposition by the author of his own conclusions.

The book uses a highly technical terminology and fortunately thirty-one of the author's own terms are explained in a glossary: eight of them deal with the evaluation of the evidence. The author quotes a large number of authorities, but without references; sometimes a clue is provided by mention of the date, but as a rule the author's name only is given. The lack of references is a serious defect, especially having in view the scattered nature of the evidence—botanical, geographical, geological, and physical. The index is also poor and incomplete.

Integrative Psychology: a Study of Unit Response. By William M. Marston and C. Daly King and Elizabeth H. Marston. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi + 558. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., 1931.) 21*s.* net.

"INTEGRATIVE PSYCHOLOGY" stands midway between the classical school of introspection and psychoanalysis. It claims to organise the subject matter of psychology and to give its adherents practical knowledge about themselves, applicable to the personal problems of their everyday lives.

The fundamental principle of integrative psychology is to emphasise the 'You' instead of the 'I', and has many claims in its favour. For example, 'I' cannot observe himself without becoming a different 'I' from that which he set out to observe; and this change is likely to affect the truth and value of his observations. On the other hand, the study of an objective element such as 'You' allows for a more accurate application of scientific method to the various problems of psychology. Integrative psychology, however, does not imply contact of the organs by environment, and thus offers a more adequate analysis of personality than behaviourism, although it does not repudiate altogether the idea of being, in a sense, mechanical. Yet it regards the integrative mechanism of human beings as a spontaneously operating device whereby the human organism may be completely freed from environment or materialistic control.

On these fundamental principles the authors of the book under review build up a very comprehensive and attractive system of psychology, in which the biological background of that science helps to explain drives, sensation, emotion, consciousness, reasoning, and personality. It would be difficult to admit, however, that integrative psychology offers a complete and self-contained alternative to the older schools of psychology.

T. G.

Tales told in Togoland. By A. W. Cardinall. To which is added the Mythical and Traditional History of Dagomba, by E. F. Tamakloe. (Published for the International Institute of African Languages and Culture.) Pp. vi + 290. (London: Oxford University Press, 1931.) 16*s.* net.

IN "Tales told in Togoland", Mr. Cardinall has made a valuable addition to the literature both of the folk-tale and of ethnography. His stories are drawn from the peoples of that part of the former German colony which has been attached to the Gold Coast for administrative purposes. In the belt of it with which he deals more particularly are peoples who are entirely unknown to anthropological science, some of them retaining traces of their ancient customs which are untouched by outside contact.

The tribes differ considerably one from another in culture. Among the more advanced the influence of Ashanti has been considerable. Notwithstanding these differences, the lore of the people and their fairy tales are very similar throughout the area and often identical. Mr. Cardinall has drawn his information from the people, peasants, hunters, and farmers, and not from the chiefs and priests. He offers some interesting comments on the stories, which range from "Just So" stories to native history. He suggests an origin for Brer Rabbit—not the chevrotain as usually held, but actually the hare—and puts forward an explanation of the transformation of the hero of the folk-tale into Ananci, the spider, which is more than probable. While thanking Mr. Cardinall for his diverting, but none the less highly instructive collection of tales and the accompanying commentary, we join with him in deploring the probability that these interesting tribes will have lost much of their primitive habit of mind and custom before they have been studied by a trained anthropologist.

Elementary Hyperbolics: for Technical and other Students; specially adapted to the Requirements of Beginners. By M. E. J. Gheury de Bray. In 2 vols. Vol. 1: *Hyperbolic Functions of Real and Unreal Angles.* Pp. xi + 351. Vol. 2: *The Applications of Hyperbolic Functions.* Pp. xii + 209. (London: Crosby Lockwood and Son, 1931.) 7*s.* 6*d.* each vol.

THIS work is by the author of "Exponentials Made Easy" and is in the same colloquial and humorous style, with chapter headings like "Where We meet again an Old Acquaintance, and with its Help, venture into a Maze and discover a Treasure Buried therein". On p. 294 we are told that "Infinity is a mysterious region: there things happen which do not happen anywhere else. There, for example, parallel straight lines meet, a thing which no properly brought-up parallel straight lines will ever do elsewhere (in Euclidean geometry). . . ." The first volume gives the ordinary mathematics of complex numbers, exponentials, hyperbolic functions, and the easier parts of analytical trigonometry, but in much more detail than usual, as the author is writing for engineers of limited mathematical powers. The proofs on pp. 64-66 are given without any mention of their weak points. The second volume, dealing with the application of hyperbolic functions, appears to be much more valuable. Most of it is concerned with electrical engineering; the rest deals with geography, navigation, strength of materials, suspension bridges, and cables.

H. T. H. P.

Der Smekal-Raman-Effekt. Von Prof. Dr. K. W. F. Kohlrausch. (Struktur der Materie in Einzeldarstellungen, herausgegeben von M. Born und J. Franck, Band 12.) Pp. viii + 392. (Berlin: Julius Springer, 1931.) 33·80 gold marks.

THIS book gives a summary of work on the Raman effect up to the middle of this year. It is necessarily largely a catalogue of numerical data, but does also contain both a good general elementary account of the subject and the essential parts of its rather complicated mathematical basis. The arrangement of the material—and it is remarkable how much has been accumulated in three years—is excellent and the author's comments authoritative and critical, so that there can be little doubt that the book will come to be the standard reference for early investigations in this still young subject. At the moment the most valuable parts for the research worker will probably be a table of Raman spectra for 482 substances, classified according to their chemical composition, and a list of 417 original papers. Incidentally, is it not time either that the phenomenon came to be described simply as the Raman effect, or that some generally acceptable designation were devised expressing its physical content?

K. G. E.

The Changing Outlook in Agriculture.*

By Sir JOHN RUSSELL, O.B.E., F.R.S.

AGRICULTURE as an art was already far advanced when the first meeting of the British Association was held in 1831. It was then entirely empirical. Scientific work was, however, beginning, and round about 1840 three important events occurred: Liebig published his epoch-making essay on the application of chemistry to agriculture, Lawes began the famous Rothamsted experiments which almost at once led to the founding of the artificial fertiliser industry, and the Royal Agricultural Society started its beneficent work of fostering the application of science to practice. Economic conditions favoured the growth of the home agriculture, and from about 1850 to 1890 British agriculture flourished. Then within a few years it collapsed. The chain of transport arrangements with the United States and Canada was completed and farm produce came on to our markets at prices with which British agriculturists could not possibly compete.

The overseas systems were inferior to our own in production per acre, but the shortage of population had necessitated the development of labour-saving machinery, so that the production per man was greater, and this higher efficiency of output won the day. British farmers suffered greatly; many became bankrupt.

Gradually it was realised that the way out of the difficulty was to specialise, and this specialisation favoured the application of science to agriculture. From 1889 onwards, when the Board of Agriculture was founded, agricultural colleges began to grow up. The pioneers of those days—Middleton, Wood, Gilchrist, Somerville, Percival, F. B. Smith—to name only a few, had a strenuous uphill task. But the pioneers kept on with their struggle, and, inspired by the faith that was in them, they carried agricultural education through the length and breadth of the countryside.

Then came the system of county agricultural organisers. These now play so great a part in British agriculture that one is apt to forget that they began only about 1900. The present widespread system was set up only in January 1919, when the Board of Agriculture, as it then was, circulated to the counties proposals for a comprehensive system of agricultural education, offering to pay 80 per cent of the organiser's salary and 66⅔ per cent of all other approved expenditure. With the organisers have grown up the farm institutes, and now there are springing up everywhere discussion societies where farmers meet to discuss technical and other matters of importance. At first no provision was made for research; then it was realised that agricultural education could not be carried on without research. Research on any important scale became possible only after 1909, when the Development Fund of £2,000,000 was set up at the instance of Mr. Lloyd George for a variety of purposes, including research.

The Development Commissioners at the outset adopted the wise policy of allocating the several sections of agricultural science to existing institutions, making grants on an adequate basis, and so ensuring a widespread interest and, perhaps more important, a widespread net to capture young and capable research workers. Crop production (soil, plant nutrition, and plant pathology) was placed at Rothamsted, animal nutrition at Cambridge and the Rowett Institute, plant genetics at Cambridge and Aberystwyth, animal genetics at Edinburgh, agricultural botany at Cambridge, dairy research at Reading, fruit at Long Ashton and East Malling, economics and engineering at Oxford, horticulture and low temperature research at Cambridge, veterinary research at Cambridge and Weybridge, helminthology at the London School of Tropical Medicine, glasshouse horticulture at Cheshunt.

The scheme is worked through the Ministry of Agriculture, and it is one of the best instances of successful combination of Government supervision of finance with adequate freedom of action for the research worker. The general result of all these activities has been that farmers have learned to cheapen production, to seek profitable outlets for their industry, to use machinery and any other aids to production. Results soon appeared. When Hall, in the years 1910–12, made his classical pilgrimage of British farming, he records as his general impression that "the industry is at present sound and prosperous". This was less than twenty years after the deep depression of the early 'nineties.

Then came the War. For the British, for the overseas Empire and the United States, it was a time of feverish activity to raise more food to sell to the Allies. Prices were fixed in England, so that money never abounded in the countryside as it had done in Napoleonic times. In spite of the sadness of the War years, the farmers of Great Britain put up a wonderful fight to produce food. After the War came three years of high prices; in 1920 wheat averaged 80*s.* 10*d.* per quarter, the highest since 1818. Then just as suddenly there came the slump; by 1922 wheat was down to 47*s.* 10*d.*

The high prices had done farmers very little good, and in the end they lost all that they had gained. Many landowners proceeded to sell their estates. The high price of produce induced many to bid for the land, and the sitting tenant had either to outbid or be dispossessed. Frequently he had to pay more in interest on loans and mortgages than he had paid in rent, and in addition he has also to maintain the buildings, gates, and roads which formerly the estate had done. He is therefore in a far worse position than the farmer of 1821 in the slump after the high prices of the Napoleonic wars.

Much worse has come. When the first rush of cleaning up after the War was over, it was realised

* From the presidential address to Section M (Agriculture) of the British Association, delivered in London on Sept. 25.

that the world's power of producing food had grown far in excess of its power of consuming food. The population had increased but the power of food production had increased much more. In consequence, prices of farm produce have fallen far more than costs of labour and of other commodities. British farmers have turned, as in the 1890's, to live stock, raising lamb, young pigs, and milk so far as possible on grass with an increasing acreage of lucerne, thanks to the success of Thornton's inoculation method. Those who cannot produce grass cheaply and easily, but who have to depend on arable land, are in a sorry plight, and the difficulty is not confined to Great Britain ; arable farmers in all civilised countries are deeply depressed.

This certainly is not the result that was expected ; on the contrary, experts had confidently predicted a food shortage. Sir William Crookes, in his presidential address to the British Association in 1898, forecast the probable world requirement of wheat for the next three decades, and showed that the sources and methods then available would continue to suffice only until 1931, when the world would begin to feel the pinch of hunger. Crookes's figures were remarkably accurate, and there can be no doubt that, had science and practice stood still since 1898, we should now be facing the horrors of world starvation. But they have not stood still, and the present position of farm prices is a measure of their advancement.

Two new and closely linked factors have come into play since 1898 and are largely responsible for the present position: the widening of the scope of science in agriculture and the agricultural development of the British Empire and of South America. In the nineteenth century agriculture had been mainly a branch of chemistry ; its professors had been chemists, its laboratories chemical. Crookes suggested more chemistry as the way out of what he called the ' colossal dilemma ' of world starvation ; he proposed the manufacture of more nitrogenous fertilisers from the air—a fantastic idea at the time, yet now our chief source of supply.

The new scientific developments came from the biological side, and the new practical developments from the engineering side. The first great biological triumphs were in plant breeding. Canada affords some of the best examples of the plant breeder's success in opening up new regions of the world for settlement. Up to the middle of the nineteenth century the Canadian wheats were suited only to the eastern provinces, Ontario and Quebec ; they were uncertain on the prairies. About 1842, David Fife, in Ontario, received for trial from a Glasgow friend several packets of wheat, which he sowed. Among the resulting plants was one that differed entirely from the rest, and also escaped damage from rust and frost, two destroyers of wheat in those times. How the seed got there, or whence it came, can never be known. It was a Galician variety. But the accident was a fortunate one for Canada, and did much to build up her wealth. The wheat plant was so good that Fife saved the seed and multiplied it, and in course of time it was widely taken up by farmers under the name of Red Fife. It proved to be eminently suited to the prairies, and as soon as the railway was completed in 1886 it was taken there by the new settlers and became the basis of their prosperity.

Man-power was long the limiting factor in Canadian farming, and this problem of saving labour has been attacked with devastating thoroughness by engineers all the world over. The tractor and the new cultivating implements at and before seeding-time, and the combine at harvesting, have revolutionised wheat-growing by dispensing with enormous numbers of men and greatly increasing the area of land needed per man as an economic unit for wheat farming. Not long ago 160 acres was the economic unit for the family farm ; now 320 acres is the lowest limit, and 640 acres is nearer the most profitable size.

Australia also has developed as the result of the activities of the plant breeder and the engineer ; the problem here was the conquest of the drought. Farrer began by producing wheats more resistant to rust and drought than the older sorts, and his pupils, Sutton and others, have continued the work. Agriculturists showed the great value of superphosphate for all crops ; they further improved the methods of cultivation, and now, as A. E. V. Richardson has shown, for each inch of rain falling during the season, the farmers of Victoria obtain one bushel of wheat, while forty years ago they obtained only half a bushel.

South Africa owes much of its advances to two other branches of biological science—veterinary science and parasitology. No part of the white man's habitation seems so suitable for insects, and especially parasites, as South Africa. So long as the white man occupied the country only thinly he could do it without difficulty, but trouble began as soon as he wished to increase his hold on the land and multiply his flocks and herds. The first to attack the problem seriously was Arnold Theiler. He founded the Veterinary Research Laboratories at Onderstepoort, of which not only South Africa but also the whole Empire is proud, and he trained up a body of veterinary research workers and officers who now, under the distinguished leadership of P. J. du Toit, are extending the good work.

We are still far from security ; in the past twelve years foot-and-mouth disease has cost the British Government more than 5½ million pounds sterling, paid to the farmers of Great Britain as compensation for animals compulsorily slaughtered, while the farmers themselves have suffered vastly more. Veterinary research is now developing at Cambridge and elsewhere, and the relationships between nutrition and disease are studied at the Rowett Institute.

The engineer has perhaps been the greatest force in the development of New Zealand agriculture. The invention of refrigeration paved the way for the great dairy and lamb industries, which are now among the most remarkable and efficient agricultural industries in the world. The exports are rapidly rising. In 1929 that of butter was valued at £13·2 millions, of cheese £7 millions, frozen meat (mutton and lamb) £9·9 millions ; in all, more than

£30 millions by refrigeration transport, as against £15 millions of wool—a truly remarkable progress.

The development of the dairy industry, however, was not simply a matter of transport: it is a triumph for the bacteriologist. In Great Britain good work has been done at the Dairy Research Institute at Reading by Stenhouse Williams, Golding, and their colleagues. Australia has recently made great progress with the dairy industry, and is now going into the question of lamb. Canada has a highly developed dairy industry.

Another result of improved storage during transport has been a great development of Empire fruit growing. Apples and oranges were formerly obtainable in England only in winter; they are now obtainable in spring and summer, thanks to the marked developments in Tasmania, the Murray region in Australia, and South Africa. Plums, peaches, grapes come in abundance from South Africa, bananas from Jamaica; not only are the total imports of fruit increasing, but also the proportion from the Empire increases; it had averaged 24 per cent for the five years 1925–29, and rose to 33 per cent in 1930; home growers supplied 26 per cent—usually their share is nearer 30 per cent. The Empire still, however, supplies less than one orange out of every four that we eat, only 39 per cent of our bananas, 16 per cent of our grape fruit, and 10 per cent of our pineapples; there are therefore considerable possibilities of further development. Demand is increasing; in 1930 the consumption of fruit per head of population in Great Britain was nearly 83 lb., as against 70 lb. in 1924. Other countries are improving their production and transport. In Great Britain, Barker, Wallace, and their colleagues at Long Ashton, and Hatton at East Malling, have greatly strengthened the fruit growers' position, and for fruit the outlook is, as for other commodities, a power of production growing greater than the power of consumption. Another important factor in the fruit industry has been the development of canning, which affords a satisfactory way of dealing with excess produce.

Engineering science has further intensified agricultural production by developments in irrigation. The greatest triumphs of irrigation in our time have been in India. The cultivable area of India has been enormously increased, and land provided for millions of peasants who would otherwise have had none.

Irrigation schemes worked by white men are so costly that only valuable products can be raised. In all cases irrigation has greatly increased the output from the land and greatly increased the supplies for the world market. If time permitted, it would be possible to go through the whole list of products of the earth and show how modern science has increased output far beyond human needs, with a resulting fall in demand and lowered prices. One could dilate on the achievements of the Dutch in Java in producing their new sugar-cane, which quadrupled the output and so lowered the price of sugar that the West Indies are in terrible distress, the sugar-beet industry of Great Britain is threatened, and all Europe would be in trouble but that they artificially keep out the new sugar. Or again, one could speak of the achievements in rubber growing, of the change over from wild rubber to plantation rubber, of the extraordinary improvements in technique, which have in the past thirty years so enormously increased the output that even the most extensive new demands of modern civilisation—rubber tyres, rubber floors—have failed to keep pace with supplies, so that the price, which in 1910 was 12*s.* 6*d.* per lb., is now reduced to 3*d.*, and may fall still lower, causing great distress to the rubber growers.

Modern science, in short, has been so successful in increasing man's power over Nature that it has brought us harvests far more bountiful than we know what to do with. Yet, although we may think in our pride that we have achieved a wonderful control over Nature, our control is really very limited, our tenure uncertain, and our margin of safety very exiguous. How long mankind will have the wit to go on developing more powers we do not know. It is quite certain that any slackening of control or failure to utilise scientific discovery by any one group of cultivators would speedily eliminate them through pressure of more enlightened and therefore more successful competitors. It is, however, not so much human competition as the opposing natural agencies that must continuously be watched. The weather can still defeat our best laid farming plans. Over large parts of our Empire there is a continuous struggle for possession between insects and men, and the margin of victory, even when we get it, is never very great.

There are also new troubles as yet only dimly seen that may easily cause great difficulty in future. The remarkable development of rapid transport has carried all over the world not only the blessings but also the evils of this earth. Pests and diseases of animals, and particularly of plants, have only to appear in one corner of the globe to spread elsewhere with great rapidity despite all regulations to the contrary, often causing enormous losses. Among the most serious troubles of modern times are the virus diseases of plants. These diseases are apparently not caused by any recognisable living organism, nor are they simple physiological disturbances; they cannot yet be attributed to any definite causal agent. They spread rapidly, being frequently carried by small insects, sometimes by mere contact, and they cannot be cured—one can only stand by and see the plants perish.

All kinds of crops are affected: sugar-cane, tobacco, cotton, sugar-beet, groundnuts, bananas, potatoes, maize, timber trees (for example, sandal), large and small fruits (for example, peach and raspberry), and most greenhouse and horticultural plants. Moreover, it is not so much sickly plants as healthy ones that suffer In Gambia the Rosetta disease cut down the crop of groundnuts to about one-third of the normal yield. In the United States in 1926 two virus diseases reduced the crop of potatoes by no less than 16 million bushels. In Great Britain the total loss cannot be estimated, but the figures recorded for various attacks vary from 35 to 75 per cent loss of crop. Worse still is the

deterioration of stocks : stocks apparently healthy and vigorous may become worthless in two to four years. Cotton growers are becoming seriously perturbed. In the Gezira last year the losses were considerable, although until recently the leaf-curl disease was unknown there. Sugar-beet in the south-western region of the United States is so seriously imperilled by the curly-top disease that the Government has set aside 300,000 dollars for its investigation. In England special grants are made to Rothamsted, Cheshunt, Bangor, and other institutions to study these diseases. Tobacco is now being badly attacked, also tomatoes and potatoes ; the latest sufferers are the narcissi and daffodils in our own gardens ; these cease to flower and shortly perish. Virus diseases are quite recent as serious plagues ; if they are old, they have hitherto been unimportant or unnoticed. Clearly, Pandora's box is not yet empty.

The United States stands easily first in elaboration of agricultural research, organised not only by the Government but also by private endowment. Both in England and in the United States, men who have made fortunes in the city have spent their money in developing agriculture or agricultural science. The America patron has spent his money on a college or research station, setting up a laboratory or some other new building, or endowing fellowships, so that a succession of vigorous young people could develop the subject, adding also greatly to their own value as workers for agricultural progress. So the gift has fructified and enriched the community in ever-widening circles. The British patron, on the other hand, has usually spent his money on his own estate, making his own experiments in farming. Some have rendered service by carrying pedigree live stock over periods of depression when the commercial farmer might perforce have had to let them go. But many have simply experimented on no very definite basis and with none of the continuity essential to the success of agricultural investigation. While, no doubt, getting much amusement out of it themselves, they have not achieved results commensurate with the time and money expended.

Without disputing the inalienable right of the Englishman to spend his money in any way he may think fit, we can still commend to the English patron the wonderful possibilities of the endowment of agricultural research. To say nothing of Lawes and Rothamsted, think what the world has gained through John Quiller Rowett's gift in 1920 of land near Aberdeen, and of £10,000 to erect buildings, thus founding the Rowett Institute. Scotland has recently had a further benefaction in the Macaulay Soil Institute set up to study the peat soils of Scotland and to help the farmers there so long as any men farm in Scotland. We remember with gratitude, and we know that our children will do so, the names of Molteno, William Dunn, Thomas Harper Adams, Charles Seale-Hayne, John Innes for their foundations in England ; Peter Waite and John Melrose for the Waite Institute in Australia, William Macdonald for the Macdonald College in Canada, Thomas Cawthron for the Cawthron Institute in New Zealand. To-day the need is not so much for new institutions as for the strengthening of some of those already in existence.

Within the Empire all agricultural experts are now in touch with the central clearing houses in Great Britain, the Imperial agricultural bureaux, the function of which is to search the world for information likely to be useful and then pass it on to the persons likely to want it. The system is working well.

World organisation of scientific investigation is proceeding rapidly. Of the three factors involved in the agricultural situation, production, marketing, and the scientific advisory and technical system, the last is by far the best organised. Much has recently been done, however, in developing better and more efficient marketing by the Empire Marketing Board and the Ministry of Agriculture.

Our greatest need, however, is a better organisation of agricultural production. A beginning has been made by the overseas farmers ; the necessity for sending all produce through one or two ports has compelled them to work through large organisations for grading, transporting, and selling the produce, with skilled representatives in Great Britain. Dealing in hundreds or thousands of tons, they reduce all costs and all wastage to a minimum. Gradually the British farmer is organising. But greater organisation is highly desirable. At present British farmers, Empire farmers, and farmers from all over the world indulge in deadly competition in the British market. In the end they obtain wholly inadequate prices. But the community as a whole does not gain because they lose.

Thanks to the inquiries made by the Ministry of Agriculture and the Empire Marketing Board, the food requirements of Great Britain are fairly well known. Our next great step forward will be to organise production on a contract basis so as to satisfy these requirements with a reasonable margin of safety, but without the terrible waste involved in those large excesses which injure the grower without benefiting the consumer.

Something of the sort is essential if farming is to survive as an occupation for the best of our people. Organised production and the development of the contract system which has done so much for the milk producers, would permit of a renewal and development of country life to the fullest extent now made possible by scientific and technical advances. By common consent many of the ills of to-day arise from the fact that for nearly a century the industrial side of our national life has been fostered at the expense of the rural side, producing an over-industrialised town population peculiarly susceptible to world economic disturbances, and now largely without employment or prospect of employment. The rural population, on the other hand, is far less sensitive to economic disturbances ; the low rate of unemployment in the countryside shows the greater independence and resilience of the conditions of country life, and points clearly to the fact that improvements in our rural life would benefit not only the countryman but also the whole community.

Faraday and Marine Boilers.

FARADAY was probably the first man of science in Great Britain to be called upon to give advice on the working of marine boilers. There is little to show that his views affected marine engineering practice at the time, for his evidence was hidden away in a Government report which few engineers read, but it is not without interest to find that subsequent experience led to the adoption of methods the germs of which are to be found in what he said.

The circumstances in which Faraday came to be associated with the matter of marine boilers were as follow. In 1822 a Select Committee of the House of Commons was appointed to consider the question of steam navigation as relating to the communication between Great Britain and Ireland by steam. The committee, of which Sir Henry Parnell, Bt., was the chairman, became known as the Holyhead Roads Committee, and it sat when Telford was busy with the great Holyhead road and the suspension bridge over the Menai Straits. At the time the inquiry was held, ten years had elapsed since Bell's *Comet* had inaugurated regular steam navigation in Europe, and in Great Britain alone there were about 150 steam vessels afloat. Most of these were running on the rivers, but the eminent marine engineer, David Napier, had proved that steam vessels could be built for work in the open sea and had successfully established services between Dover and Calais, Holyhead and Dublin, and between Glasgow and Belfast. This success in turn led to the dispatch of mails to France by steam, and in 1821 the Post Office decided to have its own steam boats. That year, therefore, the *Dasher* and *Arrow* were built for running between Dover and Calais, and the *Royal Sovereign* and *Meteor*, somewhat larger vessels, for the Holyhead and Dublin route. As these were the first steam vessels owned by any Government department, they were regarded with great interest, and the committee of 1822 was mainly concerned with the construction, maintenance, and running of the *Royal Sovereign* and *Meteor* and other vessels which it might be decided to build.

The committee sat on various days between March 21 and June 1, 1822. Among the witnesses examined were officials of the Post Office, captains of steam vessels, and well-known engineers such as Joshua Field, Bryan Donkin, Timothy Bramah, James Brown, and others. These all gave valuable information as to the size and construction of the boats, the types of engines and boilers, the staffing of the engine rooms and such matters, but it was left to Faraday, who described himself as "chemical assistant at the Royal Institution to Mr. Brande", to enlighten the committee on the chemistry of steam raising. He had to tell the committee all about the composition of sea water, what salts it contained, what happened to the salts when the water was evaporated, what action the salts had upon iron and copper, what was the effect of incrustation, what could be done to prevent deposits forming, how fires in bunkers could be avoided, and so forth.

In 1822, and for many years afterwards, marine boilers were just great rectangular tanks with internal furnaces and flues of square or rectangular section, and they were invariably fed with sea water. The engines had jet condensers, not surface condensers, and there was no way of keeping the boiler water fresh even if the boilers were filled with shore water before starting on a voyage. As, however, the steam pressure was only about 2 lb. or 3 lb. per sq. in., by taking proper precautions the density of the boiler water could be kept down, and engineers who knew their work could keep their boilers remarkably clean. In other cases there was much incrustation, while corrosion was rampant. Iron boilers in some vessels only lasted two years, and so a good many engineers adopted copper for the material for boilers.

These facts were all known to Faraday, who had prepared a long memorandum for the committee, dated from the Royal Institution, May 7, 1822, and it was in this and in his evidence he made his many valuable suggestions. One of these was that engineers should be provided with hydrometers, another that the density of the water in the boiler could be kept down by a continuous system of brining, and a third that the action of acids could be neutralised by the use of lime, potash, or soda. If copper boilers were to be used, iron bolts and fastenings should not be used, while if there was fear of fire in bunkers it would be an easy matter to fit horizontal temperature tubes of iron through which thermometers could be passed. Many strange practices were in vogue among marine engineers in the early days. Dung, potatoes, and oatmeal were all put into boilers for stopping leaks, and other substances were used with the idea of preventing incrustation. It therefore occasions no surprise to find that Faraday was asked, "Would a dry holly or thorn bush introduced, if practicable, into the boiler take off a part of the crystallisation which would otherwise adhere to the bottom of the boiler?"

News and Views.

DEC. 12 was the thirtieth anniversary of Marchese Marconi's first successful attempt to transmit a radio signal across the Atlantic. In 1901 there were no valves, no amplifiers, no sensitive receivers, and no means of making continuous waves. All that was available for transmission was a system of damped waves produced by irregular spark discharges; the coherers then used for reception were very insensitive. In 1900 a station was erected at Poldhu in Cornwall and another at Cape Cod, Mass. In designing these stations, Marconi had the help of Sir Ambrose Fleming, R. N. Vyvyan, and W. S. Entwistle. When the

Poldhu station was nearly completed, a terrific gale wrecked the tall masts that had been erected. Although greatly discouraged, Marconi erected a much less ambitious aerial system. In November 1901 another gale destroyed the antenna system at the Cape Cod station. Marconi then determined to try aerials suspended by kites and balloons. As the letter 's' is easy to transmit, he arranged that a series of these signals should be emitted at a prearranged speed from the Poldhu station during certain hours of the day. After several unsuccessful trials, Marconi heard three faint clicks in the telephone at 12.30 P.M. on Dec. 12. They were also heard by his assistant. These signals led to the building of the high-power radio station at Glace Bay in 1902, and at the beginning of 1903 commercial radio communication across the Atlantic was established. Remembering that in those days physicists and mathematicians did not know of the existence of a conducting layer in the upper atmosphere, and that consequently most of them anticipated that no result would follow from these costly experiments—and did not hesitate to say so—it will be seen how much indebted we are to Marconi's pioneering work.

IN an article in the *Nineteenth Century* for December, on Erasmus Darwin, 1731–1802, the bicentenary of whose birth was referred to in NATURE of Dec. 5, Mr. H. Pearson refers to him as the greatest English doctor of his time. No one, perhaps, knew better than Darwin the futility of many of the notions prevalent, and much of his own success depended on his insight into human nature. His methods were often experimental and sometimes risky, but a man who never tried an experiment he declared to be a fool. His great originality of mind, his independence of character, and his versatility were shown in many ways, and he was every bit as interested in human progress and the sciences and arts as he was in the ailments of his patients. Wells and witches, canals and candlesticks, pumps and ploughs were only a few of the things on which he had ideas. He was certainly a pioneer in the use of electricity for medical purposes, and when Priestley discovered oxygen, he at once envisaged the submarine vessel which "Buoy'd with pure air shall endless tracks pursue". Then, too, as Dr. Krause said, he was the first who proposed and persistently carried out a well-rounded theory of evolution. Like some of the other members of the Lunar Society, which he founded, Darwin was a sympathiser with the French revolutionists and the American colonists. Mr. Pearson gives brief biographical notes on some of the most distinguished members of that small but influential society: Keir, Galton, Wedgwood, Watt, Priestley, and others, all of whom owed something to the free and stimulating conversation of Darwin. In person, as Mr. Pearson says, he was somewhat corpulent, his face was marked by smallpox, he was clumsy in his gait, careless in his dress, and stammered excessively. Like his famous contemporary Johnson, with whom he had some resemblances, he practised an unbounded benevolence.

THE Prince of Wales was the guest at the tercentenary dinner of the Clockmakers' Company, held on Dec. 9 in Merchant Taylors' Hall to commemorate the three-hundredth anniversary of the incorporation of the Company by charter. The Master, Sir Frank Dyson, Astronomer Royal, presided. The charter was granted on Aug. 22, 1631, when the Company was styled "The Master, Wardens, and Fellowship of the Art or Mystery of Clockmaking of the City of London". It was constituted a livery company in 1766. Though to-day the Company does not exercise the same control over the trade as of old, it serves its interests in many ways. Its library of works on horology and its collection of clocks and watches are deposited in the Library and Museum of the Corporation of the City of London in Guildhall, where they are open to inspection by visitors. David Ramsey was the first Master of the Company, while among his successors have been Edward East; the Fromantels, father and son; Thomas Tompion and George Graham, both of whom are buried in Westminster Abbey; John Harris, Daniel Quare, and Thomas Earnshaw. When proposing "The Clockmakers' Company", His Royal Highness said that he was proud that the clockmakers had selected him, as the first master of the Master Mariners' Company, to propose the toast. There is no doubt, he said, that we have always been first in the field as regards chronometers, or machines for finding longitude. Some of the members of the Master Mariners' Company would be able to say what splendid instruments English chronometers are, and he expressed the hope that the Clockmakers' Company will continue to flourish and maintain the high standards for which English skill and workmanship have so long been renowned.

THE Humber ports are the largest fishing centre in the world and it was intended from the first that the Department of Zoology in the University College of Hull should co-operate with the fishing industry. To this end, A. C. Hardy, who served as marine biologist on the *Discovery* Expedition of 1925–27, was appointed as the first professor of zoology and oceanography in the College. A scheme for fisheries research was drawn up by Prof. Hardy and additional accommodation has now been provided by the College. The interest of the fishing industry in this development was shown by Sir John Marsden, president of the British Trawlers' Federation, when he formally opened the new department on Dec. 8. Sir John commented on the fact that, in the past, the fishing industry paid little attention to scientific investigations, partly because the industry itself consisted of a number of individual units working independently. This has now been changed and the Federation over which he presides represents ninety-nine per cent of the steam trawlers of Britain. The Federation, he said, is ever vigilant of its members' interests, and, we may add, is fortunate in having as its leader one who appreciates the importance of scientific research. Sir John commended the good work already being undertaken by Prof. Hardy and his staff, and said that even closer co-operation between the College and trawler owners

would be to the lasting benefit of the fishing industry. The capital cost of the new laboratories has been borne by the College, but the greater part of the maintenance will be met by a Government grant, on the recommendation of the Development Commissioners. The work to be undertaken—in brief, the distribution of the plankton of the North Sea in relation to the movements of fish, particularly the herring—was described in an article which appeared in NATURE of June 13, page 911.

THE Fourth Pacific Science Congress met at Batavia - Bandoeng, Java, in 1929, with Dr. O. de Vries as general president, and five bulky volumes of proceedings—general part and reports on oceanography, physical papers (two vols.), biological papers, agricultural papers (The Hague : Martinus Nijhoff, 1930, 60 guilders)—have recently been published. The idea of conferences for the joint discussion of Pacific problems was first mooted at the meeting of the British Association in Australia in 1914, and came to fruition in the Congress in Honolulu in 1920. Eventually the Pacific Science Association was formed as a permanent organisation of the institutions and individuals engaged in research on the scientific problems of the Pacific region, and the Java conference in 1929 was the first to meet under its auspices. Discussions and papers were confined strictly to problems of Pacific interest, and agricultural science was included for the first time. The agricultural division, however, scarcely supplies any problem of circum-Pacific scope, the Pacific Ocean being in this respect rather a barrier than a link between the countries west and east of its waters, the range of climates extending from the arctic and antarctic to the tropical types, and agriculture, therefore, may find it more suitable in the future to organise along other lines.

A WIDE range of subjects was dealt with in the physical, biological, and agricultural sections of the Fourth Pacific Science Congress. The papers, numbering about 270, were mostly short but comprehensive, and touched on problems of fundamental and practical importance. Some twenty-six countries were represented, and the foreign members were given the opportunity of joining excursions to make first-hand acquaintance with the conditions and problems under discussion. The advantages of personal contact offered by the Congress were enhanced by the facts that a total eclipse of the sun occurred during May and the Third Congress of the International Society of Sugar Cane Technologists met during June, which brought together a number of other scientific workers, who found the Pacific Science Congress a suitable meeting-place to exchange views and results.

DR. M. MCCLINTOCK, of Harvard University, gave an interesting radio talk over the Columbia Broadcasting System on Oct. 30, on street traffic engineering. He pointed out that the safe and orderly movement of traffic over streets and highways is a great national problem in America. It is estimated that more than two million pounds are wasted annually in the United States because of the delays occurring from traffic congestion. Every year there are more than 32,000 fatalities and more than a million personal injuries owing to motor-car accidents. There is an urgent demand for the mitigation of this evil. Dr. McClintock thinks that one of the most promising remedies is to be found in properly designed motor vehicles. The modern motor-car has made great strides in this direction during the last ten years. We have now four-wheel brakes, splinter-proof glass, shock absorbers, more flexible power plants, stronger bodies, and better headlights. Statistics prove that the motor of to-day is four times safer than the motor of ten years ago, but it is not yet ideally designed to function in modern traffic. Great progress has been made in securing national uniformity in the rules of the road. In the installation of 'stop' and 'go' visual signals there is still much room for improvement. Many engineers assumed that they were a panacea for all traffic difficulties. The result is that they have been installed in many cities in places where nothing but added delay, increased risk, and irritation of the driver can result. When the problem has been properly studied and all the facts obtained by statistical researches taken beforehand, smooth running has resulted. The knowledge recently gained as to the best systems of automatic control leads to the belief that in the future there will be very few traffic policemen. It has to be remembered always that, no matter how perfect the scientific control of traffic may become, the most important element is still the human one.

IN a report just issued by Steatite and Porcelain Products, Ltd., of Stourport, Worcestershire, many experiments are described which prove the value of modern research methods in improving the devices used in industry. The report discusses the design of protective fittings for the long strings of insulators used in connexion with the National Grid in Great Britain. Many have wondered why large metal rings are put at the ends of these sets of insulators. Apparently the original idea was that they would level down the voltage stresses between the individual units and thus diminish the maximum electric stress on the set. In practice the insulators when clean and dry provide an insulation far in excess of the maximum permissible. It is found that when soiled and wet the stress distribution is automatically altered for the better, and so this detracts from the usefulness of rings for this purpose. They are, however, of great use in protecting the insulators from damage when a low frequency arc occurs, as it is kept at a distance from them. Well-designed insulators withstand transient flash-overs, but a prolonged arc will damage any insulator. The report shows photographs of arcs taking place at 400 kilovolts between arcing horns, and many cinematograph and oscillograph records of arcs and flash-overs between arcing horns protecting strain insulator sets under all kinds of atmospheric conditions. These prove conclusively that the double horn type of protector serves the purpose of keeping the arc away from the insulator set and also breaks the arc. When the insulator set is used horizontally, protectors for it are much easier to design. In this

case the arc is kept clear of the insulator by the convection currents of hot air. Horns in conjunction with an arcing ring were found very satisfactory. The arc started between the horns and the ring, and then rose and broke very quickly.

THE Smoke Abatement Handbook recently issued by the National Smoke Abatement Society gives a concise but comprehensive summary of information relating to smoke abatement. The numerous facts cited include data not only on the composition and deposition of soot, the production of smoke, its effect on health, vegetation, and buildings, but also on the various smokeless fuels, their production and sources of supply, together with a directory of associations, and a list of local authorities represented on the Council of the National Smoke Abatement Society. Estimates are given of the cost of smoke to various towns; for London this is given as £6,815,000; for Manchester, £2,900,000; for Birmingham, £2,350,000; for Liverpool, £2,308,000, and for Glasgow, £1,809,000. A useful summary of both the English and the Scottish law relating to smoke emission reveals the absence of any legislation concerned with the domestic smoke which is responsible for upwards of seventy-five per cent of atmospheric pollution. Other sections on industrial smoke abatement and the domestic smoke nuisance are included, in which the factors tending to produce smoke are analysed and methods of dealing with the domestic problem are outlined. The British Electrical Development Association contributes a note on "Electricity and Smoke Abatement", and a further section outlines the contribution of the gas industry. Gas coke is fully discussed, and reference is made to the new portable inset grate which facilitates its use in open fires. The measurement of atmospheric pollution is described, and also the measurement of the obstruction of light by atmospheric pollution. The booklet provides, in accessible form, information indispensable to all who may have occasion to speak or write on the subject.

THE requirements of artificial illumination for grading grain fall under three heads: (1) colour or composition of the light; (2) intensity of illumination; (3) diffuseness of the illumination. D. C. Rose (*Canadian Journal of Research*, vol. 5, p. 64; 1931) has tested various combinations of lighting units, and finds satisfactory working from two Ivanhoe Glassteel Diffuser fixtures of 500 watts each, with a 'Trutint' glass globe, and from certain arrangements of a Cooper Hewitt mercury vapour lamp, *M* Tube type, a Cooper Hewitt hot cathode neon lamp, and a General Electric Type *S*1 sun lamp. The colour of the light is, if anything, less important than its intensity and diffusion, provided it does not differ too greatly from that of noon sunlight, which is adopted as the standard white light, with a colour temperature of from 5000° K. to 5400° K. Certain precautions need to be observed by the inspectors using the lamps to ensure accuracy of grading, but if the instructions given are duly carried out, it becomes possible to grade wheat throughout the day and night during rush periods, instead of only during a few hours with ordinary daylight. Various methods of increasing the intensity of reflected light have been tried for grading wheat by physical means, but so far none has given results of any value. Chemical tests are too lengthy, and in any case the protein content of wheat does not seem to follow the grade in any regular manner. It would seem, therefore, that the only improvement in method that is possible at present is the use of artificial light for examination as indicated above.

DR. FREDERICK V. COVILLE, botanist of the United States Department of Agriculture, and chairman of the Research Committee of the National Geographic Society of America, has been awarded the George Robert White Gold Medal of Honor, the highest horticultural award in the United States, made by the Massachusetts Horticultural Society. Dr. Coville is known for a series of botanical discoveries and experiments. For example, his adaptation of the wild blueberry to the pine barrens of New Jersey has covered hitherto desolate areas with highly productive crops. Other studies he made, such as that of a method of restricting sheep grazing in national forests, have conserved vast tracts of valuable forage. Dr. Coville is joint author of "Standardised Plant Names", which gives authoritative names and spellings of 20,000 species and varieties of plants of the United States. While experimenting with the blueberry, Dr. Coville demonstrated the effect of cold in stimulating the growth of plants, and found that the wild crab, the cranberry bush, the tamarack, trailing arbutus, and the seeds of the bunchberry would not grow until chilled. He is acting director of the National Arboretum in Washington, for which the Government has already acquired 190 acres at Mt. Hamilton, and is negotiating for more. He is a former president of the Biological Society of Washington, the Botanical Society of America, and the Washington Academy of Sciences. Forty years ago he made the first botanical survey of Death Valley, publishing his findings, which ever since have been the standard work on the plant life of that region. He has also made several other botanical surveys. Other recipients of the George White medal have included Charles S. Sargent, for many years director of the Arnold Arboretum in Boston; George Forrest, of Edinburgh, who explored Tibet and western China to bring ornamental plants back to Europe; and Dr. Liberty Hyde Bailey, the well-known writer on horticulture, of Cornell.

THE extensive museum formed by Dr. William Hunter, court physician to Queen Charlotte, consort of George III., and bequeathed by him to the University of Glasgow, contains a number of specimens of insects. Particular interest and importance is attached to these, since many of them are the actual types of species founded by the great systematist, J. C. Fabricius. In order to make these Fabrician types more accessible to systematic entomologists throughout the world, it was deemed desirable that the specimens should be accurately figured and provided with up-to-date technical descriptions. This project has been rendered possible through the generosity of the Carnegie Trustees for the Universities of Scotland,

and the first instalment of the scheme has taken shape as a volume entitled "The Fabrician Types of Insects in the Hunterian Collection at Glasgow University. Coleoptera, Part I.", by Mr. Robert A. Staig, lecturer in zoology (entomology), University of Glasgow, and published by the Cambridge University Press, 1931, price 25*s*. net. This book is well illustrated by 28 three-colour process plates with appropriate letterpress. The Fabrician specimens, it may be added, are more than one hundred and fifty years old, but the great majority are still in a remarkably good state of preservation. The coloured plates and descriptions in Mr. Staig's book are based upon the actual specimens, without attempts being made to rectify defects, etc., due to age.

THE *Comptes rendus de l'Assemblée de Stockholm*, held on Aug. 15–23, 1930, for the Section of Terrestrial Magnetism and Electricity of the International Union for Geodesy and Geophysics, is a bulky volume of 479 pages. The major part of the volume consists of reports of national committees (170 pages) and communications from individuals and institutions (184 pages). Nineteen countries contribute national reports, including Germany, which was represented, by invitation, at the Assembly, though Germany does not at present adhere to the Union; among the countries not reported on are India, South Africa, New Zealand, and the South American republics; fortunately the absence of a report does not necessarily imply inactivity in this branch of science. Among the individual communications of special interest may be mentioned an account of Swedish methods of geo-electrical prospecting, and a discussion by H. W. Fisk, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, of the secular magnetic variation in recent years. These are among the few contributions that exceed ten pages in length, the volume being in the main made up of very short reports and papers. The portrait of the late Dr. Chree, former president of the Section, forms the frontispiece.

PROF. P. LANGEVIN, of the Collège de France, Paris, who has been in China for some time on an international educational mission on behalf of the League of Nations, has accepted the joint invitation of the National Academy of Peiping, the National University of Peking, and the National Tsing-Hwa University in Peiping, China, to give a series of lectures to physicists and advanced students of physics there. The lectures were scheduled to start about the middle of December and will probably last for one month. The subject chosen by Prof. Langevin is "Les nouvelles dynamiques de relativité et des quanta et leurs applications à quelques problèmes de la théorie du magnétisme." It is hoped that the presence of Prof. Langevin, and his lectures, will serve as stimuli to the creation of an atmosphere and an active centre for research in physical science in that region. In Peiping there are six universities having physics as a department, besides one institution purely for research on that subject. Steps are also under way towards the formation of a physical society, with its aim and its organisation along the lines of those existing in other countries.

AN interesting glimpse of primitiveness in a civilised society is afforded by a cutting from the *Age*, sent to us by Prof. W. A. Osborne, of Melbourne University. The article describes the hearing of an appeal in the High Court by the Australian Pastoral Co., Ltd., against taxation imposed by the Commissioner of Land Tax. Evidence by the general manager of the company revealed the fact that the company suffered so much from the depredation of emus in the Maranoa district that at one period head money was paid for the destruction of the birds. The company used to pay 2*s*. each for grey heads (old birds), 1*s*. 6*d*. for black heads (young emus), and 1*s*. for each egg secured. They were obliged to discontinue the payments, not because of scarcity of emus, but because the company's employees would do nothing but look for emus. The interesting feature is that the standard rate of value of emus' heads during the period of proscription led to their becoming a sort of currency. Bets were made with the heads, and they were often brought into use in the making of purchases, so that they came to be looked upon as a common means of exchange.

SIR JAMES BARRETT writes from Melbourne in reference to our article "Nationalism and Science in China" (NATURE, Sept. 19, p. 469) confirming from his own knowledge and experience the extension of Chinese anti-foreign nationalism to scientific matters. "Personally", he says, "my contact with Chinese surgeons, both men and women, could not have been more pleasant, but one cannot shut one's eyes to the intensity of national feeling." He quotes, as an example, from remarks made by a Chinese surgeon at the recent Pan-Pacific Surgical Congress at Honolulu. While cordially agreeing with Sir James in certain remarks that he had made about science having no national boundaries, he deplored the fact that for three hundred and twenty to four hundred million Chinese there were only about five thousand properly qualified Chinese medical men, and went on to say that there were in effect three medical schools only in China—the Union College, Pekin, the South Manchurian Japanese Medical School, and the Hong-Kong British Medical School.

THE *Chemiker-Zeitung* for Nov. 25 directs attention to two new reagents called 'intrammon' and 'locron', which have been introduced by the I. G. Farbenindustrie Aktien-Gesellschaft for rendering wood and various textile materials fireproof. Intrammon is used for impregnating wood, and is said to be superior to other preparations of the kind, since it can be very uniformly distributed throughout the mass of the material when applied under pressure, instead of merely saturating the outer layers. This property is due to an important constituent which the manufacturers call an activator. Intrammon provides a safeguard not only against fire but also against dry-rot and mildew. Locron, on the other hand, is applied to the surface of the material, and is not brittle like preparations containing water-glass. Under the action of radiant heat, locron swells

into a voluminous, frothy crust, which acts as an insulating layer, thus protecting the underlying fibres from ignition. It can be applied to textile fibres by means of a spray.

How greatly the work of the Hawaiian Volcano Observatory is growing is shown by the appointment of two additional assistants during the last few months. In a recent *Volcano Letter* (No. 351, Sept. 17), Prof. T. A. Jaggar describes the organisation of the work at the observatory, and especially two lines of investigation on which the Volcano Association is now engaged. One is the study of the local tiltings of the ground in Hawaii in connexion with faults, earthquakes, etc., and the outlining of the boundaries of the various fault-blocks. The other is the determination of the surface-positions and depths of the foci of Hawaiian earthquakes from the duration of the preliminary tremors at three stations. The method adopted is one that has been in use for some years in Japan, but the labour of applying it is lessened by new and simple apparatus.

DR. H. R. LANG, acting secretary of the Institute of Physics, has been appointed secretary of the Institute and editor of the *Journal of Scientific Instruments*. Dr. Lang carried out research with the late Prof. H. L. Callendar, and was afterwards demonstrator in physics at the Imperial College of Science and research fellow of the Institution of Petroleum Technologists.

A SERIES of lectures on "Mycorrhiza", "Mycorrhiza in Relation to Forestry", and "Recent Researches on Tree Mycorrhiza" were given by Dr. M. C. Rayner at a number of American universities and research stations during the months of October and November. Lecture engagements at several of the Canadian universities and at various universities and research stations in the western United States were cancelled, with the intention of including them in a more extended tour during the autumn of next year.

IN connexion with the twenty-second annual Exhibition of Electrical, Optical, and other Physical Apparatus arranged by the Physical and Optical Societies to be held on Jan. 5–7 at the Imperial College of Science and Technology, South Kensington, discourses have been arranged for each evening at 8 P.M. On Jan. 5, Mr. C. C. Paterson will lecture on photocells; on Jan. 6, Mr. T. Smith will speak on photographic shutters; and on Jan. 7, the discourse will be given by Sir Oliver Lodge, on "Reminiscences".

DR. BURGESS BARNETT, who has been appointed by the Council of the Zoological Society of London to succeed the late Miss Joan Procter as Curator of Reptiles, is an old student of St. Bartholomew's Hospital. He qualified in medicine and surgery in 1915, and served as a captain in the R.A.M.C. during the War. On being demobilised, he returned to take up the post of house-physician at his old hospital, after which he was appointed medical officer to the Lobitos oil-fields in Peru. Since he has been in South America, he has collected and sent home several valuable collections of living reptiles to the Zoological Gardens. In this way he became acquainted with Miss Procter, and when on leave used frequently to help her in the treatment of difficult cases of reptilian disease. Dr. Barnett is still in Peru, and will not take up his appointment until May 1932.

WE commend to those whom it may concern, and they are many, the pamphlet on "Rats and Mice as Enemies of Mankind", by M. A. C. Hinton, issued by the British Museum (Natural History). Ten years have passed since the second edition appeared, and the third contains additional information and marks a progressive step in the national view of the rat plague, for it records the provisions of the Rats and Mice Destruction Act of 1919, which was passed while the former edition was in the press.

VOL. 2 of the *Veterinary Bulletin* will be issued monthly from Jan. 1, 1932, and will run to about 864 pages, including the index for each monthly issue and the final classified volume index. It will cover the same ground as vol. 1, but will be much more complete and will include references to all important British and foreign scientific work relating to veterinary research, administration, public health, and education. Although it was originally intended that the issues for 1932 and onwards should cover only 600 pages annually, expansion has been necessary in order to deal with the amount of material available. All communications should be addressed to the Imperial Bureau of Animal Health, Veterinary Laboratory, Ministry of Agriculture and Fisheries, Weybridge, Surrey, England.

MR. J. H. KNOWLES, 23a Beulah Hill, Upper Norwood, S.E.19, offers, in list No. 18, some two hundred second-hand books of botanical and zoological interest.

WE have received from Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, a copy of catalogue No. 450, giving particulars of some 1150 second-hand works having reference to botany, agriculture, forestry, fruit-culture, gardens and gardening, herbals, early medicine and surgery, and tobacco. The catalogue is interesting and valuable in that it contains bibliographic notes on many of the volumes listed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Mining and Technical Institute and Junior Technical Day School (Boys), Bridgend—The Director of Education, County Hall, Cardiff (Dec. 22). An inspector of schools under the City of Liverpool Education Committee—The Director of Education, 14 Sir Thomas Street, Liverpool (Dec. 31). A director of education for the Urban District of Rhondda—The Clerk of the Council, Council Offices, Pentre, Rhondda (Jan. 1). A principal of the Thomason Civil Engineering College, Roorkee, India—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Jan. 9).

Letters to the Editor.

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

Polarisation of Downcoming Wireless Waves in the Southern Hemisphere.

In the course of experiments carried out some years ago at the Peterborough Radio Research Station of the Department of Scientific and Industrial Research, Mr. Ratcliffe and I made some observations [1] on the state of polarisation of wireless waves after their reflection by the upper atmosphere. On all occasions on which it was possible to obtain reliable measurements it was found that the downcoming waves were very approximately circularly polarised with a left-handed sense of rotation. Since it was known that the waves originally emitted by the sending stations (emitters at both Teddington and Birmingham were used) were plane polarised, with the electric vector in a vertical plane, the experiments showed that the conversion to left-handed circular polarisation had been effected by ionisation in the upper atmosphere during the process of refraction.

In attempting to explain this result it was pointed out that the influence of the earth's magnetic field is such that, for the range of wave-lengths employed (300-400 metres), there is a considerable difference between the absorption coefficients and phase velocities of the two components propagated within a refracting medium containing electric charges of electronic mass. It seemed reasonable, moreover, to suppose that the polarisation of the waves observed at the ground was produced during their emergent passage through the lower part of the refracting region. For this portion of the wave track it was estimated that the direction of propagation would not differ very markedly from that of the lines of magnetic force of the earth. For propagation along this direction the theory showed that, of the two circularly polarised components which travel, the right-handed component would be much more absorbed than the left-handed, so that waves of predominantly left-handed polarisation would emerge from the ionised layer. The account of this attempt to explain the experimental results was, however, concluded with the following sentence: "But it will easily be seen that the most direct test of the above interpretation would be to carry out similar experiments at corresponding points in the Southern Hemisphere, where the resulting polarisation should be right-handed if the effect is due to the action of the earth's magnetic field".

The Australian Radio Research Board, on its formation by the Commonwealth Council of Scientific and Industrial Research in 1929, gave the prosecution of such polarisation experiments high priority on its programme, and Mr. A. L. Green (formerly of King's College, London, and of the Radio Research Stations, Peterborough and Slough), who had assisted in the English experiments, was entrusted with the task of carrying them out. Working in New South Wales, Mr. Green was able to carry out the tests under conditions which were exactly those required for a strict comparison of results in the northern and southern hemispheres. The emitting station was situated at Coogee, Sydney, and the receiving station at a point 142·7 km. south, at Jervis Bay. For these conditions the downcoming waves must have travelled along a direction only slightly inclined to that of the earth's magnetic field. In his lengthy series of observations Mr. Green has found that all his reliable records show the downcoming waves to be approximately circularly polarised with a right-handed sense of rotation. At his request I have also compared some of his records with those obtained by us in England and have confirmed his result that, under comparable conditions, downcoming waves are polarised in opposite senses in England and Australia.

An account of the complete series of Australian experiments on upper atmospheric influence on wireless transmission will, I understand, be published in due course. Meanwhile, after having had an opportunity of comparing the records in question, I have been requested to announce this very interesting difference between the results in the northern and southern hemispheres.

Experiments on the polarisation of downcoming wireless waves are of more than scientific consequence. The home Radio Research Board, on its formation in 1920, instituted a fundamental inquiry into the cause (and, if possible, the elimination) of night errors in direction-finding. It was recognised at that time that such errors were caused by the arrival at the point of observation of waves which were abnormally polarised, but the origin of such abnormal polarisation was unknown. As a result of Mr. Green's experiments it can now be regarded as certain that the influence of the earth's magnetic field is such as to produce this polarisation. We can say that 'night errors' in wireless direction-finding are due to the arrival at the receiver of waves which leave the emitter as plane polarised waves in a direction inclined to the horizontal and reach the highly ionised regions in the upper atmosphere. There, under the influence of the earth's magnetic field, they are separated into their two component circularly or elliptically polarised waves, which undergo differential absorption and changes in polarisation and are bent round until they leave the ionised regions with a direction of propagation towards the earth. On reaching the receiver they cause fading and errors in the observed direction of the emitting station. It is also gratifying to note that, in connexion with the other aspect of the inquiry instituted by the home Board, Dr. R. L. Smith-Rose and Mr. R. H. Barfield, following suggestions of Mr. F. Adcock, have developed at the Radio Research Station, Slough, a practical direction-finder which is substantially free from errors even under conditions when downcoming waves of abnormal polarisation are being received.

E. V. APPLETON.

Potters Bar,
Nov. 23.

[1] "A Method of determining the State of Polarisation of Downcoming Wireless Waves", *Proc. Roy. Soc.*, A, **117**, 576; 1928.

Oxygen and Everest.

DR. RAYMOND GREENE'S article [1] "Oxygen and Everest" is the substance of his contribution to the discussion following Prof. J. Barcroft's paper to Section I of the British Association at the centenary meeting, on "The Limits placed by Altitude to Physical Exercise".

In that paper it was recorded that recent experiments in the pressure-reducing chamber at Oxford have shown how work, claimed to be equivalent to ascending 1000 ft. per hour, can be done by human beings breathing oxygen, at a pressure much below that prevailing at the top of Mount Everest, 29,002 ft. The conclusion arrived at was that for the last 5000 ft. of the mountain, up and down, 700 litres or 30 cub. ft. of oxygen per man would be indispensable, involving in the containers and apparatus necessary

an altogether too heavy load. The problem, therefore, of climbing Everest was deemed one less for the mountaineer than for the engineer, on whom should devolve the responsibility of devising some kind of light cylinder of high tensile strength capable of containing under great pressure the requisite quantity of gas.

I may perhaps be allowed to give in brief the substance of my remarks in the discussion on Barcroft's paper, and add one or two *à propos* of Dr. Greene's views.

Following the second expedition to Mount Everest, which was the first actual assault above 23,000 ft. on the main summit, opinions differed as to the value of an artificial supply of oxygen. Finch and Geoffrey Bruce had reached 27,200 ft. using an oxygen apparatus all the way from 21,000 ft. But Mallory's party of four climbers had also attained almost an equivalent altitude, namely, 26,900 ft., entirely without oxygen equipment and relying upon their own inherent powers of acclimatisation.

The third expedition of 1924 was equipped with apparatus of an improved kind, including three cylinders of a specially light alloy ('Vibrac') steel, with a total capacity of 1605 litres, or about 57 cub. ft. of oxygen. This amount at the prescribed continuous consumption of 2 litres per minute was to provide for a 13 hours' climb, ascent and descent. But the total weight of the apparatus was about 33 lb. This, however, was later reduced to 22 lb. by discarding one cylinder and modifying the breathing apparatus.

Owing to various defects in the apparatus, to some extent consequent upon rough handling on the outward journey across Tibet, considerable delay was occasioned by the necessary repair work before a sufficient number of apparatus were available for use on the mountain. In the meantime high camps were pitched and plans laid for attempts on the summit without breathing apparatus; and these very efforts of the climbing party were the means of bringing about a degree of acclimatisation never before attained by previous climbers. Geoffrey Bruce, who had depended on oxygen in 1922, now found no perceptible relief when using it. On one occasion I carried an apparatus up to 27,000 ft., and as I was getting no benefit at 26,000 ft. I turned off the supply of gas and continued climbing with no noticeably enhanced fatigue. By living at an altitude of not less than 23,000 ft. for 11 days a very high degree of acclimatisation had been acquired.

It must not be supposed that the failure to find relief, or advantage, when using oxygen was due, as Dr. Greene has suggested, to some inherent defect in the apparatus and its supply of oxygen to the lungs. On the contrary, every apparatus eventually repaired was in perfect gas-tight condition, and by practice a suitable habit of inhaling from the mouth-piece of the supply tube had been acquired by the users.

Acclimatisation to an altitude of 27,000 ft. has been demonstrated, and there seems no valid reasons why it should not be possible to above 29,000 ft., or the top of Everest. In their record-making ascent to 28,000 ft. and above without oxygen supply, Norton and Somervell were admittedly reduced to extremely slow upward progress, but it must be remembered that neither of them was a fit man at the outset, largely owing to their having taken part in an exhausting rescue expedition not long previously. Mallory and Irvine set out on their last tragic climb with breathing apparatus, but we may never know what benefits, if any, they derived from it. In any case, there is nothing to warrant Dr. Greene's supposition that their failure to return was due to a breakdown in the oxygen apparatus.

Our general conclusions regarding the use of oxygen were long ago stated in "The Fight for Everest", 1925, page 329, wherein it was maintained that for a mountain of exceptional altitude, such as Everest, a future climbing party might advisably be provided with a light form of apparatus supplying a sufficiency of gas for the last few hundred feet of the mountain. It was strongly recommended, however, that such apparatus should be considered an emergency measure only, and acclimatisation to the highest altitudes should be resolutely aimed at. In practice, such altitudes on Everest would be about 27,000-28,000 ft., the height of the highest camp, and one to which carrying parties must ascend, unhampered by the extra individual load of breathing apparatus. For in this connexion it should not be forgotten what a high percentage of available porterage can be consumed, as it was on the Everest Expeditions, in carrying up oxygen supplies merely for the summit climbing parties.

With these things in view, a lightened and simplified apparatus was devised in 1925, and trials of its suitability for mountain use made in Snowdonia. The equipment provided for about 15 cub. ft. of gas, and its weight was not more than 12 lb.

Thus the load involved becomes a manageable one, and from the experience gained thus far it should provide ample oxygen for emergency purposes if due regard has been given to acclimatisation. The problem of the engineer, as conceived by Prof. Barcroft, would appear, therefore, to have been already largely solved by the mountaineer, though not without the earlier advice of the former. But both engineer and physiologist may be reminded that among many mountaineers the opinion prevails that if Mount Everest and other high Himalayan peaks are worth climbing at all, they should be ascended without such artificial aids as may reduce a sport to a mere laboratory experiment. If, however, in the interests of physiology the opportunity should not be missed, where, it may be asked, can this important problem of acclimatisation be better studied than under actual mountain conditions? It would seem to be as important for study as a mere duplication of the experiments carried out in a pressure chamber, where it has been shown that man can survive, when primed with oxygen, at a pressure much below that obtaining at the top of Mount Everest.

There is, however, much besides which might with profit be investigated. Dr. Greene makes no mention of the experiments which he conducted upon himself and another member of the Kamet party, namely, dosing with ammonium chloride to counteract 'alkalosis', apparently with good results. Research into all these matters, as suggested should be undertaken by the committee appointed by the British Association, might be diligently pursued as soon as possible in order that the next Everest Expedition, whenever it may receive permission to embark again on the great unfinished task, shall have all the tried advice which physiologists can provide.

N. E. ODELL.

Clare College, Cambridge,
Nov. 30.

[1] NATURE, **128**, 893, Nov. 28, 1931.

Lead Content of Rocks.

IN recent years various geochemical problems have arisen which make it important that our scanty knowledge of the lead content of rocks should be amplified and made more precise. To this end we have determined the lead in a series of samples, representing in all about 220 rocks, some of which

we owe to the kindness of Prof. Arthur Holmes of the University of Durham.

The sample to be analysed was brought into solution; silver sulphate was added and the silver and lead present in the solution were simultaneously precipitated as sulphide. The precipitate was then brought into solution and the lead deposited electrolytically as peroxide. That the deposit was actually lead peroxide was confirmed by a colorimetric test, tetramethyl-diamino-diphenylmethane being added to the solution of the deposit. To ascertain that the total lead content was actually recovered, we used the method of radioactive indicators. We added to the rock sample a known amount of the lead isotope radium D, prepared from radium emanation, and checked the yield obtained by measuring the activity of the lead peroxide deposit. As the purest chemicals commercially obtainable were found to contain quantities of lead that would have influenced our results, all the chemicals used were first purified from lead. Moreover, every precaution was taken to avoid contamination of the samples by dust which might have contained traces of lead. The results obtained are listed in Table I.

TABLE I.—LEAD CONTENT OF IGNEOUS ROCKS.

Rock Types.	Gm. Lead per gm. Rock.
Basalt, Giant's Causeway	4×10^{-6}
Gabbros and related types (composite of 67 samples)	5×10^{-6}
Essexites and related types (composite of 40 samples)	10×10^{-6}
Shonkinites (average of 2 samples)	10×10^{-6}
Soda-granites and soda-syenites (composite of 26 samples)	11×10^{-6}
Potash-granites and potash-syenites (composite of 24 samples)	14×10^{-6}
Amphibolite, inclusion in Kimberlite, Wesselton Mine, S. Africa	15×10^{-6}
Kimberlite ('basaltic' type). Dyke from 1350-foot level, Dutoitspan Mine	16×10^{-6}
Lherzolite, Baltimore, Maryland	19×10^{-6}
Granitic rocks (composite of 58 samples of widely different localities)	30×10^{-6}
Dunite, Jackson Co., North Carolina	42×10^{-6}

The average value found is 16×10^{-6} gm. lead per gm. rock, a somewhat larger value than that given by Clarke and Steiger,[1] who found $7{\cdot}5 \times 10^{-6}$ gm. per gm. rock. As shown in the communication that follows, the amount of lead accumulated in the rocks since the solidification of the earth's crust (as a result of the decay of uranium and thorium) is very much smaller. Thus, as between the atomic weights of rock-lead and ore-lead we have in most cases to expect differences only in the second decimal place. That the ore-lead must have been formed in the ancestral sun, or during the events that attended the birth of the solar system, was already pointed out some years ago by Prof. Holmes.[2]

We conclude from the above determinations that the greater part of rock-lead is also of the same origin. Although acid rocks, which have a relatively high uranium and thorium content, are found to contain more lead than basic rocks, this difference is not to be interpreted as an argument in favour of the radioactive origin of the whole of the lead in rocks, but an expression of the fact that lead, like uranium and thorium, shows a marked affinity to siliceous magmas.

It is of interest to compare the lead content of basic and ultrabasic rocks with that of meteorites as determined by Noddack.[3] The lead content of stony meteorites is near that of basalt and average gabbro, and is markedly lower than that of terrestrial ultrabasic rocks. The lead content of iron meteorites, as confirmed in this laboratory, is about ten times greater than that of stony meteorites, while that of troilite (the high lead content of which was predicted by Prof. V. M. Goldschmidt) is more than a hundred times greater (700×10^{-6}). These results show that when the earth was formed the silicate shell received only a modest share of the total lead available for partition, and that this uneven distribution has so far been compensated only slightly by the formation of lead from radioactive decay.

TABLE II.—LEAD CONTENT OF BASIC AND ULTRABASIC ROCKS AND OF METEORITES.

	Gm. per gm. Rock.
Gabbros (average)	5×10^{-6}
Kimberlite	16×10^{-6}
Lherzolite	19×10^{-6}
Stony meteorites (average)	5×10^{-6}
Iron meteorites (average)	50×10^{-6}

G. HEVESY.
R. HOBBIE.

Institute of Physical Chemistry,
University of Freiburg im Breisgau.

[1] *Jour. Wash. Acad. Sci.*, **4**, p. 58; 1914.
[2] NATURE, **117**, 482, April 3, 1926.
[3] *Die Naturwiss.*, **18**, p. 761; 1930.

IN two earlier communications on this subject[1, 2] I directed attention to the bearing on geological time and geochemical problems of Clarke and Steiger's determination of lead in a composite sample of 329 igneous rocks. The amount of lead found by these analysts was $7{\cdot}5 \times 10^{-6}$ gm. per gm. Adopting this result as the best then available, and combining it with other data, such as the uranium and thorium contents of rocks and the atomic weights of lead from different sources, I pointed out that the following inferences could be drawn:

(*a*) that the age of the earth could not be greater than some 3200 million years;

(*b*) that the atomic weight of rock-lead should fall about midway between 207·2 and 206·9, these being the respective atomic weights of common lead (that is, ore-lead) and lead of radioactive origin generated in the rocks; and

(*c*) that ore-lead could not have been derived from igneous rocks or their magmas, since the atomic weight estimated for rock-lead, 207·05, differed widely from that actually found for ore-lead.

The third of these inferences was supported by the remarkable coincidence that in the one measurement on record of the atomic weight of a sample of rock-lead (from cotunnite, 1906 eruption of Vesuvius) the average value found was 207·05 (Piutti and Migliacci, 1923), whereas for ordinary lead the same investigators obtained the value 207·19. Nevertheless, the inference has proved sufficiently disturbing, as I hoped it would, to stimulate workers in various research centres to revise and amplify the data on which it was based. If, for example, Clarke and Steiger's figure for the lead content of rocks were not fairly representative, then the whole argument would stand in need of revision. Similarly, if the ratio Th/U in rocks were greater than 2·2, then the atomic weight of generated lead would be correspondingly higher than 206·9. Moreover, the Vesuvius magma is of a rather uncommon type, widely different from that with which lead ores seem generally to be associated. An atomic weight determination of lead from rocks of the rhyolite-andesite series might therefore be expected to throw fresh light on the problem. All these lines of attack are now under active investigation, and the results announced above by Prof. Hevesy and Dr. Hobbie may be regarded as the first fruits of the campaign.

These results show that Clarke and Steiger's figure can no longer be regarded as representative. The following table makes this clear. The age of the earth is taken as 1600 million years, and the amount of lead, Pb, generated in the material of each rock or composite sample during that time is compared with the total amount of lead, Pb, found by analysis. It

Type of Rock.	U.	Th.	Pb.	Pb.	Pb/Pb.
C. and S. average .	6·0	15·0	2·6	7·5	3
Gabbros (average) .	2·4	5·1	1·0	4·0	4
Granites (average) .	9·0	20·0	3·7	18·0	5
Basalt . . .	1·5	1·7	0·5	4·0	8
Kimberlite . .	3·2	4·7	1·1	12·0	11
Amphibolite . .	0·9	3·1	0·5	10·0	20
Dunite . . .	1·4	3·4	0·6	32·0	53

Note.—The figures for U, Th, Pb, and Pb are the amounts in grams in 10^6 grams of rock.

will be seen that whereas the Clarke and Steiger figure (C. and S. average) implies that the total lead is three times the lead generated during 1600 million years, the Hevesy and Hobbie figures show that the total lead ranges from four to fifty-three times the generated lead. Dr. J. A. Smythe has recently found that a composite sample of 2950 specimens of the Whin Sill contains 24×10^{-6} grams of lead per gram.[3] The average contents of uranium ($0{\cdot}8 \times 10^{-6}$) and thorium (3×10^{-6}) are also accurately known from the work of Dr. V. S. Dubey. These results imply that the total lead in the Whin Sill is sixty times the generated lead.

From the point of view of the genesis of lead ores, the most significant of the results of Hevesy and Hobbie is that for granitic rocks. The latter include pre-Cambrian, Caledonian, and Hercynian granites from various parts of Europe (ranging petrographically from granite to granodiorite), and similar North American rocks of various ages from pre-Cambrian to Tertiary. In this representative composite sample the total lead is five times the generated lead. The atomic weight of the latter may be calculated and is found to be 206·96. If the atomic weight of the lead originally present in the earth be taken as 207·23, then that of the lead now present in granitic rocks should be between 207·17 and 207·18. Thus, if lead ores have been derived from granitic magmas, the atomic weight of ore-lead should vary between 207·23 and 207·17 according to the age, the higher value referring to ores dating from the beginning of geological time and the lower to ores formed at the present day. The values for actual ores should lie within these figures, and as shown in the list I have already compiled,[2] the most accurate determinations made since 1915 do, in fact, range from 207·22 to 207·18.

Thus, in the light of the new data now available, there is no longer any serious reason to doubt the usually accepted conclusion that lead ores have been derived from granitic and related magmas, always provided that the age of the earth is not considerably greater than 1600 million years. The maximum age previously calculated from Clarke and Steiger's figure for lead (on the extreme assumption that *all* the lead in the rocks has been generated within them) must now be replaced by a maximum several times higher than 3200 million years, a maximum so high that it ceases to have any immediate practical interest.

ARTHUR HOLMES.

The University, Durham, Nov. 16.

[1] NATURE, **117**, 482, April 3, 1926.
[2] NATURE, **124**, 477, Sept. 28, 1929.
[3] *Trans. Nat. Hist. Soc., Northumberland, Durham, and Newcastle-upon-Tyne*, p. 32; 1930.

Limits of Gaseous Explosions.

IT was stated long ago that the kinetics of gaseous reactions do not submit to the laws of classical physical chemistry. In particular, deviations from the law of mass action are best of all illustrated by the presence of the pressure limits for a thermal ignition.

The lower limit was revealed by Sagulin,[1] and its existence was confirmed by the work of Garner [2] and Hinshelwood [3] and others. Yet the upper critical pressure was known to Labillardiere [4] and was studied by Davy and Van 't Hoff.

However, the region of explosion between these two pressure limits has become clear only during recent years, owing to the works of Hinshelwood and Thomson,[5] and especially to those of Semenoff, Sagulin, Kovalsky, and Kopp.[6]

Recently, in the laboratory of the Institute of Chemical Physics in Leningrad, we have succeeded in

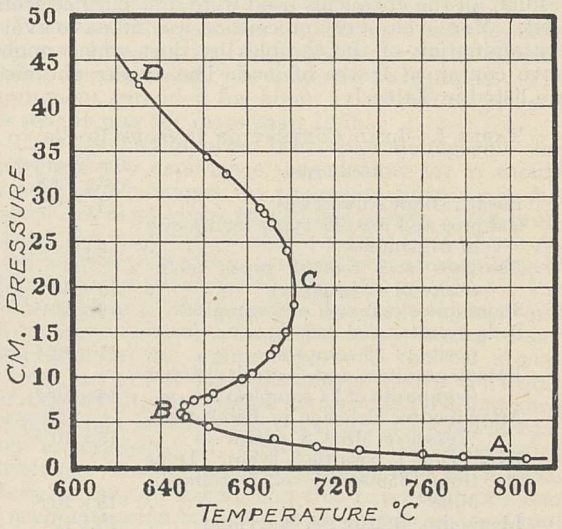

FIG. 1.

establishing a complete picture of the region of explosion for a stoichiometrical mixture of methane and oxygen. It has been found that, for a certain range of temperatures, there really exist three pressure limits of ignition. The region of ignition of the above mixture in a cylindrical vessel of quartz with a diameter of 3 cm. is given in Fig. 1, which indicates the relations experimentally obtained between limiting pressures and temperatures. The lower ignition limit is represented by the curve *AB*, above which an ignition occurs. Corresponding to this part of the curve 'time lags' from 2 min. to 20 min. are observed in dependence on temperature. Curve *BC* is referred to the upper ignition limit, with the 'time lags' from 12 min. to 20 sec. Finally, the third limit of ignition is shown in the figure by the line *CD*. In this region, for an examined temperature interval, the 'time lags' are appreciably constant and equal to 6 sec. To the point *B* correspond the pressure of 6 cm. and the temperature of 650° C.; for *C*, 19 cm. and 701° C. respectively.

The explosion is possible only to the right of the curve *ABCD*, while to the left it does not occur.

For the region of explosions between gas pressure p, absolute temperature T, and 'time lags' τ there exists a relation

$$\tau \cdot p^n \cdot e^{-\frac{\gamma}{T}} = \text{const.}$$

In our case $n = 1{\cdot}8$ and $\gamma = 42{,}000$.

We hope later on to give a detailed account and inter-

pretation of the results we have obtained, on the basis of a theory of chain reactions.

In conclusion, we wish to express our sincere thanks to Prof. N. N. Semenoff, the director of the Institute of Chemical Physics, for his interest and advice during the course of this work.

M. NEUMANN.
A. SERBINOFF.

Institute of Chemical Physics,
Leningrad, Oct. 10.

[1] *Zeit. physik. Chem.*, B, **1**, 125; 1928.
[2] *Trans. Far. Soc.*, **24**; 1928.
[3] *Proc. Roy. Soc.*, A, **125**, 294; 1929.
[4] *Ann. Ch. Phys.*, V, **6**, 304; 1817.
[5] *Proc. Roy. Soc.*, A, **5**, 122; 1929.
[6] *Zeit. physik. Chem.*, B, **6**, 307; 1930.

The Comma Butterfly in England.

I HAVE just seen the correspondence in NATURE for Oct. 31 regarding the Comma butterfly in England, and it occurs to me that some observations I have made in the south-western parts of the country may throw some light on the increasing frequency of this insect.

About twelve years ago it was usual to see perhaps four or five specimens of the Comma each year, sunny days during early October being the time when most were to be seen, but hybernated specimens were also seen on warm days in March. During more recent years, however, the number of Commas seen has very much increased, particularly during the last three or four years, not only in Somerset, but also in Dorset and Hants as well. I have noted several occasions during the last two years, both here and in the New Forest, upon which the Comma has been quite the most abundant butterfly to be seen. I have seen as many as thirteen simultaneously on one small *Buddlea* bush in the town of Bournemouth.

What appears to me, however, to be the most striking change with regard to this butterfly lies in the fact that formerly it used only to be seen here in spring and autumn, whilst during the last three years at least it has been double-brooded in this district, numerous specimens being seen about the end of June and during July also. This double-broodedness has been confirmed by finding larvæ of both broods and also a pupa of the first brood. In addition to this, in Somerset at all events, the larvæ do not now feed exclusively on hops, but also on the common elm. The perfect insect has been successfully reared from larvæ found feeding on each of these plants. Without any special search being made, twenty-five larvæ have been found during the last two years. These observations seem to suggest that the habits of the Comma butterfly have undergone a change which may well account for the greater numbers observed during recent years.

F. TUTIN.

Rose Cottage, Flax Bourton,
near Bristol,
Nov. 25.

Preservation of the Australian Flora and Fauna.

ON behalf of many people and organisations who are trying to save the Australian flora and fauna, I desire to thank you for the very sympathetic reference to the preservation problem made in NATURE of Sept. 12, 1931. Recently both governments and people have shown an increasing desire to try to save the disappearing animals and plants. This has been evidenced by the passing of the Wild Flowers Preservation Act both in New South Wales and Victoria, and by the extension of the Wyperfeld (Mallee) National Park in Victoria by the present Minister of Lands in Victoria, Mr. Bailey. Other proposed reservations are under consideration.

Particular acknowledgment should be made to Mr. F. Lewis, Chief Inspector of Fisheries and Game in Victoria, who has been most helpful in co-operating with various societies in the endeavour to preserve the unique creatures which at one time existed in Australia in very large numbers.

The Wyperfeld Park, situated about three hundred miles north of Melbourne, now covers thirty-six square miles of country and is one of the most interesting places on an interesting earth. The rainfall is very small, but the Park is traversed by the bed of the ancient Wimmera River, which in geological times flowed into a huge gulf of the sea in the north. The river now runs through the Park about once in ten years and then disappears in the sand north of the Park, but the water remains in the water-holes for three or four years before it evaporates. During the wet period, aquatic birds abound. Water is obtained in the dry period by wells and is used by the birds and animals. Along the bed of the river, red-gum (eucalyptus) grows profusely. Away from the river there is the usual semi-desert Mallee country. The birds nest in the red-gums, but apparently feed mainly in the outside country.

The Park is the home of the parrot and cockatoo family, which is increasing in numbers. It also contains emu and some of the black-faced Mallee kangaroo. Its profound interest is the way in which forms of life have survived and thrived in comparatively rainless conditions. The adaptation is remarkable.

Owing to the cultivation of the Mallee, the Leipoa or Mallee hen, popularly known as the Lowan, has practically been driven to seek refuge in the Park, and on a recent visit at least three of the nest mounds were found. There may have been many more, but they are not easy to find in the Mallee scrub, as there is no indication of their presence until one walks on to them.

Since the Park has been declared a National Reservation and has been patrolled, birds and animals have increased in numbers. Perhaps one of the most important features of the change is that the people living in the district have begun to take a pride and an interest in this unique portion of the globe.

JAMES W. BARRETT,
President, Wyperfeld National Park
Committee of Management.
103-105 Collins Street,
Melbourne, C.1,
Oct. 22.

Distribution of Agar-liquefying Bacteria.

SEVERAL strains of an organism which attacks and softens agar-agar have recently been isolated in this laboratory. The organism forms small, slowly growing, yellow colonies which grow well in the usual agar media; the colony is invariably situated in the centre of a circular area of softening. The 'hammered copper' appearance thus given to the plate is characteristic. No strain liquefies the agar. In stroke cultures the whole of the agar is in time softened, though growth does not proceed except on the surface.

The sources of the organisms were a swampy garden soil from Palmer's Green, London, and the clover side of Agdell Field, Rothamsted, both sampled in wet weather this spring. Most strains appear to be common to both soils. The optimal growth of most of the strains occurs in a medium containing about 0·3 per cent of sodium chloride, but one strain from Palmer's Green has grown on a medium similar to

Gran's, containing 3 per cent of salt. The presence of glucose depresses the growth of most strains.

The organisms have not been fully studied. While the finding of a halophilous organism in inland soil suggests several points of interest, the purpose of this letter is to direct attention to the probability of wide occurrence of organisms attacking agar, rather than to create new species. Such organisms have already been found in the Norwegian and West Indian seas, in Dutch soil and canal water, on Polish beetroot and Spanish raisins, and elsewhere. It seems likely that the discovery of bacteria able to attack hemicelluloses awaits but the search.

In view of the fact that such organisms have not been found here on thousands of 'count' plates, made directly from soil suspensions, it may be of value to mention that the present organisms, as some others have been, were isolated from filter-paper strips in the course of a search for cellulose-decomposing bacteria. With these latter the agar-liquefiers were frequently associated. HUGH NICOL.

Department of Bacteriology,
Rothamsted Experimental Station,
Harpenden, Herts, Dec. 9.

Periodic Precipitation in the Absence of Colloids.

SEVERAL writers [1] have recently discussed periodic precipitation in the presence of gels and other related phenomena. It is the object of this note to direct attention to one of the most important and significant papers [2] in this field that appears, however, to have been overlooked.

Morse and Pierce [3] indicated in 1903 that periodic precipitation and formation of Liesegang rings is not dependent upon the presence of a jelly. In his beautiful experiments described, with many photographs, in 1930,[2] Dr. H. W. Morse summarises his work of the intervening years and demonstrates the formation of Liesegang rings in pure aqueous inorganic substances. One of the most interesting is the series of rings of an alum, each ring consisting of a single branched crystal of the moderately soluble salt. Morse was able to explain his results without invoking anything more mysterious than the ordinary laws of diffusion and the very rapid increase in instability as supersaturated solutions rise in concentration.

Some of the first-named writers had queried the formation of rings of silver chloride in the presence of gelatine. It is interesting that this is one of the substances which Morse has photographed in periodic stratification as formed even without gelatine.

JAMES W. McBAIN.

Stanford University,
California.

[1] Nabar and Desai, NATURE, April 25, 1931, **127**, 628; Bolam, Aug. 8, 1931, **128**, 222; Bradford, Aug. 8, 1931, **128**, 223; Desai, Aug. 8, 1931, **128**, 223; and Hedges, Sept. 5, 1931, **128**, 401.
[2] H. W. Morse, *Jour. Phys. Chem.*, **34**, 1554; 1930.
[3] Morse and Pierce, *Zeit. physik. Chem.*, **45**, 589; 1903.

Bands in the Spectrum of Barium Hydride.

IN the last few years our knowledge of the spectra of diatomic hydrides has been greatly increased. This is especially true for the hydrides of the elements in the second column of the periodic table, the spectra of the neutral molecules BeH, MgH, CaH, ZnH, CdH, HgH, and of the ionised molecules BeH^+, MgH^+, ZnH^+, CdH^+, HgH^+ having been analysed. It therefore seemed worth while to complete the available information by studying the spectra of SrH and BaH.

Bands probably due to BaH have already been reported by Eagle,[1] who used an arc in a hydrogen atmosphere between electrodes containing barium chloride. The dispersion of his spectrometer was, however, rather small. I have succeeded now in producing these bands with such intensity that it was possible to photograph them in the first order of a 6 m. concave grating. The source was a vertical arc, the lower negative electrode made of nickel having the shape of a small oblong tub, containing metallic barium, while a nickel rod formed the upper positive electrode. The arc was enclosed in a cylindrical metal case containing hydrogen; the optimum pressure was about 4 cm.

Four distinct band-heads were found at λλ 6634, 6689, 6850, 6923 A. respectively, all shaded towards the violet. The values are in agreement with the measurements of Eagle. An approximate calculation from the perfectly resolved bands furnished a moment of inertia which fits in well with the moments of inertia for elements in the second column of the periodic table, if these bands are ascribed to BaH. The electronic transition is of the type $^2\Pi - {}^2\Sigma$ and probably is analogous to the similar transitions observed in the spectra of the other neutral molecules mentioned above. A full analysis of the spectrum will be published elsewhere. A. SCHAAFSMA.

Natuurkundig Laboratorium
der Rijks-Universiteit, Groningen,
Nov. 7.

[1] *Astro. Jour.*, **30**, 231; 1909.

Matter : Life : Mind.

IN denoting matter, life, and mind as 'events' or 'grades', General Smuts struck a happy medium between the physicists' 'stages' and the metaphysicists' 'planes'. In neither stressing nor denying a causal connexion, he succeeded in steering clear between the dangers of scientific uncertainty and meaningless profundity.

However, Prof. Boycott's letter in NATURE of Oct. 24 on this subject calls for some comment.

There will be but few dissentients in answering his query in the affirmative. But where are those 'mechanists' and 'organicists' whom Prof. Boycott saddles with assigning a quantitative relationship between matter and life? Who attributes a quantitative relationship between the combined effect of life-functions and the heterogeneous and variable system of organised matter? I submit that in the present state of our knowledge the connexion between life and living matter is *qualitative*—the former being the find and determined by the complexity and organisation rather than the mass of the latter. As to the functions by which life is perceived, we can resolve them into form, growth, orientation, and reproduction. Our physico-chemical and photoelectric experience enables us to understand and even reproduce the functions of form, growth, and direction,[1] and there is but little doubt that our research in the domain of optically active substances and radioactive isotopes will give us ere long an insight into the problem of reproduction.

As already mentioned, the functions of the living unit are related in general terms to the complexity of its organisation. In the case of viruses these functions are reduced to a minimum, with a correspondingly simplified assemblage of matter essential only to reproduction. MAURICE COPISAROW.

145 Alexandra Road,
Manchester, S.W.,
Nov. 23.

[1] Hatschek, *Proc. Roy. Soc.*, **95** A, 303; 1919. Copisarow, *J. Chem. Soc.*, 233; 1927: and *Koll. Zeits.*, **47**, 60; 1929: *ibid.*, **56**, 67; 1931.

Research Items.

Serpent Worship.—Mr. Wilfrid D. Hambly, assistant curator of African ethnology in the Field Museum of Natural History, Chicago, has made a study of serpent worship in Africa which appears as *Publication* 289 (vol. 21, No. 1 Anthropological Series) of the Museum. The study of serpent worship hitherto has been confused, but a classification of the ideas which it embodies is suggested. (1) Python worship, of which there are two unquestionable areas, one in West Africa and a smaller region in Uganda; (2) the serpent in relation to fecundity, transmigration of souls, and totemism; the only one of these with a clear geographical distribution being the reincarnated ancestor concept, which occurs continuously from the Cape to Lake Rudolph; ideas of transformation are spread over the whole continent; (3) the rainbow snake, that is, a number of stories and legends relating to snake monsters of which the basic thought is that the snake is a guardian of water, woods, ruins, or grain; (4) immunity and snake-medicines, dependent on the idea of a human soul being in communion with the snake. Evidence relating to cures of snake-bite show that the treatment is by no means entirely magical. The examination of African python worship in relation to cults and beliefs from other parts of the world provides no evidence that Africa received snake worship from extraneous sources, nor is there more than a superficial resemblance between the snake beliefs of Africa and ancient Egypt. The most fundamental ideas of all kinds of African snake belief are those of reincarnation and fecundity. The idea of the snake ancestor visiting the dwelling has a strong and clearly defined distribution from the Suk to the Zulu. Sometimes the visiting snake ancestor announces a conception. In other cases conception is inferred from the visit of any snake.

Man and the Primates.—In the *Scientific Monthly* for November, Prof. Adolf H. Schultz sets out in detail results of some of the less widely known and quite recent comparative studies on certain features pertaining chiefly to primates and their bodily proportions, which answer such questions as why the gibbon and anthropoid apes must be regarded as man's nearest relatives; whether the gaps between man and the recent anthropoids are relatively large or small when measured by the scale of differences between other primates and the like. Significant features are examined in turn. There is a tendency to increase in bodily size with advance in evolutionary development. Anthropoid apes are the only primates as large as or larger than man. Man's relative hairlessness is not unique, but an extreme manifestation of an evolutionary trend to reduce the coat of the larger primates. The nose supports the recapitulation theory. The human ear resembles most closely that of the gorilla. Man has relatively the largest head, the lower catarrhines the smallest. The high forehead of early stages of life disappears soon after birth in the apes, but is retained in man. The trunk of the higher primates has become relatively shortened by the elimination of vertebræ, allowing the pelvis to shift towards the chest, while it has become relatively short and broad. In this respect man is the missing link between apes and gibbons. In length of arm the apes, other than the mountain gorilla, have specialised to a much greater extent than man, while in length of leg man has specialised to a greater extent than the apes. The hand of man is in every respect the hand of a primate, though in breadth it is conservative when compared with that of a gorilla. The foot of man is nothing but a modification of the foot which has given rise to the foot of modern anthropoids. It is concluded that man and the large anthropoids represent the most advanced expression in all primate evolution. In some respects man is more specialised than the apes, in others the relation is reversed.

Structural Features of the Cruciferous Flower.—Two papers on the anatomical structure of normal and abnormal flowers of Cruciferæ, by Dr. Agnes Arber (*New Phyt.*, vol. 30, 1931), represent a type of investigation that is much needed to elucidate flower structure. So much of the discussion on floral morphology is based on dissections that it is time that the facts were tested with more detail and exactitude. The author is obviously not in agreement with E. R. Saunders' view of the cruciferous gynœcium, and she discusses many of her facts in relation to this argument. The fact that the placentas receive most of their vascular supply from the valve strands appears to support the bicarpellary view, but it is also shown that the lateral sepal bundles are derived from the petal bundles, showing that "vascular bundles may exhibit a complete disregard for morphological boundaries", and this makes the origin of the placental bundles carry less weight than might otherwise be the case. It would be most interesting to know the anatomical facts for the gynœcium of the two species of *Triglochin*, which would appear to be more obvious illustrations of E. R. Saunders' theory. Of less controversial nature, it is satisfactory to have confirmation of Klein's observation that the strands to the lateral sepals pass out before those of the median, thus bringing the cruciferous flower into line with the general rule for the origin of the outermost foliar structures on lateral flower or vegetative buds. The vascular supply to the inner stamens does not support the suggestion of chorisis. The squamules found in relation to young leaves and pedicels (especially in *Nasturtium officinale* R. Br.) are suggested to be "stipules of non-existent bracts". The general absence of stipules in cruciferous leaves makes one sceptical as to the stipular interpretation, though bracts may occasionally be seen subtending the lower flowers in *Cheiranthus* or *Capsella* and probably other genera also.

X-Ray Analysis of Slate.—An application of the X-ray diffraction method to the elucidation of the real nature of slate has been made by H. V. Anderson and K. C. Chesley, and their results and conclusions are presented in the *Amer. Jour. Sci.*, August 1931, pp. 103-112. Seven slates from different localities were examined, and a table is given showing the interplanar spacings in angstrom units, as obtained by the powder method, together with the principal spacings for the minerals found to be present. Evidence is forthcoming which indicates that former analyses reporting kaolin or andalusite in slate are in error, and that the probable aluminium silicate present is kyanite. The preponderance of quartz, corundum, kyanite, and mica in slates is established, and small quantities of other minerals are indicated. An attempt is made to correlate structural differences with grain size, and further work along this line is in progress. X-ray analysis confirms the fact that the cleavage is due to the orientation of the mica during its crystallisation under pressure.

Light Transmission through Fog.—Owing to the increasing importance of commercial aviation, much experimental work is being done on the transmission of visible light through fog. In the *Physical Review* for July 1931, H. G. Houghton gives an interesting account of experiments in this connexion which he has

made. He produced a fog by condensing low-pressure steam in a zinc-lined wooden chamber 300 cm. long and 25 cm. square. At one end was located the source of light—an incandescent lamp—and the necessary optical systems and filters for obtaining various bands of wave-lengths in the visible spectrum. The detecting apparatus consisted of a photoelectric cell, a two-stage direct current vacuum tube amplifier, and a sensitive milliammeter. The only difference between the artificial fog and natural fog was the size of the fog droplets. It was found that the artificial fog was composed of smaller particles of more uniform size. After some difficulty, a cell was obtained which was sensitive over the entire visible spectrum. It was found that no type of visible radiation possesses any very marked fog penetrating powers. The coloured beam of wave-length 0·490μ, however, transmitted a definite maximum percentage of light. The author concludes that the attenuation is probably due more to scattering than to absorption. The shape of the curve showing the transmission at various fog densities indicates that it is largely dependent on the size of the particles of the fog used. Hence any transmission curve is applicable only to the particular fog on which the measurements were made. The author's results apply only to a fog or haze where the particles are small. In the same journal, in conjunction with J. A. Stratton, it is proved mathematically that the particle size of the fog is a controlling factor in the transmission characteristics.

Abnormality of Radio Signals passing through High Latitudes.—Modern developments of short wave wireless communication have brought to light many interesting phenomena, such as the existence of round-the-earth echoes and echoes of long delay. Another peculiarity of such high-frequency transmission has recently been reported to us by S. Namba from the Electrotechnical Laboratory, Ministry of Communications, Tokyo, Japan. It has been noted that the signals from the New York stations received in Japan exhibit certain peculiarities which are probably attributable to the fact that the great circle passing through New York and Tokyo traverses auroral and polar regions. The New York signals are characterised by a continuous fluctuation in carrier wave frequency and a marked blurring in audible morse reception. Since it is known that the frequency emitted by the sending station is kept constant within narrow limits by piezo-electric control, the observed fluctuations in the received signal must be attributed to the influence of the transmission path. The variations in the frequency of the carrier wave are attributed to a pronounced Doppler effect, which has already been noticed to a lesser degree on signals arriving in other directions. As the main ionising agent in the polar regions is considered to be charged corpuscles shot out from the sun and deflected to the magnetic polar region under the influence of the earth's magnetic field, the ionisation in the polar atmosphere may be expected to exhibit greater fluctuations than that in non-polar regions where the main ionising agent is ultra-violet radiation. Both Doppler effect and blurred signals may therefore be abnormally marked for signals passing through high latitudes.

Quantum Theory of Electrolysis.—A new application of the quantum theory has been made by Dr. R. W. Gurney in a paper in the November issue of the *Proceedings of the Royal Society*, entitled "The Quantum Mechanics of Electrolysis". The fundamental idea in this is that the quantum mechanics does not require the same intimate contact between particles for a transfer of charge between them that is pictured on classical theory. This conception has already been employed in several problems, such as those encountered in connexion with the neutralisation of positive ions at the cathode of a discharge tube, and is here applied in particular to the electrode phenomena in solutions to which a potential less than that required to effect decomposition has been applied. Bowden and others have recently made a careful study of the small currents which pass under such conditions, and have embodied the results of their experiments in a number of simple relations. By modifying the theory of neutralisation at a gas-solid interface to allow for the hydration of the ions and other effects peculiar to electrolytes, Dr. Gurney has now been able to obtain all Bowden's results theoretically, and to obtain both qualitative agreement and excellent numerical values for the coefficients in Bowden's expressions. Dr. Gurney has actually developed his theory as if the hydrated ions were molecules in the spectroscopic sense, but this specialisation of the problem is a matter of convenience and not a necessary feature of his work.

Combination of Hydrogen and Oxygen.—When a mixture of hydrogen and oxygen is exposed to a hot quartz surface a reaction occurs which is gentle or explosive according to the conditions of the experiment. W. L. Garstang and H. L. Hinshelwood have given an account of some investigations on the kinetics of the change when it is catalysed in this way in a paper published in the November number of the *Proceedings of the Royal Society*. They have been able to show by a few relatively simple experiments that the active centres on the solid, which are responsible for much of what occurs, are chiefly concerned with the reacting oxygen in the first instance. The centres have, in fact, been shown to absorb oxygen with great rapidity to a kind of saturation state, whereas they remain only sparsely populated with hydrogen. If an aluminium vessel is substituted for one of quartz no low-pressure explosion occurs, but a vigorous reaction still takes place on the surface.

Artificial Rubber.—The production of artificial rubber by the chemists of the E. I. du Pont de Nemours is announced in the November *Journal of the American Chemical Society*, some additional details being given in the news edition of *Industrial and Engineering Chemistry*. The process depends on the addition of hydrochloric acid in aqueous solutions containing cuprous and ammonium chlorides, to monovinylacetylene, with the production of chloro-2-butadiene-1,3 according to the equation:

$$CH \equiv C—CH=CH_2 + HCl = CH_2=CCl—CH=CH_2,$$

the product (which is closely related to isoprene) being called chloroprene. The chlorine atom in the molecule is very firmly bound. By the controlled polymerisation of chloroprene, which takes place very rapidly and easily, a rubber-like material is obtained to which the trade name 'duprene' is applied. This is the synthetic rubber. Although the cost of production of duprene will be many times greater than the present market price of natural rubber, the material is to be manufactured, since it is believed that commercial uses will be found for it because of its unique properties. The material formed by the polymerisation of chloroprene is fully vulcanised without any additions, and the polymerisation can be stopped at an intermediate point with the production of a plastic polymer having the general properties of unvulcanised rubber, which may be mixed with fillers, diluents, etc., and the vulcanisation completed by heating at 110°-130° C. for a short time. An artificial latex was also prepared. Duprene is denser and more resilient than natural rubber, but is not plastic. It resists the action of many liquids which attack rubber. The X-ray structure of

stretched duprene, unlike that of polymerisation products of isoprene, resembles that of natural rubber, giving a fully developed fibre diagram showing a number of definite layer lines, the identity period along the fibre axis being 4·8 A., identical with that of β-gutta-percha.

Saccharification of Wood.—In a communication to the Society of Chemical Industry on Nov. 1, Drs. H. A. Auden and W. P. Joshua described a process for the transformation of wood cellulose into fermentable products on an industrial scale. With an improved method they have succeeded in obtaining thirty-five to forty gallons of alcohol per ton of dry sawdust. This makes the process commercially profitable where the cost per ton of dry sawdust is not more than five shillings and a supply of 200 tons per twenty-fours hours is available. The method was worked out in the Research Laboratory of the Distillers' Company, Epsom. It consists in forcing acidulated water (containing two parts per thousand of sulphuric acid), at a temperature of 180° C. and twelve atmospheres pressure, through sawdust packed in lead-lined vessels. Under these conditions 45-50 per cent of the sawdust is changed into fermentable sugars. The molasses thus obtained are fermented with yeast in order to obtain alcohol. A preliminary treatment of the sawdust with superheated steam has been found advantageous, because it removes resins and other undesirable constituents and also helps the hydrolysis.

Extensibility of Protoplasm.—A communication on the effects of salts on the extensibility of protoplasm, by Prof. William Seifriz and Janet Plowe, appears in the *Journal of Rheology*, vol. 11, No. 3 (Easton, Penn.). The elastic properties of protoplasm are important because of their close relation to other properties of living matter, for example, imbibition, contractility, and structure, and to biological processes like cell-division and amœboid movement. By means of the microdissection method Prof. Seifriz has determined the maximum distance to which protoplasm can be stretched. Strips of the upper epidermis of the bulb scales of *Allium cepa* were first placed in aqueous solutions of the nitrates of potassium, sodium, calcium, etc. Afterwards the cells were plasmolised in sugar solution so that the cell-wall could be cut without injuring the protoplasm, and the protoplasm was drawn out by means of the micro-needle. It was found that treatment with calcium, strontium, and magnesium increases the elastic limit of the protoplasm, while potassium, sodium, and lithium decrease it. Their relative action may be expressed by the series Ca>Sr>Mg>K>Li>Na.

Astronomical Topics.

Eclipse Observations and the Einstein Shift.—Prof. E. Freundlich gave an account of his observations of the Einstein bending of light by the sun's gravitation at the meeting of the Royal Astronomical Society on Dec. 11. Notes on a similar lecture delivered at Oxford on Dec. 2 appeared in NATURE of Dec. 12, p. 993. Prof. Freundlich was probably the very first to attempt observations on the problem; he went to Russia in August 1914 with that end in view, but the outbreak of war caused obstacles to be put in his way, and nothing could be done. Abortive attempts were made at subsequent eclipses; at last he attained full success in Sumatra in the eclipse of 1929. Many precautions, suggested by the experience of others, were taken; in particular, a field of stars at a distance from the sun was photographed during totality, as well as the eclipse field; the two fields were again photographed simultaneously at a later date.

The measures and reductions were made in several different ways, but all agreed in giving a shift at the sun's limb of about 2·25″, which is half a second greater than the Einstein theoretical value. Freundlich also rediscussed the measures made at previous eclipses, and expressed the opinion that they are better satisfied by his value than by the Einstein one, and that the excess is a real phenomenon, though its cause is unknown.

Most of the speakers in the discussion showed unwillingness to depart from the Einstein value; Sir Arthur Eddington, however, admitted that the views of the nature of light that are now held make it more complicated than was formerly supposed, so that it is possible that the Einstein equations may not give a complete account of its behaviour.

The Origin of Comets of Short Period.—About half a century ago, R. A. Proctor pointed out that the theory of the capture of these comets by the giant planets involved many serious difficulties. There would not be enough close approaches of comets to Jupiter to provide it with such a large family of comets. This is still more the case than Proctor realised, since convincing proofs have been deduced that the life of these comets is short (of the order of a few centuries), so that the supply must be frequently replenished.

Very few astronomers have supported Proctor's view that these comets were erupted by the giant planets, but *Astr. Nach.* 5826 contains a long paper by S. Vsessviatsky which reaches a similar conclusion, and extends the suggestion to include those of the minor planets that have orbits close to that of Jupiter. Many American astronomers favour the suggestion that minor planets are associated with comets in their origin. One of Proctor's arguments was based on the Leonid meteors. Le Verrier had suggested that Tempel's Comet, which formerly contained the meteors, made a near approach to Uranus in A.D. 126, and had its orbit changed from a parabola to an ellipse. Proctor pointed out that an extremely close approach to Uranus would be necessary, and that the cometary mass would need to be condensed to an extent far beyond what we observe in comets; otherwise different portions of it would experience different perturbations, whereas observation shows that the orbits of all the meteors are nearly identical.

Catalogue of Double Stars.—A further instalment of the large catalogue of double stars that is being formed at the Union Observatory, Johannesburg, is published in *Circular* 85 of the observatory. It contains 2017 measures of 488 pairs made in the years 1928–30. The limits of Right Ascension are 13^h to 24^h. As a rule, measures of each star were made on four nights, the separate results and means being given. There are interesting notes on sixty-five pairs; five of them are proved to be merely optical pairs, but the great majority are true binaries. Other notes give comparisons with previous measures, or with ephemerides, where these have been calculated. The pair Innes 600, in south decl. 60°, may have the short period 14 years, or 28 years if the quadrant of the 1913 measure should need reversal. The pair Hussey 298 has described nearly a revolution in thirty years, but apparently its orbit has not been computed yet. A note on α Centauri states that photography gives better results than visual measures; the recent measures give as the correction to Finsen's ephemeris, published in 1926, angle +0·30°, distance −0·08″. The great majority of the measures in the catalogue were made with the 26-inch refractor, but a few were made with the 9-inch.

The Ramsay Memorial Laboratory of Chemical Engineering at University College, London.

THE opening of the Ramsay Laboratory of Chemical Engineering by His Royal Highness Prince George, on Nov. 26, marks an important advance in the scientific training of men for industry.

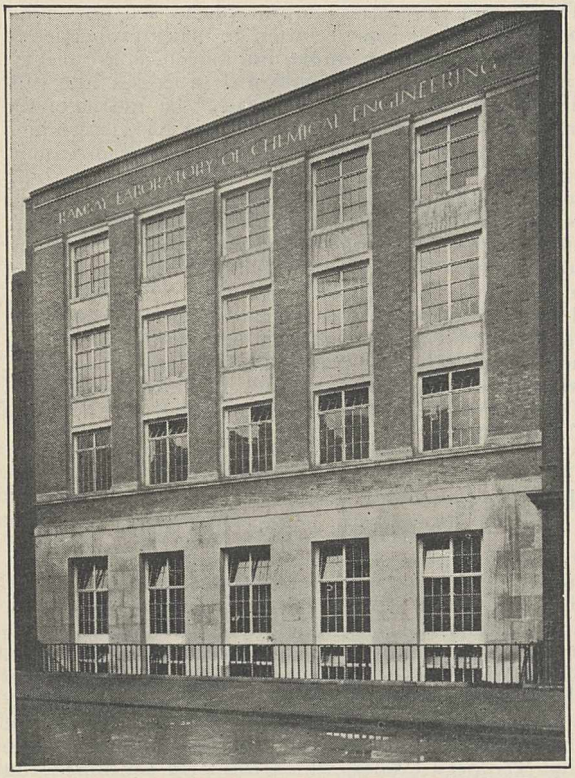

Photo [*Larkin Bros.*

FIG. 1.—Ramsay Laboratory of Chemical Engineering.

The new laboratory is the first in Great Britain to be designed specifically for chemical engineering training and research. It provides facilities whereby men who have already graduated in chemistry or engineering can obtain a supplementary training, both theoretical and practical, in the principles underlying the design, fabrication, testing, and operation of the different types of plant which are used in the industrial operation of a chemical process.

The course of training normally occupies two years. During the first year, the student receives a systematic training in chemical engineering principles by means of lectures and relevant experimental work. The subjects dealt with include the flow of fluids and the transfer of heat, the physical and chemical characteristics of construction materials and the methods of plant fabrication, the principles of mechanical and structural engineering and the production and distribution of energy in works, the design and operation of unit types of chemical plant, the preparation of flow sheets of materials and energy balances, and the lay-out of plant, factory administration, and industrial economics. The lectures are supplemented by practical training in machine drawing, in plant fabrication, and in the erection, testing and operation of both small and semi-large scale plant units.

During the second year, the student carries out original investigations, either in the laboratory or in a works.

The new laboratory (Fig. 1) has been built as an extension to the old building, which, in addition, has been completely rearranged. The laboratory now occupies a frontage of 60 ft. on Gordon Street, from which it extends for 120 ft. in the direction of the chemistry building. The new building is constructed of steel and reinforced concrete, and is faced with 2-inch Suffolk brick and Portland stone. It consists of five well planned and appointed stories. A noticeable feature of every room is the generous lighting provided by the large and well planned windows.

In its arrangement and equipment, the building presents many new features. In addition to the usual lecture-room, library, and general laboratory facilities, there are a finely equipped machine shop, in which semi-large scale plant can be constructed or repaired, and a large and lofty industrial laboratory (Fig. 2) which is well equipped for the erection, testing and operation of semi-large scale plant. Special laboratories are provided for distillation, for the testing of fuels, and for crushing and grinding operations. The second floor is devoted entirely to the study of fluid flow and heat transfer on a scale which is comparable with that obtaining in works practice. On the top floor are three research laboratories, each of which is capable of accommodating five or six workers.

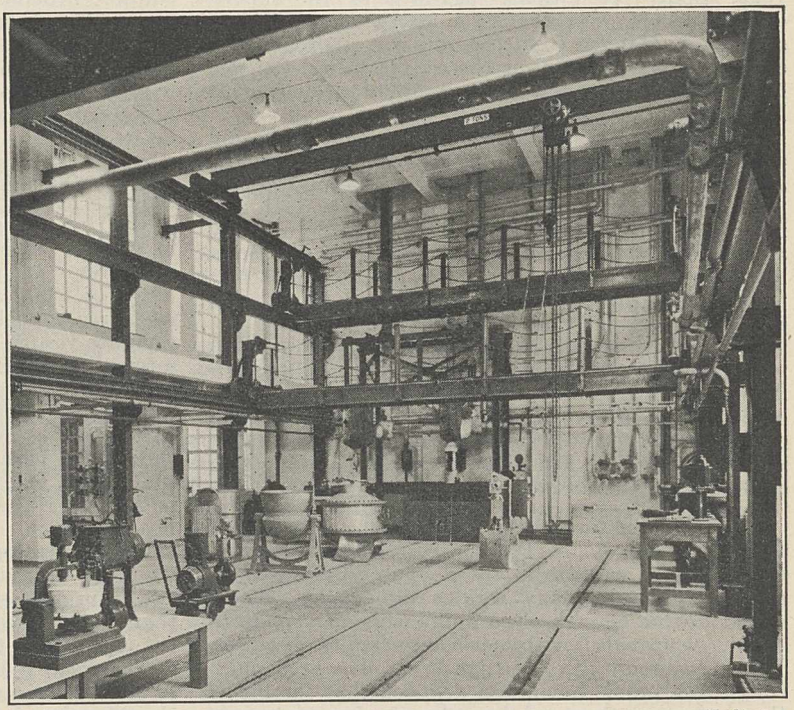

Photo [*Larkin Bros.*

FIG. 2.—Industrial laboratory.

At the rear of the building and just outside the machine shop is an unloading bay, served by a two-ton travelling crane, which can deliver heavy goods either into the machine shop or through trapdoors into a wide service corridor which runs through the basement to the industrial laboratory.

Perhaps the most striking feature is the industrial laboratory, which occupies practically the entire basement of the new section. This laboratory is 60 ft. long, 40 ft. wide, and 25 ft. high. It is equipped with a two-ton travelling crane, and is spanned by two portable platforms, respectively at 11 ft. and 17 ft. above the floor-level. The concrete floor is provided with special slots to facilitate the fixing of plant; there are also ample drainage facilities. Staging is provided at one end of the laboratory for liquor stock tanks and feed tanks.

Five thousand gallons of softened water can be stored beneath the basement floor, whence it can be pumped to large service tanks on the roof. From there, it can flow by gravity to two 3-inch ring mains surrounding the industrial laboratory, or to the fluid flow laboratory on the second floor. This water can be used as boiler feed or for cooling or condensing purposes. Other ring mains are provided in the industrial laboratory for mains water, gas, steam and compressed air.

Steam for process working is obtained from a vertical boiler, arranged for oil or coke firing, and capable of evaporating 600 lb. of water per hour at pressures up to 200 lb. per sq. in. Two smaller boilers are provided at different points in the building.

The machine shop measures 45 ft. × 18 ft. × 25 ft. high, and is situated in the basement of the old building. It is fitted with a one-ton travelling crane, and contains the machine tools necessary for turning, milling, slotting, shaping, drilling and sawing. Running along one side of the shop is a gallery equipped with precision lathes and sensitive drilling machines for fine instrument making. There is also equipment for welding and small forging.

The erection and equipment of the new laboratory have been made possible by the far-sighted generosity of a number of leading firms and individuals in the chemical and allied industries, who subscribed a capital sum of more than £26,000 and guaranteed an annual income of £4000 for a number of years. Valuable equipment has been provided by many manufacturers of chemical plant.

The laboratory will accommodate fifty students and research workers. This session, the total number of students in the laboratory is thirty. In its organisation and general atmosphere, the laboratory seeks to resemble the development department of a modern chemical works. Every effort is made, also, to maintain and develop the closest connexion with industry. Each member of the staff has had extensive industrial experience both in Great Britain and abroad. Many of the present students, also, have held important positions in industry.

Psychology and Organised Religion.

THE *Journal of Social Psychology* (vol. 2, No. 4) has an article by Prof. Raymond Pearl discussing some points of psychological interest arising out of the American Census of Religious Bodies, 1926. His aim is to see if any evidence, other than that of general opinion, exists to support the view that there has been for some time past a gradual decay of religious influence in European civilisation. He quotes from an eminent man of science, a Wesleyan minister, a Church of England vicar, and a young American clergyman, all of whom maintain that there is increased indifference to organised religion.

If this is so, then here is a problem of social psychology that ought to be studied. Prof. Pearl makes a beginning by analysing such official returns as are available, namely, those provided by the census of religious bodies in the United States. This is a census of religious organisations and is taken every ten years.

During the period 1916–26 the tables show that while church membership has increased at a rate slightly more than the rate of the growth of the population as a whole, yet the increase is very small. It has always been recognised that religious organisations have played an important part in the social life of their members, being at some periods almost the only means of organised social diversion. Hence it seems pertinent to compare the growth of religious organisations with the growth of other forms of social activity. National banks have increased at rather more than three times the rate of the churches, the consumption of alcoholic liquor increased by 4·5 per cent in one year, the manufacture of playing cards by 80·3 per cent, and cigarettes by 97·4 per cent, and still greater was the development of motion-pictures, automobiles, and radio apparatus. It looks as if several non-religious forms of diversion grew in magnitude and presumably in influence during the decade considered.

Again, organised religion has always realised the importance of training the young, and for this end has evolved the Sunday School. Analysis of the records shows that in the older and more highly developed sections of the country the number of scholars has either decreased or increased by an insignificant percentage, whereas in the newer and less developed sections of the country there have been substantial increases. Comparing the membership of the different denominations, a tendency is shown for those characterised by a narrow and rigid body of doctrine, and therefore appealing to the less intelligent groups of the population, to grow more rapidly than those the more liberal doctrines of which appeal to the more intelligent.

The paper is important, not so much for the generalisations, which are admittedly tentative, as for the method employed and for the interest of the point of view.

In *Human Biology* (September 1931), John R. Miner discusses the relationship between church membership and commitments of prisoners. From data available from the Netherlands and the United States, he concludes that there is little evidence that the churches play any large part in the prevention of crime.

Orbit and Mass of Pluto.

LICK Bulletin 437 contains an exhaustive study by Dr. E. C. Bower, of Pluto, the new planet discovered in 1930. All the prediscovery images have been utilised, except those obtained on Flagstaff plates in 1915. Reference is also made to a possible image on a Franklin-Adams plate taken in 1903. Mr. P. J. Melotte, who detected this image, now considers that it is too ill-defined and doubtful to use, in the absence of any confirming images in neighbouring years. The perturbations have been treated in the manner adopted by Dr. P. H. Cowell for Halley's comet. The centre of gravity of the sun and the four

great planets is taken as origin, and the motion calculated by mechanical quadratures. The final residuals of Pluto are all less than 4″, which is not unduly large, as in many cases the images were ill-defined and far from the centre of the plate. The period is 248·43015 years, and the eccentricity 0·2486438 (it is an aid to memory that the first three digits in these two elements are the same); the perihelion passage is on Sept. 30, 1989. There will not be a conjunction with Neptune at minimum distance (3 units) for about eight thousand years.

The determination of Pluto's mass from Neptune depends largely on the two observations made by Lalande in 1795. As he observed the Right Ascensions to the nearest half-second of time only, they are not exact enough to give a precise result; it is shown that a mass of Pluto, 1·3 times the earth's, gives a zero residual in 1795, while a zero mass makes the 1795 residual 9″. It will, however, be possible to derive a fair value of Pluto's mass from its recent approach to Neptune, when the latter has been observed for some eighty more years, as its orbit will then be known independently of Lalande's positions. Dr. Bower suggests that the approach to Uranus in 1968 (distance 13 units) should also be utilised; for this purpose a long series of accurate positions of Uranus, especially from 1940 to 2000, should be obtained. He suggests photography, with the magnitude of Uranus reduced to that of the comparison stars.

The only estimates of Pluto's mass that can be made at present are based on its stellar magnitude and apparent diameter; these both suggest a mass smaller than that of the earth. However, the unexpectedly high value for the mass of Triton, recently found at Mt. Wilson, suggests a similar possibility for Pluto. M. Baldet, as the result of visual observations with the Meudon equatorial, concludes that the diameter does not exceed 0·2″ (Report of the Paris Observatory for 1930).

Dr. Bower's article contains an accurate ephemeris of Pluto from August 1931 to June 1932; this is for the equinox of 1900; Dr. Bower notes that this is the most convenient equinox if one uses positions of the comparison stars derived from the astrographic catalogues; these contain fainter stars than those given in other catalogues. The images of brighter stars on the Pluto plates are too large for accurate measurement.

A New System of Film Projection.

WELL-ATTENDED demonstrations were given at the premises of Messrs. Robinson, King and Co., Ltd., in Stratford, London, of an invention by Dr. R. T. A. Innes, formerly Union Astronomer, Johannesburg, for increasing plasticity and saving space in projection of films. In place of the usual screen a large plane mirror is to be installed, the picture being projected on an ordinary screen so situated that the audience sees it in the mirror. It may be behind them, or on the ceiling. In the demonstration it was behind, the projector being behind and above the mirror.

Regarding the increase in plasticity claimed, we must confess that we failed to perceive it as regards black and white films. It is also claimed that the effects of grain and scratches are masked, but the films shown were not worn; a slight diminution in the sparkle due to grain was perhaps noticeable. An excellent coloured film shown was, however, certainly improved. Colour adds plasticity to films, and Dr. Innes's plan really 'varnishes' the picture, as it were, and thus adds somewhat to the brilliance and depth of the colour. The effect is similar to the difference between matt and glazed photographs, and would finally, as in this case, be a matter of taste. The lure of devices of this kind for inventors is due to the psychological fact that any change in the tint or texture of a photograph, if it is novel, is at first pleasing, since the photograph is inherently inadequate as a representation of three-dimensional reality. The change is usually imagined to make the picture more real—to fulfil our unconscious wish: this will be remembered when the tinting of films was first introduced, and it accounts for the plastic effect of colour. The unsophisticated are immensely pleased by an extremely brilliant glaze on photographs. But these joys are fleeting: custom soon stales them.

The other advantages claimed are more substantial. Installed in a small room or hall, practically the whole floor space may be filled with seats from which a good view is obtained, since even those close to the mirror see the screen as at a convenient distance. Those at the back have a more distant view than they otherwise would, but can still see well. Thus the available space is much increased. The field for the invention is thus chiefly in small, cramped halls, and in education and advertising.

Difficulties arise from the fact that mirrors exceeding a certain size are expensive to make and handle. Even a small screen would need to be built up of two or three parts, and means would have to be found to make the join unobjectionable. Also, the film is seen reversed if projected upon the screen in the usual way, while serious loss of light occurs with through projection, apart from the fact that the gain in space would no longer be present. With on-projection, therefore, the film has to be turned round in the projector, and few projectors allow of this being done with sound-films, since it brings the sound track on the wrong side. However, one portable equipment at least is available in which this difficulty does not occur, and with such an apparatus and Dr. Innes's mirror a small room could be packed with spectators who would all get a satisfactory view.

University and Educational Intelligence.

CAMBRIDGE.—Dr. F. C. Phillips, of Corpus Christi College, has been appointed University lecturer in petrology.

In a report to the University on forestry in the University curriculum, the General Board states that there is practically no future for graduates trained in forestry except in Government forest services. Only twenty to twenty-five of these posts are available each year, and there are no fewer than five university schools, including that at Cambridge, training candidates for these posts. As a result of investigations, the Committee of the General Board concludes that the University is not justified in maintaining a forestry organisation as a recruiting ground for Government services, partly because the demand is so small, but even more because the Committee considers that University policy in forestry teaching cannot be reconciled with the present official view. It is accordingly recommended that the Department of Forestry be suppressed, examinations in forestry for the ordinary B.A. degree be discontinued after 1934, and examinations for the diploma in forestry cease in October 1935.

SHEFFIELD.—The Council of the University has made the following appointments: Mr. B. H. Bentley, lecturer in botany, to be professor of botany; Dr. R. N. Rudmose Brown, lecturer in geography, to be professor of geography; Mr. L. E. S. Eastham, to be professor of zoology; Dr. J. Florey, to be professor of pathology; and Dr. J. W. Edington, to be professor of bacteriology.

AT the Indian Institute of Science, Bangalore, the service of Dr. M. O. Forster as director has been extended until April 1933. Dr. V. Subrahmanyan has been appointed professor of biochemistry.

AT the end of the year Dr. R. S. Clay is resigning the principalship of the Northern Polytechnic, London, a post he has occupied for twenty-nine years. The governors, staff, students, and members of clubs and societies who have been associated with him during this long period wish to assist in offering some token of their regard and affection, and a committee has been set up to give effect to this general desire. The honorary treasurer of the committee is Mr. W. M. Macbeth, Northern Polytechnic, Holloway, London, N.7.

THE International Federation of University Women has issued a report of its sixteenth council meeting, held at Wellesley College, Massachusetts, last April under the chairmanship of the president of the Federation, Prof. Winifred Cullis, and attended by women graduates of thirty-one countries. Prominent among the activities of the Federation is the establishment of research fellowships to give university women the opportunity of a year's work in a foreign country. The fund for this purpose already exceeds five thousand pounds, exclusive of the collections of the American Association of University Women, which will be allocated partly to national and partly to international fellowships.

Birthdays and Research Centres.

Dec. 20, 1876.—Dr. W. S. ADAMS, director of Mount Wilson Observatory.

My chief interest for many years has consisted in physical and quantitative studies of stellar spectra. Theoretical astrophysicists have carried on much able research during recent years on problems of stellar constitution and radiation, and the need for observational evidence to aid in discriminating among different theories is pressing. This is especially true of investigations dealing with temperatures and pressures in stellar atmospheres, the opacity coefficient, and the abundance of the elements in different states of excitation and ionisation.

Specific observational studies at Mount Wilson are dealing with the character, intensities, and contours of stellar spectral lines, their differential displacements, and the application of spectral criteria to the determination of the absolute brightness and the distances of stars.

Dec. 22, 1862.—Dr. VAUGHAN CORNISH, past president of Section E (Geography) of the British Association and of the Geographical Association.

The secret of scenic beauty is the enhancement which landscape derives when the grouping happens to be harmonious, whether this be a matter of locality, as when the physical features are harmonious, or of season, as when light or colour are happily blended or contrasted.

During the last six years, I have published a number of original papers in which the principle of harmonious grouping has been applied both to the landscape of the wild and to the scenery of civilisation, and in a chapter entitled "Watching the Seasons" in a recently published book on "The Poetic Impression of Natural Scenery" I have shown its application to the changes of sunlight and foliage.

Every advance in the systematic study of natural beauty will be a social benefit, since an enhanced appreciation of the countryside will provide the majority of our people with a corrective for the inevitable artificiality of urban life.

Societies and Academies.

LONDON.

Royal Society, Dec. 10.—**Sir Arthur Eddington**: On the mass of the proton. From the theory of the cosmical constant developed in a previous paper, a wave equation for an electron is developed, which, however, is incomplete. The correct equation contains the factors 10 and 136, representing the number of degrees of freedom associated with the respective energy terms. The mass of a particle satisfying this wave equation is given by an equation having two roots, which evidently correspond to electrons and protons, and their ratio is 1847·60. It is verified that the two roots represent charges of opposite sign.—**P. S. H. Henry**: The specific heats of air, oxygen, and nitrogen from 20° C. to 370° C. Further developments of the new constant flow calorimeter for the determination of the specific heats of gases at constant pressure are given. These results, whilst agreeing with those obtained by the sound velocity method at room temperature, show a much higher rate of increase of the specific heats with temperature, and a closer approximation to the curves predicted by means of Boltzmann's hypothesis from the spectroscopic frequencies of vibration of the molecules.—**W. L. Francis**: Studies in membrane behaviour (1). Equilibrium membrane potentials are measured for a buffer concentration gradient of 10 : 1 using $N/40$-$N/400$ and N-$N/10$ solutions. The e.m.f.'s with and without gelatine on the membranes are compared over the pH range 2·35-7·3. The results, more particularly with weaker solutions, appear to support the modified diffusion theory, that is, the anions are retarded in basic solution and the cations in acid solution. Direct evidence, given by determinations of the transport numbers of the sodium and acetate ions across the membrane in $N/2$ solution, vetoes this theory. Assuming that the membrane potentials are made up of the ordinary diffusion potential and an opposed e.m.f. due to the combination or adsorption of ions on the protein, an explanation is suggested which conforms with the known behaviour of gelatine in electrolyte solutions.

PARIS.

Academy of Sciences, Nov. 9.—**E. Jouguet**: The secular stability of the rotors of turbines. A discussion of the criteria of stability according to Stoidola's hypotheses, with the additional criterium suggested by Lamb.—**H. Vincent**: A theory of the constitution of antibodies. A comparison of the properties of antitoxins and cryptotoxins (toxin + sodium salicylate). Both form a stable complex with the toxin and both are dissociated when the pH is lowered to 4·7: although the toxin is neutralised, it is not destroyed in either case.—**André Blondel**: The mutual inductances of magnetic leaks in transformers with several secondaries.—**Erik Westzynthius**: The distribution of integers which are not divisible by any one of the n smallest prime numbers.—**A. Marchand**: Various extensions of the idea of a continuum of limited order.—**J. Favard**: A proposition of Minkowski.—**S. Finikoff**: Stratifiable parabolic congruences: transformers of R_0 surfaces.—**J. Herbrand** and **C. Chevalley**: New demonstration of the theorem of existence in the theory of the body of classes.—**H. Parodi**: The method of integration by successive arcs giving, in the calculation of the elementary arc, an approximation as close as desired.—**Georges Giraud**: Problems of values at the boundary in the case of discontinuous data.—**J. A. Lappo-Danilevski**: The construction of the normal integral matrix of a system of linear differential equations in the neighbourhood of a pole of its coefficients.—**A. Markoff**: A general property

of Birkhoff's minimal ensembles.—**Jacques Devisme**: Some partial differential equations.—**Arnaud Denjoy**: A theorem of Wiman.—**Bernard Salomon**: Mechanical integrators with holonomial linkages.—**Al. Proca**: The theory of radiation.—**A. Foch** and **J. Bariol**: The motion of a viscous fluid in the neighbourhood of a disc oscillating about its axis.—**Th. Got**: The value of the Dunkerley formula and its analogues for the approximate calculation of the first critical velocity of a rotating axis.—**D. Barbier**: The distribution of the poles of the orbits of double stars.—**Maurice Curie** and **A. Lepape**: The thermal conductivity of the rare gases. A modification of the thermometric cooling method of E. Müller was used. Data are given for the first time for krypton and xenon; the previously published results for helium, neon, and argon are confirmed.—**G. Bruhat** and **J. Thouvenin**: The double refraction produced by the compression of amorphous silica and crystallised quartz and its dispersion in the ultra-violet. Two specimens of fused silica show comparable double refractions on compression, the differences between them being only 5-6 per cent. This double refraction is about 40 per cent higher than that of crystalline quartz. Havelock's formula for the variation of the double refraction with the wave-length is considered to be only a first approximation.—**Mlle. M. Quintin**: The activity coefficient of the bivalent copper ion in solutions of its sulphate. In the range of concentration studied, including some relatively high concentrations, the Debye theory applies to solutions of copper sulphate, if a correction factor for the dimensions of the ions is included.—**S. Rosenblum**: The long path α-rays emitted by ThC + C′ and some determinations of the velocities of the α-rays. The direct measurement of the velocity of the α-rays has been determined with the aid of the large electromagnet of the Academy of Sciences by the method of magnetic focalisation.—**Paul Woog**, **Mlles. Emilie Ganster** and **Fanny Coulon**: The variation of the point of thawing out of mineral oils accompanying changes in their state.—**P. Bary** and **E. Fleurent**: The degradation of india-rubber solutions of various concentrations. The changes were followed by the alterations in the viscosity of the solutions.—**L. Riéty** and **G. Salager**: An electromotive force of filtration of abnormal value. Solutions of mercuric cyanide, flowing through a capillary tube, set up abnormal electromotive forces, ranging from 0·65 to 3·025 volts with varying concentration.—**J. Sambussy**: The action of a continued difference of potential on acetone and ether.—**Maurice Lambrey**: A method of studying the decomposition of gun-cottons at the ordinary temperature. The method is based on the increase of the γ absorption bands of nitric oxide in presence of an inert gas (hydrogen). Clear evidence has been obtained by this method that various specimens of carefully purified gun-cotton evolve traces of nitric oxide at 30° C.—**André Kling** and **Daniel Florentin**: The mode of action of dehydrating catalysts in the hydrogenating cracking of phenols. Contrary to expectations, the activity of certain catalysts (alumina, blue oxide of molybdenum) is increased by a preliminary heating to 750° C.—**Frèrejacque**: The autoxidation of uric acid in the presence of amines.—**E. Aubert de La Rüe**: The extension of the granular eruptive rocks in the Kerguelen Archipelago.—**Yang Kieh**: The prolongation towards the west of the dislocated zone situated to the north of the Marche chain.—**Henri Besaire**: The stratigraphy of the sedimentary formations of the province of Analalava, north-west Madagascar.—**V. Frolow**: The fall of the Oronto in 1929–30.—**E. Diénert**: The condensation of water vapour in the soil.—**Mlle. Lucie Ricard**: The vascular insertion of rootlets.—**A. Kopp** and **D. d'Emmerez de Charmoy**: New results on the diseases of sugar cane and maize.—**Polack**: Which colours do all colour-blind people fail to distinguish? A modified test for colour-blindness is suggested, stress being laid on the separation of blue, violet, purple, and greenish blue. Separation of the red and green is possible in certain colour-blind people.—**Raymond-Hamet**: The indirect vaso-dilatory action of the ergot alkaloids.—**Fernand Mercier**: The influence of dextrorotatory pseudo-cocaine on the hypertensive action of adrenaline. The two optically isomeric cocaines have a different physiological action as regards the hypertensive effect produced by adrenaline.—**Mme. M. L. Le Roux**: The experimental removal of the ovaries of *Gammarus* and its effect on the evolution of the oostegites.—**A. Vandel**: The existence of males of parthenogenetic origin and the genotypical constitution of the parthenogenetic females of *Trichoniscus* (*Spiloniscus*) *Elisabethæ*.—**J. Parrod** and **Mlle. Y. Garreau**: The oxidation products of *d*-mannose by ammoniacal copper oxide in the presence of air, at the ordinary temperature. The oxidation products, oxalic acid, imidazol, and *d*-arabino-tetroxy-butyl-4-imidazol, were the same as those previously isolated from the oxidation of *d*-glucose under similar conditions.—**H. Belval**: The lævorotatory glucides of the bulbs of *Lycoris*.—**F. Vlès**, **A. de Coulon**, and **A. Ugo**: The factors of the evolution of tar cancer in mice.

ROME.

Royal National Academy of the Lincei, May 17.—**T. Levi-Civita**: Concerning the notes of Hatzidakis and Sakellariou on central motions.—**C. Miranda**: Extension of the theorems of Hilbert-Schmidt and Picard to singular linear integral equations.—**C. Rimini**: The flexion of surfaces.—**T. Viola**: Noteworthy properties of continuous functions.—**Pia Nalli**: Rigid transports of vectors on surfaces. The results previously deduced for varieties with any number of dimensions are applied to surfaces.—**W. Fenchel**: Channel waves of permanent type.—**N. Hatzidakis**: Observations on a paper by M. Sakellariou on "A Class of Central Motions".—**A. Belluigi**: The gravimetric depression of Carpaneto.—**M. Lombardini**: Geometric considerations for periodal analysis. The properties of the extremes, zeros, and flexes of the sum of two sine curves, previously considered, are now utilised for deducing the necessary simple conditions to be satisfied by the distribution of the zeros, extremes, and flexes in order that a curve may be regarded as the sum of two sine curves.—**Orazio Specchia**: Raman spectrum of the ion SO_4.—**R. Zoja**: The distribution of the tensions in a solid with rectilinear axis and with rectangular transverse section of variable dimensions (3).—**R. Einaudi**: The relations existing between Euler's variational equations and the canonical equations of mechanics.—**Goffredo Vitali**: The calculation of a lens. Pacella's method of calculating a plano-convex lens leads to very simple results when the plane face is replaced by a spherical surface with its centre at the focus of the lens.—**Paolo Straneo**: The unitary theory of gravitation and electricity (3). Further consequences of the unitary equations. Certain considerations, mainly qualitative, bearing on the author's unitary theory are discussed, with some of the more immediate and simpler consequences, and the general scope of the theory.—**L. Malossi**: Double sulphates of bismuth with alkali metals (2). Double sulphates of bismuth and lithium. The system $Bi_2(SO_4)_3$-Li_2SO_4-H_2O forms the two compounds, $Li_3Bi(SO_4)_3$, $2H_2O$ and $Li(BiO)SO_4$, H_2O.—**P. Pratesi**: Reactions of addition to unsaturated organic compounds. Application of the electronic theory of valency to unsaturated molecules of various types results in verification of all the regularities with regard to the formation of additive compounds established by Markownikow and Ipatiew

for particular classes of compounds.—G. B. Bonino and P. Cella: Raman spectrum of hydrogenated derivatives of naphthalene. The Raman spectra of deca- and tetra-hydronaphthalene are compared with those of naphthalene and cyclohexane.—G. B. Bonino and L. Brüll: Raman spectrum of dichlorobromomethane. Whereas the Raman spectra of chloroform and bromoform exhibit six frequencies, five of them intense, dichlorobromomethane displays one more, owing to the possibility of oscillations Cl-Br, this not occurring with the other two compounds. The ratio between the values of $\cos^2\beta$ for chloroform and bromoform equals the inverse ratio between the permanent electric moments for the two compounds. If this relationship holds also for dichlorobromomethane, the electric moment for this compound should be $1{\cdot}25 \times 10^{-18}$.

Diary of Societies.

FRIDAY, DECEMBER 18.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University College), at 10.30 A.M., at 2.15, at 4, and at 5.30.

ROYAL SOCIETY OF MEDICINE (Physical Medicine Section), at 5.30.—Prof. A. V. Hill: The Liberation of Energy by Muscle (Samuel Hyde Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.

SOCIETY OF DYERS AND COLOURISTS (Glasgow Section) (at George Hotel, Glasgow), at 7.15.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Royal Technical College, Glasgow), at 7.30.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—Christmas Lecture.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.

SOUTH LONDON BOTANICAL INSTITUTE (at 323 Norwood Road, S.E.24), at 8.

INSTITUTE OF CHEMISTRY, at 8.—Sir Frank E. Smith: The Chemist and the Community (S. M. Gluckstein Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Rev. Dr. C. Alington: The Education of the Average Man.

SATURDAY, DECEMBER 19.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Physiology, University College), at 10.30 A.M., and at 2.15.

BRITISH PSYCHOLOGICAL SOCIETY (Annual General Meeting) (at 55 Russell Square, W.C.1), at 2.30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Roger Fry: Great French Painters (3).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.

MONDAY, DECEMBER 21.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with South Wales Section of Institute of Chemistry) (at Cardiff Technical College), at 7.30.—Christmas Lecture.

TUESDAY, DECEMBER 22.

LONDON NATURAL HISTORY SOCIETY (at London School of Hygiene and Tropical Medicine) (Plant Galls Section), at 6.30.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Segrave Club, Wolverhampton), at 7.30.

Discussion.

TUESDAY, DECEMBER 22.

CONWAY HALL (Red Lion Square), at 7.—Dr. F. H. Hayward and the Celebration Fellowship: Celebration of Science (Geology).

Official Publications Received.

BRITISH.

Report of British Delegates of the Meeting of the International Council for the Exploration of the Sea, held at Copenhagen, March 23rd-28th, 1931. Pp. 9. (London: Ministry of Agriculture and Fisheries.)

India: Meteorological Department: Scientific Notes. Vol. 3, No. 30: The Structure of the Sea-Breeze at Poona. By Dr. K. R. Ramanathan. Pp. 131-134+9 plates. 1 rupee; 1*s.* 9*d.* Vol. 4, No. 31: The Lunar Atmospheric Tide at Kodaikanal and Periyakulam. By Dr. S. K. Pramanik, S. C. Chatterjee and P. P. Joshi. Pp. 5. 4 annas; 5*d.* (Calcutta: Government of India Central Publication Branch.)

The Parliament of the Commonwealth of Australia. Report on Tour of Inspection of the Oil-Fields of the United States of America and Argentina, and on Oil Prospects in Australia. By Dr. W. G. Woolnough. Pp. 118. (Canberra: H. J. Green.) 5*s.*

Mysore Geological Department. Records, Vol. 29, 1930. Pp. iv+38+2 plates. (Bangalore: Government Press.) 2 rupees.

The North Staffordshire Field Club. Transactions and Annual Report, 1930-31. Edited by the Rev. E. Deacon. (Vol. 65.) Pp. 169+A25-A50+7 plates. (Stoke-on-Trent.) 7*s.* 6*d.*

The Indian Forest Records. Vol. 15, Part 3: Standard, Commercial and Heartwood Volume Tables (Factory Working) for Khair (*Acacia catechu*, Willd.) in North India. By H. G. Champion and Ishwar Das Mahendru. Pp. iii+16. 5 annas; 6*d.* Vol. 16, Part 5: Investigations on the Seed and Seedlings of *Shorea robusta* Gaertn. F. By H. G. Champion and B. D. Pant. Pp. v+33+6 plates. 1.6 rupees; 2*s.* 3*d.* (Calcutta: Government of India Central Publication Branch.)

Journal of the Chemical Society. October. Pp. v+2509-2831+x. (London.)

The Zoological Survey of India. Memorandum on the Proposals for Retrenchment. By Sir C. V. Raman. Pp. 19. (Calcutta: The Author, 92 Upper Circular Road.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 6, No. 4, October. Pp. 345-482. (Cambridge: At the University Press.) 12*s.* 6*d.* net.

Proceedings of the Royal Society. Series A, Vol. 134, No. A823, November 3. Pp. 356. (London: Harrison and Sons, Ltd.) 18*s.*

Canada: Department of Mines: Mines Branch. Investigations in Ceramics and Road Materials (Testing and Research Laboratories) 1928-1929. (No. 722.) Pp. ii+143+3 plates. (Ottawa: F. A. Acland.)

Department of Agriculture: New South Wales. Veterinary Research Report No. 6, Parts 1 and 2. By Dr. H. R. Seddon. Pp. 91+6 plates. (Sydney, N.S.W.: Alfred James Kent.)

Bulletin of the Department of Zoology, Panjab University. Vol. 1: Fauna of Lahore. 2: Entomostraca (Water-Fleas) of Lahore. By G. L. Arora. Pp. 62-100+plates 5-8. (Lahore.) 3 rupees.

British Cast Iron Research Association. Tenth Annual Report for the Year ending June 30th, 1931. Pp. 16. (Birmingham.)

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 17, No. 3, October. Pp. 617-1048. (Plymouth.) 15*s.* net.

Royal Society of New South Wales, Sydney. Presidential Address by Prof. O. U. Vonwiller delivered on May 6, 1931. Pp. 36. (Sydney.)

Department of Scientific and Industial Research. Report of the Springs Research Committee. Pp. iv+75. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

Empire Marketing Board. Dairy Research: a Report to the Empire Marketing Board. By Sir William Dampier. (E.M.B. 44.) Pp. 60. (London: H.M. Stationery Office.) 1*s.* net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 1, No. 5: Abnormalities in the Blood Vascular System of the Anura. By Dr. Charles H. O'Donoghue. Pp. 179-224. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 5*s.* 6*d.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1403 (Ae. 524—Spin 61): Measured Spins on Aeroplane H. By S. B. Gates. Pp. 5+2 plates. 6*d.* net. No. 1408 (Ae 529—T. 3060): Relation between Heat Transfer and Surface Friction for Laminar Flow. By A. Fagé and V. M. Falkner. Pp. 30+12 plates. 1*s.* 6*d.* net. (London: H.M. Stationery Office.)

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 6, November. Pp. 259-297+plates 30-33. (London: Dulau and Co., Ltd.) 10*s.* net.

Malacological Society of London. Library Catalogue (Radley Bequest) 1927. Pp. 23. (London: Dulau and Co., Ltd.) 1*s.* 6*d.* net.

The Victorian Bush Nursing Association. Report and Statement of Accounts to 30th June 1931. Pp. 266. (Melbourne.)

The Geological Survey of India. Memorandum on the Proposed Retrenchment. By Sir C. V. Raman. Pp. 12. (Calcutta: The Author, 92 Upper Circular Road.)

Proceedings of the Institution of Chemists (India). Vol. 3, Part 1, October. Pp. 90. (Calcutta.) 4 rupees.

Catalogue of Indian Insects. Part 21: Lycidae. By Richard Kleine. Pp. iii+52. 1.2 rupees; 2*s.* Part 22: Phalonidae and Chlidanotidae. By T. Bainbridge Fletcher. Pp. iii+15. 6 annas; 8*d.* (Calcutta: Government of India Central Publication Branch.)

Publications of the Dominion Astrophysical Observatory. Vol. 4, No. 15: Luminosity of Planetary Nebulae and Stellar Temperatures. By H. Zanstra. Pp. 205-260. 40 cents. Vol. 6, No. 1: Two Binary Orbits. By W. E. Harper. Pp. 10. Vol. 6, No. 2: The Orbit of H.D. 185936. By S. N. Hill. Pp. 11-16. Vol. 6, No. 3: Measurements of the Wave Lengths of Strong Oxygen and Nitrogen Lines in the Region λ3880-4705. By C. S. Beals. Pp. 17-24. Vol. 6, No. 4: Solar Motion Graph. By J. A. Pearce and S. N. Hill. Pp. 2. 25 cents. (Ottawa: F. A. Acland.)

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 9, Memoir No. 2: Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch), Part 4. By Dr. L. F. Spath. Pp. iv+279-550+plates 48-102. (Calcutta: Government of India Central Publication Branch.) 34.12 rupees; 53*s.* 6*d.*

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