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International Aspects of Agriculture.

IT is sometimes said that agriculture is no subject for internationalism. Indeed, this dictum was not infrequently hurled at those who, after the War, made the first tentative attempts to start or to revive the international handling of agricultural problems. Oblivious of the fact that the produce markets of the great countries were becoming, with a decisive rapidity which was leaving all arguments in the rear, scenes of the most bitter struggles of international competition, the old-fashioned agriculturist was still arguing up to a few years ago—and in a few cases even continues so to argue to-day—that the knowledge and practice of each country are all-sufficient for that country. This point of view has not been without its influence on the research side of the subject. It has certainly affected in no small degree the study of the best means of getting the results of the experiment stations adopted in practice.

The doctrine of national self-sufficiency in matters agricultural has wrought deep havoc particularly on the social side of agricultural life. It is greatly delaying the fruitful interchange of social experience between the agriculture of different parts of the world. Wherever it has been broken down the results bid fair to be beneficial, and it is to the advantage of European agriculture that it has been able to revive and to place on a hopeful basis a body which even before the War stood for the international idea among research workers and also among practical farmers. The Fifteenth International Agricultural Congress recently held at Prague under the auspices of the International Commission of Agriculture went with a swing, and reflected great credit on a body which seems genuinely representative of large sections of European agriculture, even if it has not yet managed to secure adequate representation from Great Britain, Australia, or the Americas.

The International Commission of Agriculture stands for independence from government action. It is of course accustomed to work in friendly relations with the great State organisations which handle agriculture on an international footing, such as the League of Nations, the International Labour Office, and similar bodies. Indeed, one of its most important functions is to help in conveying the opinions of the research and of the farming world to these and other official organisations, in which effort it has been singularly successful of recent years, as all can testify who have followed its activities since 1927, the year of the World Economic

Conference convened by the League of Nations at Geneva. But it does not profess to resemble these official institutions, and guards most jealously its essential prerogative of opinion and action independent of all government influences.

Men of science can only view with sympathy ideals such as these. What the International Commission of Agriculture is now trying to accomplish from the practical farmers' point of view—to focus and to harmonise world opinion on world problems—pure science has always tried to do in its own magnificent field. It has had one great advantage. If practical agriculture has too frequently been wrongly argued to be a national craft, then science, as has always been admitted, is from its very nature international. Even popular opinion now endorses this view ; elementary text-books do homage to it.

Nor has science in any way improperly disowned its world character when joining hands with agriculture. However frankly and rightly agricultural experiment stations and demonstration farms have been financed and controlled by national authority and for national ends, their results have been yielded up for the good of all. No trade secrets are possible for the investigator of agricultural science so long as that profession follows in the footsteps of the workers in pure science.

There is, however, a shadow side to this free trade in intellect ; it leaves the intellectual, after years of labour, with an empty purse. No government and no institution responsible for experimental work in the sciences bearing on agriculture can afford to pay salaries on so handsome a scale as to be at all commensurate with those massive rewards which sometimes accrue to the authors of mechanical and other inventions capable of being patented and then exploited by private enterprise. While this does not deter the man with a genius for biological investigation, it undoubtedly affects adversely the recruitment of biological students. Prof. T. G. Hill admitted this difficulty in his presidential address to Section K (Botany) of the British Association in referring to the present dearth in the British Empire of trained botanists for administrative and technical services when he said the work must be its own reward.

Such disadvantages are met with in the whole profession of science, but apply with particular force to the biological scientific career. While, however, in other departments of science some alternative reward, principally of reputation, fame, and distinction, comforts the soul of the investigator, the agricultural investigator appears to share very markedly neither in the honours which fall to academic science nor in the material rewards of commerce. The irony of the position is that successful work of the kind which he undertakes may spell not merely thousands to a few individuals but positively millions to a whole country. In his recent presidential address to Section M (Agriculture) of the British Association, Sir John Russell stated that, by using improved methods of cultivation, the farmers of Victoria, Australia, now obtain one bushel of wheat for each inch of rain falling during the season, whereas forty years ago they obtained only half a bushel. In Java the Dutch have produced a new sugar cane which has quadrupled the output of sugar. The production and use of artificial fertilisers in the past thirty years have changed completely the problem of the world's food supply, while the figures as to the great national wealth created by new agricultural strains of wheat, such as Marquis in Canada and the United States, run into sums of astronomical dimensions.

It would, therefore, seem a simple act of justice and of wise policy to arrange that some encouragement should occasionally be held out to the agricultural inventor. That such reward should be international in character would also appear to be thoroughly appropriate when we remember the universal application of most great agricultural advances. It thus becomes pertinent to direct attention to a recent highly interesting suggestion put forward by the Secretary-General of the Czechoslovak Academy of Agriculture, Dr. Edouard Reich, which might serve the end contemplated. Simultaneously with the Fifteenth International Congress of Agriculture already referred to, though not directly in connexion with it, the Czechoslovak Academy of Agriculture, which is a research and educational institution serving the needs largely of countries in eastern and central Europe, held a meeting of its corps of foreign members. At this meeting, Dr. Reich put forward various suggestions designed to further international co-ordination of scientific and intellectual effort applied to the agricultural domain. Among these suggestions was one for the foundation of a prize in agriculture. It was estimated that an endowment fund of about £10,000 would have to be collected by subscription. It is much to be hoped that the organising committee of distinguished men of science and other workers who were elected to deal with the proposals put forward at the meeting will be able to work out the details and carry them into practical effect.

The Biological Nature of the Viruses.*

By Dr. H. H. DALE, C.B.E., Sec.R.S.

THE viruses are a group of agents, the existence of which would certainly be unknown to us but for the changes produced by their presence in the bodies of higher animals and plants. They seem to have one property at least of living organisms, in being capable, under appropriate conditions, of indefinite reproduction. We know nothing of their intrinsic metabolism : it has even been asserted that they have none. Few of them have yet been rendered visible by the microscope ; it is, indeed, a question for our discussion whether any of them have yet been seen or photographed. It is a question, again, whether any of them, or all of them, consist of organised living units, cells of a size near to or beyond the lowest limits of microscopic visibility; or whether, as some hold, they are unorganised toxic or infective principles, which we can regard as living in a sense analogous to that in which we speak of a living enzyme, with the important addition that they can multiply themselves indefinitely. Some, however, would attribute this, not to actual self-multiplication, but to a coercion of the infected cells to reproduce the very agent of their own infection.

The problems presented by the nature and behaviour of the viruses cannot fail to raise questions of the greatest interest to anyone concerned with general physiological conceptions. What is the minimum degree of organisation which we can reasonably attribute to a living organism ? What is the smallest space within which we can properly suppose such a minimum of organisation to be contained ? Are organisation, differentiation, separation from the surrounding medium by a boundary membrane of special properties, necessary for the endowment of matter with any form of life ? Or is it possible to conceive of a material complex, retaining in endless propagation its physiological character, as revealed by the closely specific reaction to it of the cells which it infects, though it is not organised into units, but uniformly dispersed in a watery medium ? Among those who study the viruses primarily as pathogenic agents, these questions provide matter for debate ; I suggest that they are questions with which the physiologist may properly be concerned.

I cannot deal with the history of the subject; but it is of interest to note that Edward Jenner was dealing, in small-pox and vaccinia, with what we now recognise as characteristic virus infections, long before there was any hint of the connexion of visible bacteria with disease. Pasteur himself was dealing with another typical case of a virus infection in the case of rabies. The clear recognition, however, of the existence of agents of infection, imperceptible with the highest powers of ordinary microscopic vision, and passing through filters fine enough to retain all visible bacteria, begins with Ivanovski's work in 1892 on the mosaic disease of the tobacco plant, brought to general notice and greatly developed by Beijerinck's work on the same infection some seven years later; and with Loffler and Frosch's demonstration, in the same period, that the infection of foot-and-mouth disease is similarly due to something microscopically invisible, and passing easily through ordinary bacteria-proof filters. Since those pioneer observations the study of viruses has spread, until they are recognised as the causative agents of diseases in an imposing and still growing list containing many of the more serious infections of man, animals, and plants.

If we are to discuss the biological nature of the viruses, it is obvious that we should begin by attempting some kind of definition. What do we mean by a virus ? And what are the tests by which we decide that a particular agent of infection shall be admitted to, or excluded from, the group ? But a few years ago I think that we should have had no difficulty in accepting three cardinal properties as characterising a virus, namely, invisibility by ordinary microscopic methods, failure to be retained by a filter fine enough to prevent the passage of all visible bacteria, and failure to propagate itself except in the presence of, and perhaps in the interior of, the cells which it infects. It will be noted that all three are negative characters, and that two of them are probably quantitative rather than qualitative.

Such a definition is not likely to effect a sharp or a stable demarcation. We shall see that its failure to do so is progressive. Nevertheless it would still be difficult to refuse the name of virus to an agent which fulfils all three criteria ; and we must therefore, in consistency, apply it, on one hand, to the filtrable agents transmitting certain tumours, and, on the other hand, to the agents of transmissible lysis affecting bacteria, and now widely known and studied as bacteriophages. But the strict application of such a definition, based on negative characteristics, must obviously narrow its scope with the advance of technique. We may look a little more closely at the meaning of these different characters.

Microscopic visibility is obviously a loose term. Rayleigh's familiar formula, in which the lower limit of resolution is equal to one-half the wavelength of the light employed, divided by the numerical aperture of the objective, only gives us the smallest dimensions of an object, of which, with the method of transmitted illumination habitually used in former years, a critical image can be formed. There can be no doubt that the separate particles of practically all the agents to which the term virus would be applied fall below this limit of size. To put it in plain figures, their diameter is less than 0·2 micron. On the other hand, progress has recently been, and continues to be, rapid in the direction of bringing into the visible range minute bodies associated with a growing number of viruses. This has been effected, on one hand, by improvement in

* From the presidential address introducing a discussion on the subject in Section I (Physiology) of the British Association in London on Sept. 28.

staining technique, which probably owes its success largely to increase of the natural size of the particles by a deposit of dye on their surface ; and, on the other hand, by forming visible diffraction images of the unstained particles with wide-aperture dark-ground condensers, and by photographing the images formed of them with shorter invisible rays. Mr. Barnard has obtained such sharp photographic images of the bodies associated with one virus, measurements of which give their natural size by simple calculation.

The reaction of a cautious criticism to such a demonstration seems to have taken two different directions. There has been a tendency, on one hand, to exclude an agent from the group of viruses as soon as the microscope could demonstrate it with some certainty. Many have for years thus excluded the agent transmitting the pleuro-pneumonia of cattle, though the status of this organism has been compromised even more by the success of its cultivation on artificial media. Visibility seems to have rendered doubtful the position of the Rickettsia group of infections, and, if the test is logically applied, the process of exclusion can scarcely stop before the agents transmitting psittacosis, fowl-pox, infectious ectromelia, and even vaccinia and variola, have been removed from the group of viruses into that of visible organisms.

In discussing the biological nature of viruses as a whole, however, we can scarcely begin by accepting an artificial and shifting limitation of that kind. The real task before us, rather, is to discuss to what extent the evidence of these recent developments, which appear to show that some of the agents, known hitherto as viruses, consist of very minute organisms, can safely be applied to other viruses which are still beyond the range of resolution. Do these also consist of organisms still more minute, or are any of them unorganised ? Another line of criticism, sound in itself, while not excluding from the virus group these agents for which microscopic visibility has been claimed, demands more evidence that the minute bodies seen or photographed are really the infective agent, and not merely products of a perverted metabolism which its presence engenders.

It is obvious that complete evidence of identity cannot be obtained until a virus has been artificially cultivated in an optically homogeneous medium. Meanwhile it is a question of the strength of a presumption, on which opinions may legitimately differ. Let us recognise that the evidence is not perfect, but beware of a merely sterilising scepticism. I suspect that the attitude of some critics is coloured by past history of the search for viruses and especially by that part of it concerned with the curious objects known as ‘ inclusion bodies ’, which are readily demonstrated with relatively low powers of the microscope, in the cells of animals and plants infected with certain viruses. From the earlier and admittedly hasty tendency to identify them as infective protozoa, opinion seems to have swung too quickly to the opposite extreme, of dismissing them as mere products of the infected cell. It is so comparatively simple, in some cases, to separate these bodies, that it is surprising that so few efforts have been made to test their infectivity. However, the power of such a body to convey at least one virus infection has been demonstrated ; and since they have further been shown, in several cases, to consist of a structureless matrix packed with bodies looking like minute organisms, the burden of proof in other cases seems to me, for the moment, to rest on those who suggest that they consist wholly of material precipitated by the altered metabolism due to the infection.

The physical evidence, obtained by filtration through porous fabrics and colloidal membranes, and by measuring rates of diffusion, is, of course, purely concerned with the size of the units of infective material, and must be taken in conjunction with the evidence provided by the microscope. The crude qualitative distinction between the filterable and non-filterable agents of infection has long since ceased to have any real meaning. There is no natural limit of filterability. A filter can be made to stop or to pass particles of any required size. It is now realised that the only proper use of a filter in this connexion is to give a quantitative measure of the maximum size of the particles which pass it. Evidence from failure to pass must always be subject to correction for the effects of electrostatic attraction and fixation by adsorption on the fabric of the filter. A large amount of filtration evidence has, further, been vitiated by reliance on determinations of the *average* pore size of the filter. In dealing with an infective agent, the test for the presence of which depends on its propagation under suitable conditions, it is obviously the maximal pore size which is chiefly significant.

For these reasons a good deal of the evidence showing that certain viruses can be detected in the filtrates, obtained with filters which will not allow hæmoglobin to pass in perceptible quantities, must be regarded at least with suspicion. Dr. Elford has recently succeeded in preparing filter-membranes of much greater uniformity, with a small range of pore-diameters. His measurements, with these, of the sizes of the particles of different viruses, show a range approaching the dimensions of the smallest recognised bacteria, on one hand, and falling as low, in the case of the virus of foot-and-mouth disease, as about three or four times the size of the hæmoglobin molecule ; the latter being given not only by filtration - data, but also by other physico - chemical measurements, such as those obtained by Svedberg with the ultra-centrifuge. It should be noted, as illustrating the difficulties of the problem and the uncertain meaning of some of the data, that Elford has regularly found a bacteriophage to be stopped by a membrane which allows the foot-and-mouth virus to pass ; while, on the other hand, recent determinations of the rate of diffusion of bacteriophage, made by Bronfenbrenner, put the diameter of its particles at 0·6 of a millimicron, that is, only about one-fifth of the accepted dimensions of the hæmoglobin molecule. If we accepted such an estimate, we should be obliged to conclude, I think, not merely that the bacteriophage is unorganised, but that its molecules are something much simpler than those of a high-molecular protein. It has even been suggested, though on very imperfect evidence, that it may be a moderately complex carbohydrate. Are we, then, to suppose that the foot-and-mouth virus is a similarly unorganised and relatively simple substance? It is difficult to do so, in view of the series of other agents, all conforming in many aspects of their behaviour to the classical type of the foot-and-mouth virus, and yet showing a range of dimensions up to that at which their units are apparently becoming clearly visible by modern microscopical methods.

It will be clear, indeed, that, if we accept the lowest estimates for the size of the units of some viruses, such as the bacteriophage and the agents transmitting some plant diseases, we cannot by analogy apply the conception of their nature, thus presented, to viruses consisting of organisms which are ceasing to be even ultramicroscopic; and we should be led to doubt the identity with the virus of the bodies which the microscope reveals. If, on the other hand, we regard the still invisible viruses, by analogy with those already seen, as consisting of even much smaller organisms, we can only do so by rejecting the conclusions drawn from some of the physical evidence. It is, of course, possible that some of the agents called viruses are organisms and others relatively simple pathogenic principles in solution; but to assume at this stage such a fundamental difference, among members of a group having so many properties in common, would be to shirk the difficulty.

The third negative characteristic of a virus, namely, its failure to propagate itself, except in the presence of living cells which it infects, may obviously again provide an unstable boundary, shifting with the advance of our knowledge and skill. We may regard it as not only possible, but even likely, that methods will be found for cultivating artificially, on lifeless media, some of those viruses at least which have the appearance of minute organisms. It would be playing with nomenclature to let inclusion in the virus group depend on continued failure in this direction. On the other hand, the dimensions assigned to the units of some viruses, representing them as equal in size to mere fractions of a protein molecule, might well make one hesitate to credit them with the power of active self-multiplication. Experience provides no analogy for the growth of such a substance by self-synthesis from the constituents of a lifeless medium; the energetics of such a process might present an awkward problem. To account for the multiplication of such a substance at all, even in cells infected by it, we should be driven, I think, to the hypothesis which has been freely used to account for the propagation of bacteriophage, on one hand, and of typical viruses like that of herpes, on the other; namely, that the presence of the virus in a cell constrains the metabolism of the cell to produce more.

Bordet has used the reproduction of thrombin by the clotting of the blood as an analogy for the suggested reproduction of bacteriophage in this manner. Another, and perhaps closer, analogy might be found in recent evidence that a culture of pneumococcus, deprived of its type-specific carbohydrate complex, can be made to take up the carbohydrate characteristic of another type, and then to reproduce itself indefinitely with this new, artificially imposed specificity. The response of the cells of the animal body to even a single contact with a foreign protein, by the altered metabolism producing immunity, and often persistent for the lifetime of the individual, may suggest another parallel; but here the protective type of the reaction is in direct contrast to the supposed regeneration by the cells of the poison which killed them.

Boycott, again, has emphasised the difficulty of drawing a sharp line of distinction between the action of normal cell-constituents, which promote cell-proliferation for normal repair of an injury, and the virus transmitting a malignant tumour, or that causing foot-and-mouth disease. I do not myself find it easy, on general biological grounds, to accept this idea of a cell having its metabolism thus immediately diverted to producing the agent of its own destruction, or abnormal stimulation. It is almost the direct opposite of the immunity reaction, which is not absent, but peculiarly effective in the response of the body to many viruses. It is difficult, again, to imagine that a virus like rabies could be permanently excluded from a country if it had such an autogenous origin. The phenomena of immunity to a virus, and of closely specific immunity to different strains of the same virus, are peculiarly difficult to interpret on these lines.

This conception, however, of the reproduction of a virus by the perverted metabolism of the infected cell has been strongly supported by Doerr, in explanation of the phenomena of herpes. There are individuals in whom the epidermal cells have acquired a tendency to become affected by an herpetic eruption, in response to various kinds of systemic or local injury. From the lesions so developed, an agent having the typical properties of a virus can be obtained, capable of reproducing the disease by inoculation into individuals, even of other species, such as the rabbit, and exciting, when appropriately injected, the production of an antiserum specifically antagonising the herpes infection. Such phenomena have a special interest for our discussion, in that they can be almost equally well explained by the two rival conceptions. One regards the herpes virus as a distinct ultramicroscopic organism, and the person liable to attack as a carrier, in whom the virus can be awakened to pathogenic activity and multiplication by injuries weakening the normal resistance of his cells to invasion. The other regards it as a pathogenic principle produced by cells in response to injury, and awakening other cells to further production when transmitted to them.

This forms a good example of the central difficulty in dealing with the group of agents at present classed together as viruses. They seem to form a series; but we do not know whether the series is real and continuous, or whether it is formed merely by the accidental association, through a certain similarity in effects, and through common characteristics of a largely negative kind, of agents of at least two fundamentally different kinds. If we approach the series from one end, and watch the successive conquests of microscopical technique, or if we consider the phenomena of immunity over the whole series, we are tempted to assume that all the viruses will ultimately be revealed as independent organisms. If we approach from the other end, or consider analogies from other examples of a transmissible alteration of metabolism, we may be tempted to doubt the significance of the evidence provided by the microscope, and to conclude that all viruses are unorganised, autogenous, toxic principles. If we take the cautious attitude of supposing that both are right, and that viruses belonging to both these radically different types exist, where are we going to draw the line? Is the test to be one of unit dimension? If so, what is the lower limit of the size of an organism? Are we to suppose that inclusion bodies can only be produced by viruses which are independent organisms? And if so, does this conclusion also apply to the 'X' bodies associated with the infection of plant cells by certain viruses?

If we try to form an estimate of the lower limit of size compatible with organisation, I think we should remember that particles which we measure by filters of known porosity, or by photomicrographs, need not be assumed to represent the virus organisms in an actively vegetative condition. They may well be minute structures, adapted to preserve the virus during transmission to cells in which it can resume vegetative life. Attempts to demonstrate an oxidative metabolism in extracts containing such a virus, separated from the cells in which it can grow and multiply, and to base conclusions as to the non-living nature of the virus on failure to detect such activity, must surely be regarded as premature.

Our evidence of the vitality of its particles is, as yet, entirely due to their behaviour after transmission. They may accordingly contain protein, lipoid and other molecules in a state of such dense aggregation that comparisons of their size with that of the heavily hydrated molecules of a protein in colloidal solution may well give a misleading idea of their complexity.

Apart from their known function as the agents transmitting many of the best known among the acute infections, it is impossible, to anyone having even a slight knowledge of the recent developments which began with the work of Rous and Murphy, to doubt that in the advance of knowledge concerning the nature of the viruses in general lies the brightest hope of finding a clue to the dark secret of the malignant tumours. In unravelling what is still such a tangle of contradictions, the animal biologist needs all the help that can be given by concurrent study of the analogous phenomena in plants.

Eels and Conger Eels of the North Atlantic.

By Prof. JOHANNES SCHMIDT.

IN the course of the Danish investigations on the life-histories of the fresh-water eels (1904–1931) important data about the congers have been obtained. I hope it will be possible some time to give a more detailed picture of the history and distribution of the fresh-water eels and congers of the various oceans. Referring to my earlier publications,[1-8] I propose here to deal with the relation between the European and the American conger, which is generally referred to the same species as the European one. The investigation is mainly based upon a study of the larvæ and their distribution.

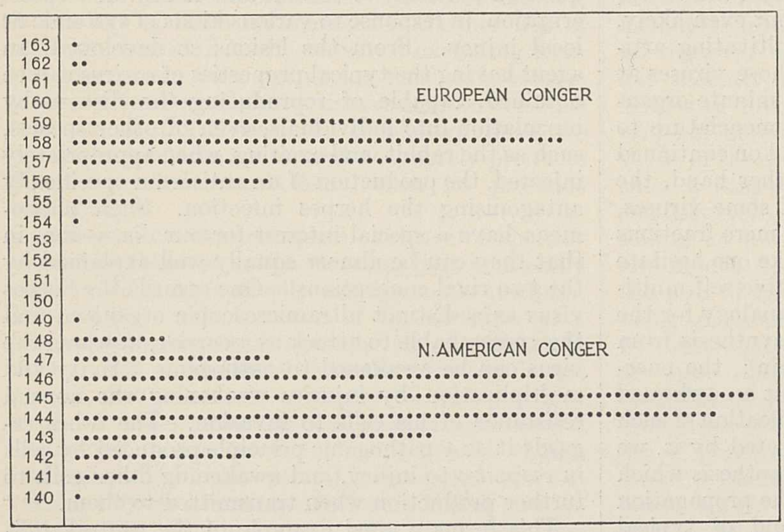

FIG. 1.—European and North American Conger (*Conger vulgaris* and *Conger oceanicus*). Number of myomeres in larvæ: *Conger vulgaris* (top graph), average of 201 specimens, 158·16; *Conger oceanicus* (lower graph), average of 288 specimens, 144·63. (Countings by Miss Esther Hansen.)

In the North Atlantic area, we obtained about 2500 larvæ belonging to the genus *Conger s. str.* By counting the myomeres we found that the material falls into two distinctly separate groups (Fig. 1). In the former, the number of myomeres varies between 154 and 163 with an average of 158·16, in the latter between 140 and 149 with an average of 144·63. So there is no overlapping of the two groups.

On marking the distribution of the larvæ of the two groups upon a chart, we find that the larvæ with the high myomere number occupy quite another and a much larger area than those with the smaller number. As shown by the charts (Figs. 2 and 3), the distribution is much like the one I have found in the case of the larvæ of the European and the American fresh-water eel respectively. Similarly, there is in both cases an overlapping of the areas.

We have determined the number of vertebræ in several hundred adolescent and adult specimens of the European conger (*Conger vulgaris*) and have found values between 153 and 161 (average between 157 and 158), which corresponds well with the above-mentioned values of myomeres in the group of larvæ with the higher number, the number of myomeres of the larvæ being a little higher than the number of vertebræ of the adult fish. This fact also holds good of the fresh-water eels and other murænoids.

As to the number of vertebræ in adult specimens of congers from North America, my material is much smaller than that for the European conger. Through the kindness of the United States Bureau of Fisheries, however, I received in 1922 four adult specimens originating from Woods Hole, Mass. A determination of their number of vertebræ gave the following figures: 143, 144, 144, 145, which is in complete agreement with the values of the group of larvæ with the smaller number.

In the circumstances, it is clear that the American conger is a species differing from the European one, and that it ought to be given a specific name. For want of types, I have applied for advice to American colleagues, namely, Prof. H. B. Bigelow and Mr. A. E. Parr, who think that the name used by Mitchell (*Jour. Ac. Nat. Sci. Phila.*, p. 407; 1818), namely, *Anguilla oceanica*, should be chosen. The fish in question being stated by Mitchell to occur "off New York", there is scarcely any doubt that he really had before him the American species with the smaller number of vertebræ. So we name the North American species *Conger oceanicus* as distinct from the European *Conger vulgaris*. However, I wish to direct attention to the fact that the name does not apply to the conger occurring in South America (Argentine), which by our investigations has proved to be different from the North American species.

The distribution of *Conger oceanicus* is not nearly so wide as that of *Conger vulgaris*. We know that it occurs off the Atlantic coast of the United States, but we know little more. In the West Indies we have found quite tiny larvæ, a fact that permits us to conclude that here is the breeding place of the species. The appearance of these tiny larvæ agrees with the corresponding stages of development of *Conger vulgaris* described and pictured by me in 1912 [4] and 1913.[6] The tiny stages, however, which Eigenmann (1902) hatched from pelagic eggs taken by the schooner *Grampus* south of Nantucket lightship, do not belong to *Conger* but to an *Ophichthys* or a closely related form, a fact to which I have already directed attention.[5]

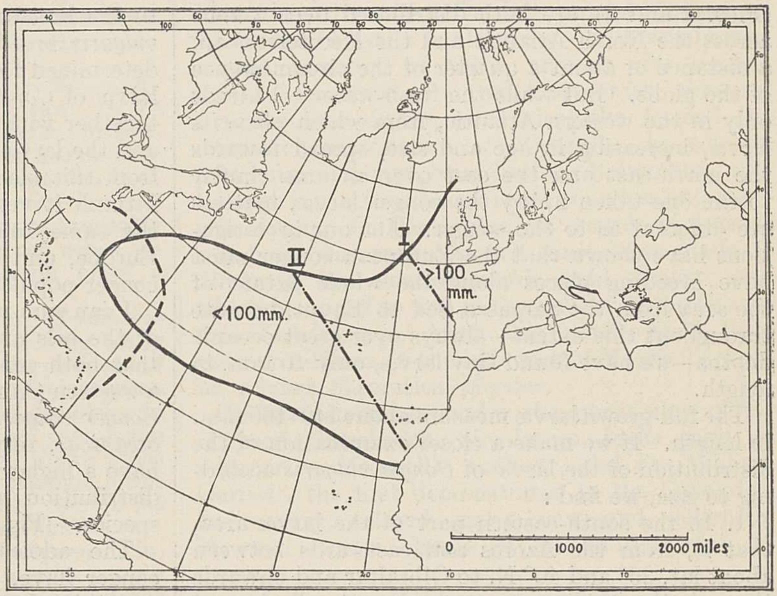

FIG. 2.—Distribution of unmetamorphosed larvæ of the European and North American species of congers (*Conger vulgaris* and *Conger oceanicus*). *Conger vulgaris*: East of line I all larvæ were more than 100 mm. long, west of line II all were less than 100 mm. in length, according to Danish investigations, 1904–1931. The American species indicated by *broken*, the European by *unbroken* curves. In contrast to the fresh-water eel, *Conger vulgaris* breeds in the Mediterranean and in the Eastern Atlantic.

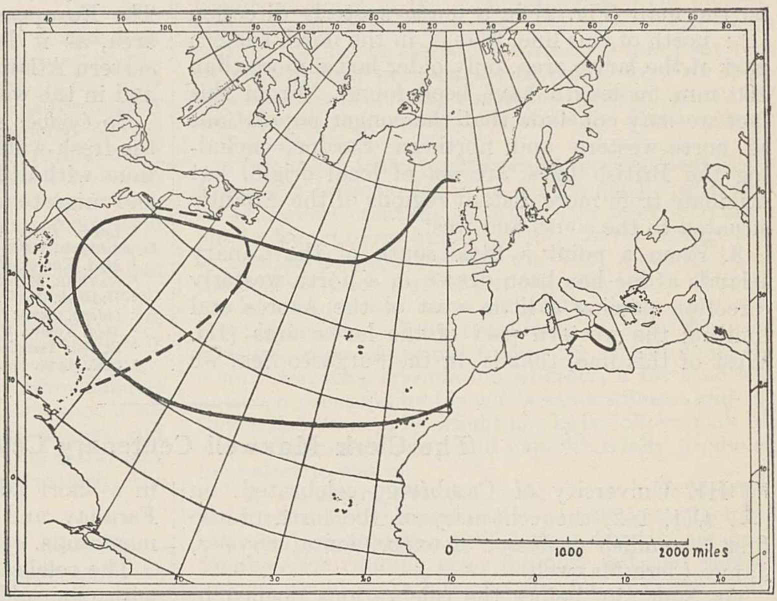

FIG. 3.—Distribution of unmetamorphosed larvæ of the European and North American species of fresh-water eel (*Anguilla vulgaris* and *Anguilla rostrata*). The American species indicated by *broken*, the European by *unbroken* curves. *Anguilla vulgaris* only breeds in the Sargasso Sea west of long. 50° W.

I have already mentioned that there is a striking agreement between the distribution of the larvæ of the two *Conger* species and those of the two *Anguilla* species. It is especially interesting to compare the two European species, *Conger vulgaris* and *Anguilla vulgaris*, which, as shown by the maps (Figs. 2 and 3), are both distributed over a zone across the North Atlantic and the Mediterranean, a distance of about a quarter of the circumference of the globe. But while the fresh-water eel breeds only in the western Atlantic, from which place its larvæ, increasing in age and size, spread towards the north-east and the east over an area similar to the one taken up by the conger larvæ, matters are different as to the conger. For our investigations have shown that the European conger must have breeding places along the whole extent of the area from the Sargasso Sea to Egypt, because throughout this extent—always over great oceanic depths—we have found tiny larvæ, only 10 mm. in length.

The full-grown larvæ measure about 140–160 mm. in length. If we make a closer examination of the distribution of the larvæ of *Conger vulgaris* according to size, we find :

1. In the south-eastern part of the larvæ area, that is, from the Azores and eastwards between about lat. 30° and 40° N. to Gibraltar and onwards through the Mediterranean to Egypt, all sizes of larvæ from tiny to full-grown ones were found. This fact shows that we are dealing here with local conger populations.

2. From Cape Finisterre a line has been drawn on the map (Fig. 2) in a north-westerly direction (I) ; north of this line, that is, in the north-eastern part of the larvæ area, only older larvæ more than 100 mm. in length have been found. From this fact we may conclude that the conger populations of north-western and northern Europe, including the British Isles, are *not* of local origin, but originate from more distant regions of the Atlantic situated to the south and west.

3. From a point a little south of the Canary Islands a line has been drawn in a north-westerly direction passing a little west of the Azores and limiting the western part of the larvæ area (II). West of this line, that is, in the Sargasso Sea, we only found tiny (10 mm. in length) or half-grown larvæ, but none attaining a length of 100 mm. As the adolescent conger lives in shallow water, these larvæ must be the offspring of conger populations that have undertaken very long migrations to the breeding places. The origin of the *Conger vulgaris* breeding in the Sargasso Sea cannot be determined for certain at present. Since the tiny larvæ of *Conger vulgaris* occur in the Sargasso Sea together with the tiny larvæ of our European eel, and the larvæ, like those of the eel, increase in size from this place towards the north and north-east, I think it very probable that they migrate along the same routes to north-western and northern Europe, and that they are the offspring of the conger populations living there.

I can sum up as follows : it is a common feature of the eels and conger eels of the North Atlantic that both genera have an eastern (European) and a western (American) species, *Anguilla vulgaris* and *Conger vulgaris*, and *Anguilla rostrata* and *Conger oceanicus*, respectively. Both the eastern species have a higher number of vertebræ and a far wider distribution of the larvæ than the two western species. (Fig. 1.)

The adolescent European eel and European conger have, in the main, the same distribution, and this also holds good of their larvæ, when no account is taken of the age (size) of the latter. (Figs. 2 and 3.)

The European eel breeds in the western Atlantic and only there, in a limited area of the Sargasso Sea. The European conger has a much wider breeding area, as it breeds in the Mediterranean, in the eastern Atlantic between the Azores and Gibraltar, and in the west Atlantic (the Sargasso Sea).

So *Conger vulgaris* is not a biological unity like the fresh-water eel. It comprises different populations with different breeding places, breeding time, and migratory tendencies.

[1] *Rapp. Proc. Verb. Conseil perm. intern. l'Explor. de la Mer* Copenhagen, 1906.
[2] *Med. Komm: Havunders., Fiskeri*, Bind 3, No. 3, Copenhagen, 1909.
[3] NATURE, March 9, 1911.
[4] *Vidensk. Medd. Dansk naturh. Foren.*, Copenhagen, Bd. 64, 1912.
[5] *Intern. Revue Hydrobiol. Hydrogr.*, Bd. 5, Leipzig, 1912.
[6] *Med. Komm. Havunders., Fiskeri*, Bind 4, No. 2, Copenhagen, 1913.
[7] British Association, Hull Meeting, 1922.
[8] *C.R. Acad. Sci.*, Paris, t. 179, Oct. 20, 1924.

The Clerk Maxwell Centenary Celebrations.

The University of Cambridge celebrated, on Oct. 1–2, the centenary of the birth of the first Cavendish professor of experimental physics, James Clerk Maxwell.

On Sept. 30, before the celebrations opened in Cambridge, memorial tablets to Faraday and Maxwell were unveiled in Westminster Abbey. The tablets are of the same size as that which marks Kelvin's resting-place, and they lie on the opposite side of the Newton floor-slab. There could be no more appropriate site. The short service was conducted by the Dean, and was attended by about four hundred members and delegates from the Royal Institution, delegates of the Maxwell celebration, and members of the University of Cambridge. The Master of Trinity unveiled the memorial, and in a short address emphasised the links between Faraday and Maxwell and their claims to such memorials.

The celebrations opened in Cambridge on Oct. 1, with the old Maxwell wing of the Cavendish Laboratory as its headquarters. About eighty official delegates had been nominated by the principal academies and learned societies of the world and by the home universities. Capt. J. Wedderburn Maxwell represented Maxwell's family, and there were present also some fifty guests, including at least twelve of those who had worked with Maxwell or sat at his lectures in the first days of the Cavendish Laboratory and many of those who have since helped to build up the school of experimental physics in Cambridge. A luncheon to the official delegates was given by the newly appointed Vice-Chancellor, the Master of Corpus, who in an introductory speech said that he counted himself fortunate in having this amongst the first of his new duties. The toast of the delegates, proposed by Lord Rutherford, was replied to by the Marchese Marconi and also by Prof. Max Planck, who said:

"Maxwell's centenary is indeed a festive day—a day of honour for the physicists of all countries. In his personality we see not only the erudite savant mastering every domain of physics, but also the imaginative artist, who, like no other, knew how harmoniously to combine the separate material of investigation and thus to further its development. It is pre-eminently with Maxwell that this interweaving of sober intellectual activity with artistic intuition plays a particularly characteristic part.

"In physics, intuition is a peculiar thing. Nowadays it has somewhat fallen into discredit, having really recently done a deal of harm: first in the province of relativity, where the seemingly evident conception of the simultaneousness of two events occurring in different places proved a gross delusion; then again in the province of the quantum theory, where it has proved absolutely impossible with the common forms of intuition completely to grasp the connexions between corpuscular and undulatory motion.

"And yet those are wrong who wholly reject intuitions by asserting that theoretical physics is only concerned in the mathematical working out of the results of measurements. For he who quite forgoes tentative flights of imagination will never be struck by a new idea which can be made fruitful for experiments. Yet a careful distinction must be made between the operations of the intellect and those of fancy. Here Maxwell sets us a classic example. His theory of electrodynamics was originally founded on quite special ideas of the mechanical nature of the ether, in accordance with the fact that in his time the mechanical conception of Nature was considered nearly a matter of course, having received strong support through the discovery of the principle of conservation of energy. But after, by the aid of such mechanical notions, Maxwell had found his electromagnetic differential equations and had recognised the extent of their efficiency, he did not hesitate in pushing aside as a negligible accessory the mechanical interpretations of the differential equations, in order to make them independent and to give his theory its pure and sublime shape. Perhaps this most clearly characterises Maxwell's physical manner of thinking.

"Thus to-day, when we are beset by more difficult problems, Clerk Maxwell can still teach us a good deal, and it is with the expression of sincere thanks and warm wishes that we greet the home of his activities: the University of Cambridge and particularly the Cavendish Laboratory."

After this impressive opening, the Vice-Chancellor and delegates proceeded in procession to the Senate House, where, after the welcome and presentation of delegates, the Master of Trinity delivered the memorial lecture, dealing first with Maxwell's life and personality and finally with his work. This address forms the first of the essays in the commemoration volume which has been published by the University Press.

After the ceremony in the Senate House, the guests were entertained by the Master and Fellows of Peterhouse, the college where Maxwell spent his first days in Cambridge. In the evening the reception given by the Master and Fellows of St. John's College filled the hall and combination room with a brilliant assembly.

Three of the main scientific addresses were given in the Arts School on the morning of Oct. 2. Prof. Planck's address on "The Influence of Maxwell on Theoretical Physics in Germany" will remain long in the memory of those present. Sir Joseph Larmor charmed the assembly with personal reminiscences of the celebrities who formed the scientific environment of Maxwell; he told in particular of a visit from Ludwig Boltzmann, who through misfortune had arrived penniless and without luggage in Cambridge, in search of models which he was sure Maxwell must have made to illustrate his electrodynamic field theory, and which he hoped to find in the lumber of the Cavendish Laboratory. After this, Prof. Niels Bohr gave an address on the influence of Maxwell's work on modern theoretical physics.

In the afternoon, under the presidency of Sir Richard Glazebrook, Sir James Jeans gave an address on Maxwell's methods, and Dr. William Garnett, the first demonstrator in the Cavendish Laboratory, related many new and delightful Maxwell stories. Some of his address may be quoted:

"Perhaps to see Maxwell at his best was to see him at play. Few things could give him more pleasure than a new toy, whether designed by himself or anyone else, provided it showed some ingenuity in its design or construction; and to exhibit these toys to his friends at home in the evenings was a great delight. Maxwell's improved Zoetrope with its concave lenses and his real image stereoscope afforded much interest to visitors, but perhaps his favourite toys on these occasions were the flying butterflies with their revolving antennæ which he made to fly about the drawing-room at Scroops Terrace.

"But if one looks for Maxwell's most characteristic feature, it is to be found in his sympathy with and love for every creature. Though very fond of country life, he would never hunt or shoot. In Cambridge and in London he nursed friends who were seriously ill, at the cost of much time taken from his work. During his last two years his work at the laboratory was greatly interrupted by the illness of Mrs. Maxwell, in whose room he would frequently sit all night. It is an interesting speculation whether, if his time had not been occupied by his wife's serious illness and the Cavendish papers, he would not have followed up his electromagnetic theory and experimentally produced long electric waves.

"It was during the visit of the comet in 1874, when unfortunately the comet's tail was a subject of general conversation, that Maxwell's terrier developed a great fondness for running after his own tail, and though anyone could start him, no one but Maxwell could stop him until he was weary. Maxwell's method of dealing with the case was, by a movement of the hand, to induce the dog to revolve in the opposite direction and after a few turns to reverse him again, and to continue these reversals, reducing the number of revolutions for each, until like a balance wheel on a hair spring with the maintaining power withdrawn, by slow decaying oscillations the body came to rest.

"I have been asked what Maxwell did when he wanted an experimental test of a theory and had not thought of one, or when a piece of apparatus behaved quite unexpectedly. According to his own statement he 'dreamt over it properly', which he considered 'the best method of resolving difficulties of a particular kind which may be found out especially by the laws of association'."

Sir Ambrose Fleming spoke of his work at the laboratory during the last few years of Maxwell's life, and of Maxwell's lectures, attended only by three students. He presented to the laboratory the notes he took of Maxwell's last lectures. He thought it strange that Maxwell never lectured or spoke of his theory of electromagnetic waves. He had never heard any proposal for an experiment on electromagnetic radiation, and although there is in existence a letter from Maxwell to Garnett where he promises to write down for Fleming "a scheme for a radiating wire experiment", one is driven by the absence of any later development to conclude that this referred to the thermal radiation for the oil-cooled coils which were then being used for the B.A. experiments.

After Sir Oliver Lodge had wound up the addresses with an account of the development of wireless from Maxwell's equations to Marconi and the B.B.C., the proceedings were transferred to the Cavendish Laboratory, where, in the old rooms designed so carefully by Maxwell, were laid out for the first time since Maxwell's death the treasures which were bequeathed by Mrs. Maxwell.

The laboratory can count itself fortunate in Maxwell's characteristic of saving everything of interest from his toys, manuscripts, and apparatus. In one group were assembled the relics of his childhood and adolescence. The models of the regular solids made at the age of thirteen showed Maxwell's early geometrical interests; the strained pieces of glass and gelatine used in his early investigations on the optical properties of elastic solids when placed in the polariser showed the now familiar coloured strain figures, which could be compared with the same figures sketched out by Maxwell eighty years ago. The improved form of Zoetrope referred to by Dr. Garnett, with its clearly executed drawings of vortex rings in motion, and the drawings of more elaborate operations, in which his imagination was aided by the clear brush of Jemima Wedderburn, proved a great attraction. There was also his real image stereoscope which he constructed for the teaching and study of solid geometry, and the ophthalmoscope which he used for the study of the eyes of his friends.

In the next group could be seen the development of Maxwell's scientific interests; the colour-top with its sectors of different colours which he constructed whilst a graduate of Trinity College in 1854, and which was used to establish his colour equations and for the investigation of colour blindness; here also was the more perfect instrument of his last years in Aberdeen—the colour-box with its slits and prisms for combining different components of white light in any desired proportion. To illustrate his work on the dynamics of rigid bodies were three models of his dynamical top; the original wooden top used to entertain and mystify his undergraduate friends in Trinity College and the more perfect instrument of his Aberdeen days with its screws for the adjustment of the principal moments of inertia and devices for showing the motion of the instantaneous axis of rotation. One of the important applications of this top has been to show the connexion of the figure of the earth with a periodic variation in latitude. As a reminder of Maxwell's first excursion into statistical theory was shown the model of Saturn's rings constructed to illustrate two of the possible methods of propagation of waves amongst the particles of the rings; by it stood the original oscillating disc apparatus used for the measurements on the viscosity of gases which were carried out in his King's College days in his home in Kensington. There was also the small note-book with its record of swings and 'log decs.', and the triumphant letter to Tait announcing the independence of viscosity and pressure.

The activities of Maxwell as a member of the British Association Committee on Electrical Standards were fully illustrated by the spinning coil lent by the Science Museum to its old home, the apparatus used for the determination of the ratio of the units by balancing the electrostatic attraction of two discs against the electromagnetic repulsion of two coils, and the great B.A. electrodynamometer constructed in 1867 and used later by Lord Rayleigh for the determination of the ampere.

Most interesting of all, perhaps, were the manuscripts and letters of Maxwell. The delegacy of King's College, London, had kindly lent three of the small note-books in which Maxwell used to write down his examination questions, and in one of which are the first chapter headings of the "Electricity and Magnetism". Practically the whole of the manuscript of the first edition of the "Electricity and Magnetism" is in the possession of the laboratory, and various parts were exhibited, together with Maxwell's copy of the first edition. Here also were the manuscripts of his later papers, the note-books of his undergraduate days, and the notes of his lectures taken by Sir Ambrose Fleming. With the original plans of the Cavendish laboratory was a letter to Thomson asking for advice and giving his idea of what a laboratory should contain:

> "A place on the ground floor with solid foundations for things requiring to be steady. Access to the roof for atmospheric electricity. A place with good ventilation to set up Grove or Bunsen's batteries without sending fumes into the apparatus.
>
> "A good clock in a quiet place founded on masonry, electric connexion from this to other clocks to be used in the experiments, and from here connexion to machines for making sparks, marks on paper, etc.
>
> "A well-constructed oven, heated by gas to get up a uniform high temperature in large things.
>
> "A gas engine (if we can get it) to drive apparatus; if not, the University men in good training in four relays of two, or two relays of four, according to the nature of the experiment.
>
> "We should get from the B.A. some of their apparatus for the Standards Committee. In particular, the spinning coil and the great electrodynamometer."

Here also were letters to Tait announcing the discovery of the law of distribution of radiation and the famous catechisms to Thomson " concerning demons ".

If one sought evidence for the unchanging perversity of scientific writers, there was Maxwell's letter written in October 1876:

" How vile are they who quote newspapers, journals, and translations by number of vol. and page, instead of the year of grace, as if one should refer to the standard No. 16240 instead of Oct. 10, 1876. Lockyer always alters a reference to Nature for Sept. 7, 1876, into vol. ?, p. ?, as if all promoters of natural knowledge counted everything from the epoch when Nature first began."

Most interesting pictorial records of Maxwell's early life were provided by Jemima Wedderburn's sketch-book, very fortunately saved from the recent fire at Glenlair and lent by Capt. Wedderburn Maxwell for the celebration. There one could see the child of three years of age gazing in awe at the fiddler at the servants' dance, wondering, no doubt, 'what was the go of it'; there, too, his escape from his unsympathetic tutor by paddling himself into the middle of a pond, together with other charming sketches of early life at Glenlair. The Institution of Electrical Engineers lent its portrait of Maxwell, and Dr. William Garnett sent the original of the well-known photograph of his later years.

As a final entertainment, the guests were shown the connexion of Maxwell's colour work with modern work on colour photography.

In 1861 Maxwell prepared for a Royal Institution lecture three lantern slides of a bow of ribbon taken through solutions of sulphocyanide of iron, chloride of copper, and ammoniated copper. The slides were projected on to a screen by means of three lanterns. Mr. Thorne Baker, of Messrs. Spicer, Ltd., reconstructed the projection, using the original slides, and then showed a colour film of the procession of delegates from Corpus Christi College to the Senate House which had been taken the previous day. The projection was very successful, the brilliant blue of Prof. Cabrera's robes being particularly well reproduced.

The proceedings closed by a banquet in Trinity College.

The addresses presented on the occasion of the Clerk Maxwell centenary celebrations have been brought together and issued as a single volume.* The book forms a most fitting permanent memorial of Maxwell's achievements and personality, linking certain aspects of his work with that of Faraday, placing it against the background of his time, and showing its influence on those great movements in scientific thought which have completely revolutionised our outlook.

It is no easy matter either to review or to summarise adequately a volume dealing with a life which has touched and dominated so many activities of our modern world. Planck puts the matter in a nutshell when he points out that Maxwell's work has materially influenced two great regions of conceptual thought, the regions which deal with the physics of particles and with the physics of continuous media. In half a dozen masterly pages, Planck sketches the development of the kinetic theory, shows how Maxwell's great discovery of the velocity distribution law roused the interest and enthusiasm of Boltzmann, and how these two masters, marching along different ways, one attempting " to find the statistical laws of a complicated mechanical structure by considering the structure simultaneously in a number of different states, while Boltzmann, on the other hand, preferred to follow over a long period of time a single structure through its manifold changes of state", laid the foundations of the modern science of statistical mechanics.

There is no more fascinating chapter in the history of kinetic theory of gases than that which describes the difficulties encountered by the theory when dealing with certain irreversible processes. Here again these two pioneers followed very different routes, and Maxwell's artifice of looking on a collision as a rapid and continuous transition from the initial to the final state governed by a repulsive force which varied according to the inverse fifth power of the distance, roused Boltzmann to a high pitch of enthusiasm. His famous comparison of Maxwell's work to a musical drama is unique in the literature of science:

" At first are developed majestically the Variations of the Velocities, then from one side enter the Equations of State, from the other the Equations of Motion in a central field; ever higher sweeps the chaos of formulæ; suddenly are heard the four words 'put $n=5$'. The evil spirit V vanishes and the dominating figure in the bass is suddenly silent; that which had seemed insuperable being overcome as if by a magic stroke. . . . Result after result is given by the pliant formulæ till, as unexpected climax, comes the Heat Equilibrium of a heavy gas; the curtain then drops."

Sir J. J. Thomson's essay tells the story of Maxwell's greatest contribution to science—the theory of the electric field—with all the force and authority of one of whose influence on post-Maxwellian physics it can with literal truth be said, *pars magna fuit*. It is difficult in these days, when the concept of lines of force is a school commonplace, to realise the state of electrical science in 1855, when Maxwell's first paper appeared. An imposing mathematical superstructure had been built on the inverse square law and the notion of action at a distance, and, indeed, if we endeavour not to be wise after the event, we see that there is a measure of justification for Sir George Airy's dictum when he says that he " can hardly imagine anyone who knows the agreement between observation and calculation based on action at a distance to hesitate an instant between this simple and precise action on the one hand and anything so vague and varying as lines of force on the other."

* James Clerk Maxwell: a Commemoration Volume, 1831–1931. Essays by Sir J. J. Thomson, Max Planck, Albert Einstein, Sir Joseph Larmor, Sir James Jeans, William Garnett, Sir Ambrose Fleming, Sir Oliver Lodge, Sir R. T. Glazebrook, Sir Horace Lamb. Pp. vi+146+2 plates. (Cambridge: At the University Press, 1931.) 6s. net.

Nevertheless, although the exponents of the theory of action at a distance took little account of the properties of space, Faraday's fundamental experiments show that this neglect is erroneous. After all, it is necessary to take cognisance of such elementary results as those shown on rotating a coil (*a*) when a magnet is in the neighbourhood of the coil, (*b*) when the magnet is removed. Faraday expressed the difference by saying that space traversed by magnetic lines of force is in the electro-tonic state.

Maxwell's physics was that of the Scottish school, and he had a passion for exhibiting and explaining his views by means of a model. In his model of the magnetic field he represents "the lines of magnetic force . . . by cylinders rotating round these lines as axes, the magnitude of the force being represented by the velocity of rotation and its direction by that of the axis of rotation". The cylinders, in order that they may rotate in the same direction, must not be geared directly, but something of the nature of idle wheels must be introduced. The part of the idle wheels is played by electric particles, symbolised as small spheres. It is not difficult to see that changes in the magnetic field (that is, in the velocity of rotation of the cylinders) will produce motion of the spheres—that is, will give rise to an electric current; and it is the great virtue of the model that it suggests that changes in the electric force will give rise to motion of the cylinders—that is, will create a magnetic field. There is no need to labour the matter further. We may leave it here with Sir Joseph Thomson's comment that "the introduction and development of this idea was Maxwell's greatest contribution to Physics".

We have remarked on Maxwell's partiality for a model; and it is difficult, based as our mechanical views are (or were) on laws deduced from observation of large-scale phenomena, not to extrapolate our macroscopic conceptual world into the region of the infinitely small. So we obtain a concept of a gas based on billiard-ball mechanics; so we give the realities of elasticity and density to a luminiferous ether. Maxwell ran no such danger. His model was never confused with the physical reality (whatever that may be), and could be cheerfully discarded when it had done its work. "The changes of direction which light undergoes in passing from one medium to another are identical with the deviations of the path of a particle in moving through a narrow space in which intense forces act. This analogy was long believed to be the true explanation of the refraction of light; and we still find it useful in the solution of certain problems, in which we employ it without danger as an artificial method. The other analogy, between light and the vibrations of an elastic medium, extends much farther, but, though its importance and fruitfulness cannot be over-estimated, we must recollect that it is founded only on a resemblance *in form* between the laws of light and those of vibrations."

It is of this passage that Sir James Jeans remarks that it reads almost like an extract from a lecture on modern wave-mechanics.

In these two great divisions of physical science Maxwell's influence has been supreme. But any memorial of Maxwell which did not include some account of his wonderfully attractive personality would suffer seriously. Fortunately a few personal friends are still with us, and Dr. Garnett, Sir Ambrose Fleming, Sir Richard Glazebrook, and Sir Horace Lamb have added some precious details to that store from which many of us have been wont to glean—Campbell and Garnett's "Life".

Perhaps not enough has been made of Maxwell's remarkable genius as a writer of light verse. His mind was nimble, versatile, and scholarly; he had, moreover, that sympathetic understanding of an author which is the first essential for a successful parodist; and hence results the production of a volume of verse, small in itself, but of remarkably high quality. Much of his verse is technical, and its appeal is to a narrow audience; but such a parody of Tennyson as is seen in the well-known stanzas beginning

> "The lamplight falls on blackened walls"

is not unworthy of Calverley.

The autumn of 1931 has been a memorable period in the history of the physical sciences in Britain; it has seen the centenary of the British Association; it has seen the centenary of one of Faraday's fundamental discoveries; in celebrating the centenary of James Clerk Maxwell, we honour one whose life in its gentleness, its geniality, its single-hearted devotion to a lofty ideal is, equally with his contributions to science, a κτῆμα ἐς ἀεί—a treasure for all time. ALLAN FERGUSON.

Henry Cavendish, 1731–1810.

OF all the many members of the Cavendish family who have made the name famous, none will probably be remembered longer than the distinguished eighteenth-century natural philosopher, the Honourable Henry Cavendish, the bicentenary of whose birth falls on Oct. 10. The founder of the fortunes of the family was the fourteenth-century judge, Sir John Cavendish, who was murdered in Jack Straw's rising in 1381, but from whose descendants came both the first dukes of Newcastle and the earls and dukes of Devonshire. William Cavendish, the fourth Earl of Devonshire, the statesman of the reigns of Charles, James, and William and Mary, became the first Duke of Devonshire, and it was from him Henry Cavendish traced his descent, being the son of Lord Charles Cavendish, son of the second duke.

Cavendish was born on Oct. 10, 1731, at Nice, where his mother, Lady Anne Grey, daughter of Henry, Duke of Kent, had gone for the sake of her health. He was educated at the school of Dr. Newcombe in Hackney, and in 1749, at the age of eighteen, entered Peterhouse, Cambridge. Four years later he left the University without, however, taking a degree. Little is known of his early manhood, but in 1760, three years after his father had been awarded the Copley Medal of the Royal Society for his " Very Curious and Useful Invention of making Thermometers ", he, too, became a fellow of the Society, and six years later, after reading his first scientific paper, was also awarded the Copley Medal, "for his Experiments relating to Fixed Air ".

Already deeply absorbed in scientific research, thence onward his study and laboratory claimed practically every moment of his life. His published papers were by no means numerous, but they firmly established his reputation, and as time went on he came to be regarded both at home and abroad as the foremost British natural philosopher of his age.

Cavendish occupied himself with many branches of physical science, including chemistry, meteorology, heat, magnetism, electricity, mathematics, and astronomy, but it was in the realm of chemistry that he first made his mark. He proved the elementary nature of hydrogen, he established the practical uniformity of atmospheric air, he was the first to show that water is not an elementary body but a compound of hydrogen and oxygen, and he discovered the composition of nitric acid. When sparking a mixture of common air and oxygen over potash he made observations which were not properly explained until Rayleigh and Ramsay in 1894 discovered argon. His great contemporaries included Black, Priestley, Scheele, Bergmann, Lavoisier, and others, whose work created a revolution in chemical science. A tremendous controversy for long raged around the question of who first discovered the composition of water, but it would probably never have occurred had Cavendish acted on Faraday's advice to investigators to " work, finish, publish ".

The chemical researches of Cavendish were well known to his contemporaries; it has remained for the last two generations to learn of his many discoveries in electricity. Only two of his electrical papers were published in his lifetime, but he left behind him a mass of manuscripts and note-books which, though containing many ' pearls of scientific truth ', were allowed to remain hidden for nearly a century. After the opening of the Cavendish Laboratory at Cambridge, the princely gift of the Chancellor, William Cavendish, seventh Duke of Devonshire, and the appointment of Clerk Maxwell as Cavendish professor of experimental physics, these manuscripts were placed in Maxwell's hands, and after much study were published in 1879. A further and enlarged edition of Cavendish's papers was issued in 1921, edited by Sir Joseph Larmor, Sir Edward Thorpe, and others. They showed that Cavendish had made electrical condensers and had measured their capacity, that he had anticipated Faraday's work on specific inductive capacity, and had completed an inquiry amounting to an anticipation of Ohm's law.

In another branch of science, geophysics, Cavendish is remembered for his capital experiment for determining the density of the earth. The plan adopted and apparatus used for the experiment were devised by the Rev. John Michell, rector of Thornhill, Yorkshire. He died before he could carry out the investigation, but his apparatus passed to the possession of Wollaston of Cambridge, and was given by him to Cavendish. The results obtained by Cavendish in 1784 were not far different from those obtained by later investigators working with more refined apparatus, and are a tribute to that care and exactness which characterised all his researches.

The character of Cavendish has baffled many inquirers. His habits were more those of a recluse than of a scion of a noble house. At first given an allowance of £500 a year by his father, after his fortieth year he was a man of immense wealth, and Biot after his death spoke of him as " le plus riche de tous les savants, et probablement aussi le plus savant de tous les riches ". All his life he was shy, reserved, and taciturn, Brougham saying that " he probably uttered fewer words in the course of his life than any man who ever lived to four score years, not at all excepting the monks of La Trappe". Yet, from his bachelor home on Clapham Common, he would come to attend the weekly dinners of the Royal Society Club, and his library, housed in Dean Street, Soho, was available for all men of science. His life was written by Prof. George Wilson, who had to admit that Cavendish was singularly passionless: " An intellectual head thinking, a pair of wonderfully acute eyes observing, and a pair of skilful hands experimenting and recording, are all that I realise in reading his memorials ". Of such a man anecdotes were sure to be told, and among them was the strange one of the manner of his death. Feeling his end was near, he said to his servant, " Mind what I say—I am going to die. When I am dead, but not till then, go to Lord George Cavendish and tell him—go! " He died on Feb. 24, 1810, at his house at Clapham, and on March 8 his remains were removed to Derby and interred in the family vault in All Saints' Church.

Obituary.

SIR HOWARD GRUBB, F.R.S.

FOR more than sixty years, Sir Howard Grubb, who died at Kingstown, Co. Dublin, on Sept. 16, at the age of eighty-seven, was actively engaged in the design and manufacture of astronomical and other optical instruments. He was born in Dublin in 1844 and educated at a private school and at Trinity College, Dublin, as a civil engineer. His father, the late Thomas Grubb, F.R.S. (1800–1878), who was engineer to the Bank of Ireland, founded a small works near Charlemont Bridge early in the nineteenth century, where he manufactured for the

Bank some ingenious machines for engraving, printing, and numbering the bank notes. He took up practical optics as a hobby and quickly acquired great skill in the art of lens and mirror making. One of his first reflectors, equatorially mounted, was the Armagh 15-inch, in 1835. In 1865 he undertook, at the request of the president and council of the Royal Society, to design and manufacture a 4-foot reflecting telescope for Melbourne, Australia, which he completed in 1868. This instrument was the largest in the southern hemisphere until quite recently.

Thomas Grubb retired from business in 1868 and was succeeded by his son Howard, who had left Trinity College two or three years previously, in order to assist his father with the Melbourne telescope. In 1878 Howard Grubb contracted to build the 27-inch refractor and three domes for the Vienna Observatory. This telescope, at that time the largest existing refractor, was completed in 1881. Among other large instruments which he built were the 24-inch photographic refractors for Cape Town and the Radcliffe Observatory, Oxford, the 26-inch 'Thompson' refractor, and the objective of the 28-inch refractor for Greenwich, the 26½-inch refractor for the Union Observatory, Johannesburg, and the 40-inch reflector for Simeis, Crimea.

One of Sir Howard Grubb's most difficult undertakings was the construction, about 1890, of the 13-inch photographic refractors for the International Photographic Survey of the Heavens, of which he made seven. The conditions were exacting, the objectives requiring to be of the same focal length within very small limits, and the clock driving much more accurate than had hitherto sufficed for visual observations. In this connexion he perfected a means of controlling the driving mechanism by an independent pendulum, so that an error of a fraction of a second in the movement of the telescope was immediately detected and corrected. Numerous other improvements in telescope and revolving dome construction are due to him, and he is credited with being the first to suggest the rising floor, that at the Lick Observatory being partly of his design.

About 1905 Sir Howard Grubb invented and patented the submarine periscope, which was adopted by the British Navy. During the War he supplied about ninety-five per cent of these instruments required for the British submarines, and it was in connexion with these contracts that the Admiralty moved the works from Dublin to St. Albans. He returned to Dublin after the business was taken over by the late Sir Charles Parsons in 1925, but placed his knowledge and experience freely at the service of the new company which Sir Charles formed at Newcastle-on-Tyne, styled Sir Howard Grubb, Parsons and Co. The proprietors of these works are Messrs. C. A. Parsons and Co., Ltd.

Sir Howard Grubb was elected a fellow of the Royal Society in 1883 and knighted in 1887; he was also Hon. M.A.I. (Dublin), senior vice-president of the Royal Dublin Society, honorary member of the Royal Institute of Civil Engineers (Ireland), and was appointed, in 1913, scientific advisor to the Board of Irish Lights, in succession to the late Sir Robert Ball. He received the Cunningham gold medal of the Royal Irish Academy in 1881 and the Boyle medal of the Royal Dublin Society in 1912.

Sir Howard was in the first rank of men of science, and astronomy in particular owes him a great debt. His genial disposition made him a host of friends, and his death will be much regretted. He married in 1871 Mary Hester, daughter of George Hamilton Walker, M.D., of Louisiana, U.S.A., who predeceased her husband by a few months only. He leaves two sons and a daughter.

News and Views.

On Oct. 14 occurs the centenary of the death of the French astronomer Jean Louis Pons, who in his day was famous as a discoverer of comets. Born at Des Peyres, Hautes Alpes, on Dec. 24, 1761, he entered Marseilles Observatory in 1789, in 1819 became director of a newly founded observatory at Marlia, near Lucca, and in 1825 director of the observatory of the museum at Florence, where he died. Between 1801 and 1827 he discovered no fewer than thirty-seven comets. One of these, discovered on Nov. 26, 1818, when Pons was at Marseilles, now called after Encke, was shown to have a period of only 3¼ years, and its return on May 24, 1822, as Encke predicted, was observed by Dunlop at the observatory of Sir Thomas Brisbane at Parramatta. This was the second instance, Halley's being the first, of the recognised return of a comet. The comet found by Pons on July 20, 1812, was also studied by Encke, who determined its period as 71 years. It was rediscovered by Brooks in America on Sept. 1, 1883.

The subject of calendar reform is to be discussed in the present month in a League of Nations Conference at Geneva. In preparation for this meeting, the Parliamentary Committee on Calendar Reform has held a card referendum, addressed to a large number of representative people in Great Britain. A summary of the results is given in the *Times* for Oct. 1. It appears that 82 per cent of the voters are in favour of reform, provided that it can be obtained without too much dislocation. The 13-month scheme is evidently unpopular in Great Britain; there is a decisive majority against it. Ninety per cent of the voters favour a stabilised Easter; this, however, apart from public holidays, is an ecclesiastical, not a civil matter, and it will not lie within the scope of the Geneva Conference. The *Times* summary does not give any information on the question of putting certain days outside the normal reckoning of weekdays. This is one of the points that encounters a good deal of opposition, both from religious motives and from reluctance to discontinue a time-unit that has been running without a break for about three thousand years.

Acting on the discovery of the skeleton of a Bushman on the farm of Mr. Fred. S. Wells in the Zuurberg Mountains, Mr. F. W. FitzSimons, the Director of the Port Elizabeth Museum, excavated the site and obtained four more skeletons. One was buried in a sitting posture, the rest flexed and on their sides. With each skeleton there were bracelets of stone and ivory, necklaces of finely worked ostrich egg-shell beads, pygmy stone implements, and a miscellaneous assortment of the typical larger kinds. The Zuurberg mountains are some fifty-five miles from Port Elizabeth, and the site of the find is on top of a mountain, a mile on the Port Elizabeth side of the Zuurberg Hotel. From the nature of the soil overlying the skeletons and other evidences, Mr. FitzSimons believes the burials were made about a thousand years ago. In 1922, it will be recalled, Mr. FitzSimons, assisted by Mr. Fred Wells, unearthed nine skeletons. This, then, is the second discovery in the Zuurberg of fossil Bushmen of pure lineage totally untainted by any fusion with other races.

A new world air speed record of 408·8 miles (657·76 kilometres) per hour was created by Flight-Lieut. G. H. Stainforth at Calshot on Sept. 29. The seaplane used was one of the Vickers-Supermarine *S 6 B*, specially built for the recent Schneider Trophy competition, fitted with a Rolls-Royce *R* engine and a special airscrew to suit the somewhat different conditions that arise in the relatively short bursts of maximum speed. During part of the run a speed of 415·2 miles per hour was recorded. It is estimated that this engine was giving 300 horse-power more than the one used during the Schneider trials, which was rated at 2300 horse-power. A special fuel mixture of petrol, wood alcohol, and tetra-ethyl was used. The wood alcohol was tried for the first time in order to reduce the engine temperature at full power, as the problem of dissipating the heat generated without introducing extra radiating surface with its accompanying head resistance has proved to be the most serious one on these machines. The tetra-ethyl was obviously used for suppressing pre-ignition and engine knock.

The actual observed straights were flown at a height of 50 metres according to regulation, and Stainforth made the turns by climbing into them and diving out again on to the straight. This manœuvre has the advantage of reducing the speed on the turn and regaining it from the momentum of the dive. Carried out at speeds in the neighbourhood of 400 miles per hour, it is a very real evidence of the extraordinary skill and cool-headedness of the pilot. It was noticeable that after the first run, when once the engine was thoroughly warmed up and the pilot had obtained the ideal throttle setting, there was no further sign of any trail of smoke from the exhaust. The balance between the engine requirements and the amount of fuel forced into it by the supercharger was being maintained so delicately that the engine was just consuming all the fuel supplied to it, thus paying tribute to the accuracy of the work of the engine designer, the blender of the fuel, the mechanics responsible for the final tuning up, and the pilot who was handling it in flight.

A meeting of the Lord Mayor and Sheriffs' Committee has been held in the Guildhall, London, to take steps in connexion with the festivities on Lord Mayor's Day, Nov. 9, and it is stated (*Times*, Oct. 1) that the Lord Mayor elect, Alderman Maurice Jenks, desires that the Show should contain a pageant designed to illustrate the assistance scientific discoveries have given to industry during the past half-century; and the effect invention and the practical application of invention have had upon the daily life of the people, and especially the Londoner. While the difficulties of turning such an idea into a spectacle suitable for the London streets are obvious, it is hoped that they are capable of being overcome. With regard to this, we think that if the great power companies, the shipping companies, the cold-storage companies, the technical colleges, and similar bodies are asked to co-operate, there should be no difficulty in arranging a very striking display. The adoption of electric light and power, the practice of refrigeration, the use of the internal combustion engine for motor cars and aeroplanes, communication by wireless telegraphy and telephony, are but a few of the gifts of scientific discovery and invention to practical affairs in recent times, and there is probably no side of life in London which has not benefited by modern invention. We wish the promoters of the scheme every success.

At the annual meeting of the Australian National Research Council, a report by a sub-committee appointed in 1930 to consider a change in constitution was received and adopted. The recommendations were: that the name of the Council be changed to that of Australian Academy of Sciences; that the Academy be incorporated under the Companies Act of New South Wales and registered under the Companies Acts of other States; that the number of members be increased from 100 to 150; that the publication of a journal be undertaken; and that one of the objects of the Australian Academy be to act as the National Research Council. The adoption of the report was unsuccessfully opposed by representatives of a society recently constituted in Canberra under the title of Royal Society of Australia. The action taken in Canberra, without general consultation with leaders in scientific work elsewhere in Australia, was adversely criticised, the majority taking the view that the reconstituted Research Council was the appropriate body to fulfil the functions of a Royal Society for the Commonwealth.

Lord Blanesburgh, Prime Warden of the Worshipful Company of Goldsmiths, delivered the inaugural address at the formal opening on Oct. 5 of the thirtieth session of the Sir John Cass Technical Institute, London, on Tuesday last. Lord Blanesburgh said that he hopes that the proposals which have been made and are so near fruition for the extension of the Institute will not be indefinitely postponed, and that there will always be secured by the maintenance of its activities a supply of those skilled in applied science to meet the demands made by the future. Swift and unsettling world changes have taken place during the past thirty years. Aviation and wireless are two discoveries of science which alone have revolutionised, and will revolutionise, the world as it was known thirty years ago. Such discoveries, however, have not prevented political unrest nor economic depression, each of which is probably attributable to the fact that, as result of new discoveries, old-established customs pass away and old-established industries are made obsolete. The world to-day needs young minds, ready to face the new situation with fearlessness and courage, and without hesitation if the time comes to destroy the ideals of the market that have had their day. Fortunately, educational help is available for the best young men and women of the land, so that that which has been obtained for humanity by the genius of inventors and discoverers may not be lost by the apathy or ignorance of their successors.

If the machinery of science, Lord Blanesburgh continued, were withdrawn or went out of gear, and the elaborate structure on which the supplies of comforts, luxuries, and conveniences depend were to fail, mankind would be left defenceless and unable to provide even the barest necessities of life. It is accordingly essential that there should always be those ready to repair the machine when it falls into disrepair, and there must indeed be a new supply of those well qualified to keep the machinery going by themselves being abreast of all new discoveries. Civilisation is on its trial; it could not survive another war. It may even perish without one. The battle for its defence may be fierce and prolonged, but, if human nature remains what it has always been, in the long run it will be to the efficient, to him or her of strong mind and high character. To the young people who have enlisted in this crusade and who have enrolled themselves in a high service to their fellows, Lord Blanesburgh said he would have them be strong and of a good courage, and he would also have them, if need be, to live dangerously. No ideal should be too high, and there should be a healthy contempt for the second-rate.

In his report as the Entomologist to the U.S. Department of Agriculture, for the year ended June 30, 1928, Dr. C. L. Marlatt summarises the manifold activities of his charge. Owing to the changes authorised in 1927, which led to the establishment of a new organisation designated the plant quarantine and control administration, the work carried out by the Bureau of Entomology in co-operation with the Federal Horticultural Board, in enforcing quarantine measures relating to many of the most important introduced pests, has been transferred to this new body. It had, for a long time, been felt that the growing amount of regulatory work of this kind was handicapping research on the biology and control of insect pests which form the primary function of the Bureau. During the year under review, Dr. L. O. Howard retired from the post of chief of the Bureau, which he had held since 1894. It is, however, gratifying to note that Dr. Howard will remain in the Bureau, under the title of Principal Entomologist, to follow up lines of work bearing upon his special interests. The report, like its predecessors, deals with an immense range of investigations bearing upon agricultural crops and animals, insect-borne human diseases, forest pests, apiculture, and certain domestic troubles, such as furniture pests and the ravages of clothes moths. In addition to work of this character, progress with a general insect-pest survey, and taxonomic investigations carried out in the U.S. National Museum, also come under review.

A feature of particular interest in Dr. Marlatt's report concerns the prevalence of insect life in the upper air. By the adoption of special insect-collecting traps, carried between the wings of aeroplanes, it was found that an unexpectedly large number of insects are present in the upper air. Many of these are species which possess little or no power of flight and are consequently carried involuntarily by air currents. It would seem from the records so far obtained that the stronger flying species are capable of largely controlling their flight so as to be able to confine themselves to relatively low altitudes. On the other hand, species which have never been suspected as being wind-borne have been apparently carried by upward air currents and so caught at great elevations. There is every indication that the problem is one of definite practical importance, particularly in relation to quarantine measures which are solely concerned with restriction of spread on land.

We are so used to regarding Michael Faraday as a physicist that it comes as a surprise to read an article by Prof. Fraser Harris, in *Discovery* for October, in which he discusses a lecture given by Faraday at the age of twenty-seven to the London City Philosophical Society in 1818. The title of the lecture was "Observations on the Inertia of the Mind". In this lecture he pointed out that apathy represents the inertia of a passive mind, industry that of an active mind. In 1899, Prof. Fraser Harris, unaware of the lecture by Faraday, put forward his hypothesis of 'functional inertia', the functional inertia of rest and the functional inertia of movement. The former is expressed by the latent period, the latter by the phenomena of after-discharge. This principle, Prof. Fraser Harris points out, has been confirmed by Spearman when he says, "Cognitive processes always both begin and cease more gradually than their apparent causes". Even so far back as 1679, Hobbes had said, "Like water troubled, an organ of sense will remain in motion after the removal of the exciting agent". The most recent work in neurology confirms the existence of inertia. Spearman directs attention to the gradual rise and fall of sensory intensity and the latency and after-discharge of reflexes. Blake-Pritchard introduces "inertia of the system" and

(*Continued on p.* 633.)

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Reviews.

Paul Tannery and the History of Science.

Mémoires scientifiques de Paul Tannery. Publiés par L.-L. Heiberg et H.-G. Zeuthen. Tome 10 (Supplément au Tome 6) : *Sciences modernes, généralités historiques, 1892–1930.* Édité avec la collaboration de Joseph Pérès. Pp. xvi + 500. (Toulouse : Édouard Privat ; Paris : Gauthier-Villars et Cie, 1930.)

THE last volume of Tannery's "Mémoires" has a special and immediate interest in view of the recent International Congress of the History of Science and Technology. We have in it the latest views and full evidence of the quality of a man belonging to a class too little known and much needed in England. He was a scholar of the most profound and unquestioned thoroughness, who gave his life to research in a branch of learning which we regard as a side issue but is in fact at the centre of human progress, namely, exactly how men have come to think as they do about scientific questions, especially in the realms of mathematics, physics, and astronomy. On the first of these matters he was at his death probably the most completely informed man in the world. But his special quality, which should commend this volume to English readers, was his constant effort to see the details, which he knew so well, as part of the general process of thought. He was in fact a philosopher as well as a specialist in scientific history. To English students, as a rule, it seems sufficient to know what the particular group of men in the past were working at, and the very idea that there is a general movement of thought is suspect. For this fault the work and temper of Tannery and men like him are a wholesome corrective. They are to be found more abundantly in all other countries than our own. France and Germany lead the way, with Italy as a good third, while America, more open-minded than ourselves, welcomes the spirit and is vigorously following in a more popular way.

It was a tragedy in the life of Tannery that on the occasion when he might have found a large sphere for his views and activity in Paris, personal and sectional interests were allowed to exclude him. A chair had been founded in the Collège de France in the spirit of Comte, for teaching the general history of science, and it was occupied on the first occasion by Pierre Laffitte, who was both Comte's titular successor and also well qualified by his own attainments and influence to fill it. On the death of Laffitte, it was generally expected that Paul Tannery would be chosen, and his name was actually sent up to the Minister by the professors on the committee for appointment. At the last moment, however, pressure was brought to bear by the more orthodox followers of Comte, and a specialist on physics was appointed instead. It was a grievous blow to Tannery and a serious loss to the establishment of a philosophic view of the history of science both in France and throughout the world.

Such men are rare anywhere, and in England we have scarcely yet begun to reckon with their possibility or the desirability of encouraging them. No university in Great Britain has such a chair, though they are to be found in Germany and are frequent in the United States. Nor is there any section of the British Association devoted to the history of science.

The volume before us opens with a pathetic note by Mme. Tannery lamenting the loss of Heiberg, who with Zeuthen had been helping her in the production of her husband's "Mémoires". Others in France have come forward to make possible the completion of the work, and its interest makes one hope that more may be done, especially on the lines of completing the short general history of science up to 1850 which he had sketched and of which several lectures printed here would form part.

Tannery had a strong view that for such a general history no attempt should be made to bring the narrative up to date. We should choose a point at which the sciences have taken a definite and ascertainable shape, and the object of our study would be to show how they had reached it. If we attempt to come later down, the conflict of hypotheses and the complexity of the new matter are so great that no definite impression can be obtained. Time must elapse before the seething mass settles down into a shape that can be visualised. These are all considerations connected with his governing idea of synthesis. We need some distance of vision before science as a whole makes a connected show of its natural articulations, and when that has been gained, we may attempt to go further and see the relations of the scientific side with the other aspects of civilisation. Tannery foresaw that larger synthesis, but had little hope of being able to contribute to it himself.

Everyone, however, who has even the smallest interest or knowledge, would find these scattered papers inspiring. The syllabus he drew up for a course in the history of science for the highest class of a *lycée* is the best that we have seen. It is sane, clear, and well-balanced. He begins himself from the conservative, classical point of view, giving by far the largest place to the Greeks. But he was always ready to modify his preconceptions in view of fuller knowledge or with maturer judgment. His treatment of Comte is an admirable example of this. Starting with the deepest sympathy and appreciation of Comte's work from the philosophical and social point of view, he goes on to re-think and correct the details. In this way the law of the three stages is examined and the truth in it separated from the error. As a correction of the historical evolution of sciences from the most abstract (mathematics) to the most concrete (biology and sociology), he shows the high importance and seniority of medicine.

The book is full of interesting matter of this kind, all based on exhaustive knowledge and expressed with the calm and clarity of a master.

F. S. MARVIN.

Ethnological Survey of a South African Tribe.

The Bavenda. By Dr. Hugh A. Stayt. (Published for the International Institute of African Languages and Cultures.) Pp. xviii + 392 + 48 plates. (London : Oxford University Press, 1931.) 30*s*. net.

IN her able introduction to this work, Mrs. Hoernle points out with regret that no adequate monograph on any of the South African tribes has been written during all the years in which black and white have been in contact in that subcontinent. This regret will be shared by many, and it may, moreover, be considered as remarkable evidence of a failure to realise that the natives of South Africa have been and still are the greatest asset which the country possesses; for it is mainly by the help of their brawn that the present stage of prosperity has been achieved, and thus careful study of their life history is essential. It is true that Callaway wrote of the Zulus, Lagden of the Basutos, and Stow of the native races ; but for all that, Mrs. Hoernle's contention is correct. The only two works dealing with the natives of the southern half of the continent which are comparable with Dr. Stayt's monograph are Smith and Dale's "Ba-Ila" and Junod's "Life of a South African Tribe", but the subjects of both of these works live outside the Union of South Africa. Dr. Stayt's work comes as a revelation, for, as an occasional visitor to South Africa, one felt that owing to long-continued disintegration of the tribes it would probably be impossible to gather up the threads and construct a real picture of the indigenous culture of any native tribe in that area. The author has, however, been fortunate enough to discover that the Ba-Venda, living as they do in the valleys of the Zoutpansberg Range of the North Transvaal, have tenaciously preserved their ancient traditions and culture up to present times.

The achievement is all the more remarkable inasmuch as the author suffers from one of the gravest disabilities an anthropologist can experience—blindness. In view of this, it is amazing how he can have accomplished so much ; his courage and perseverance command the deepest respect, and the devoted assistance of his wife must not be ignored. It is, moreover, especially fitting that Dr. Stayt should be a South African, and we trust that this admirable piece of research may stimulate many other workers in the Union to emulate his example. Dr. Stayt's monograph covers the field in a very systematic manner, commencing with a description of the terrain, then dealing with the history ; unfortunately, however, the author has to confess that the latter is rather vague and fragmentary, and evidence as to the early migrations of this stock will have to be pieced together bit by bit from investigations, yet to be made, farther to the north. He then deals in detail with their daily life, food, and industries, and so on ; proceeds to describe the life of an individual from birth to death, their social relationships, form of government, religion, magical beliefs ; and so to their folklore—in all, a very complete conspectus.

As is the case in many African tribes, the Ba-Venda are a composite people which have now become a compact entity, and it could not have been easy to disentangle the elements of their culture which were derived from the various components. The problem becomes particularly acute where an effort is made to ascertain which of their physical characteristics belong to the original Venda stock and which are superimposed by comparatively recent intermixture with the Sutho people and others.

The Ba-Venda provide a typical example of Bantu culture. The word 'Bantu', of course, refers only to a language group, but in most cases those who use a Bantu tongue exhibit other affinities which betoken connexion with the same racial stock. Anyone, for example, who is acquainted with the social anthropology of so-called Bantu tribes so far north as Kenya cannot fail to be impressed by the recurrence of social customs, religious beliefs, etc., in spite of the distance intervening; space will not admit of great detail, but these recurrences are so numerous as to preclude the possibility of separate but similar development. The sacred stones erected in the villages as a representation of their ancestors have their parallel in places as remote from each other as North Kavirondo and Kikuyu; the re-burial of the remains of a chief at the ancestral home of the tribe Phaphuli is also a feature of the Awa-Wanga of North Kavirondo; the placing of a stone in a tree, by a traveller, to delay the setting of the sun until his journey is concluded—not Bantu this time, but a custom in vogue among some of the Hamitic tribes of Kenya. These are a few examples taken at random. To find the birthplace of other customs we should probably have to make a comparison with tribes to the north-west of their present habitat.

There is little doubt that when the ethnological survey of Africa is more advanced we shall, by careful analysis of customs and beliefs, be able to trace with considerable accuracy the past migrations of native races and discover the various racial elements which go to make up the assemblages now designated as tribes.

The chapter on "Puberty and Initiation" is an important one, for, owing to the secrecy of the ceremonies attending the latter, it is but rarely that the European investigator is able to make a detailed study. As is usual, there are many features repugnant to European sentiment, but for all that, the importance of these ceremonies as a part of native life should not be under-estimated. The discipline and even suffering undergone by the initiates is a crude form of educational training, and the lesson of obedience to the tribal law learnt at this period is one which leaves its mark for life. It is a potent cement which helps to hold a tribe together. While sympathising to some extent with good-hearted missionaries who strive to induce governments to crush these practices, we would venture to suggest that legislation against a custom is rarely effective; it only tends to drive it underground and to produce a lasting sense of injustice. Rise in culture will in time cause these customs to die, but what will replace them? It is the duty of those responsible to see that the substitute is ethically effective.

The religion of the Ba-Venda conforms to the pattern evolved by the stock. There is the mysterious monotheistic deity called Ralu vhimba, but, as is usual, he has but little appeal to the ordinary man, who is more concerned with placating and giving due service to the spirits of his ancestors. Earth tremors are particularly identified as manifestations of the Supreme Deity.

In connexion with medicine and magic, a careful description is given of certain curious divination bowls used by this tribe. These are of considerable importance, for it is believed that we here have evidence of the native origin of the so-called zodiacal bowls found at Zimbabwe and upon which the school which pleaded for Phœnician origin laid so much stress.

It is only desired to lodge two minor criticisms of this exhaustive monograph: the print is rather small, and the price of the book is high.

C. W. H.

Astronomy for All.

(1) *The Stars in their Courses.* By Sir James Jeans. Pp. xi + 188 + 47 plates. (Cambridge: At the University Press, 1931.) 5*s.* net.

(2) *Astrophysik auf atomtheoretischer Grundlage.* Von Prof. Dr. Svein Rosseland. (*Struktur der Materie,* herausgegeben von M. Born und J. Franck, Band 11.) Pp. vi + 252. (Berlin: Julius Springer, 1931.) 21·20 gold marks.

(3) *The Stars of High Luminosity.* By Cecilia H. Payne. (Published for Harvard College Observatory.) Pp. xiii + 320. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.)

(4) *Flights from Chaos: a Survey of Material Systems from Atoms to Galaxies; adapted from Lectures at the College of the City of New York, Class of 1872 Foundation.* By Harlow Shapley. Pp. vii + 168. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 12*s.* 6*d.* net.

(5) *Man and the Stars.* By Harlan True Stetson. Pp. xiii + 221 + 31 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1930.) 12*s.* 6*d.* net.

(1) HERE is astronomy to suit all tastes. We may go even further, for Sir James Jeans's book has the power to create a taste which in large part it satisfies. It embodies all the rare qualities

of exposition for which the author is justly famous, and the treatment, even of subjects with which Sir James's pioneer work is not intimately concerned, bears the stamp of originality. The book is avowedly and actually one to be read for pleasure rather than for profit (although, needless to say, profit inevitably follows from the reading), and we may truthfully add, in the language usually employed in describing literature of this class, that there is not a dull page from start to finish. About fifty of the pages are occupied by excellent reproductions of the finest of astronomical photographs, and, indeed, the book as a whole appeals more to the senses than to the mind. It originated in a series of wireless messages to the ear, and it carries the reader in a magic rocket through space and time, inviting him the while to use his eyes. Maps of the sky, with descriptions of the constellations and tables of simple data, are added as souvenirs of the journey.

Regarded in this light the book is almost beyond criticism, but we cannot quite shake off an awkward suspicion that theoretical astronomy is scarcely a legitimate subject for a novel. Seeing is believing, and because of its vividness the pageant which passes before our eyes leaves us unaware that it is largely an imaginary representation of what the astronomer merely feels in his blind groping among the mysteries. Alternative representations are of necessity excluded, and where a warning that we may be deceived is unavoidable, it is given almost reluctantly, with the result that—to change the metaphor—we are given a sumptuous meal when what we need is an appetite. The uninitiated reader is likely to lay the book down with the feeling that the most important secrets of astronomy have been read; he is not likely to feel with Galileo the overwhelming force of "those wise, ingenuous, and modest words—*I do not know*". But, all the same, he will have had a delightful experience.

(2) Prof. Rosseland's book is of an entirely different character. Those who are familiar with the excellent "Struktur der Materie" series to which it belongs will have a general idea of its scope, and will need no assurance of the excellence of its printing and production. The book, the author tells us, is intended as an introduction to astrophysics for physicists who are concerned with astronomy and astronomers who are concerned with physics, and although limits of space necessitate a high degree of condensation and the omission of certain parts of the subject—particularly those concerned with solar magnetism—a great deal of ground is covered in a very satisfactory way.

Prof. Rosseland writes with commendable clearness and strikes just the right balance between impartial exposition and critical selection. Considering the rigidity of the treatment, mathematical formulæ occupy a remarkably small proportion of space, and are not difficult. The book is, however, essentially theoretical, the data of observation being mainly confined to the first dozen pages. The chief subject of the book is the physics of the interiors and atmospheres of stars, and the treatment of this, in fact, together with a chapter of thirty-five pages on the nebulæ, comprises almost the whole volume. It is a pity that Milne's new approach to the problem of stellar structure was not in time to be included, for it might have shifted somewhat the general point of view which the author adopts in facing this problem. Prof. Rosseland's view of the present situation would be of considerable interest. There are several illustrations, which are well reproduced.

(3) More food for the specialist is provided by Miss Payne, but her book, unlike that of Prof. Rosseland, is almost entirely devoted to observational material. It is in no sense a practical handbook, for methods of observation are never described, although the difficulties inherent in them are sometimes mentioned in so far as they bear on the validity of possible interpretations. Neither is it a mere collection of data; the facts are throughout regarded in the light of existing theory, with which the reader is presumed to be familiar.

The book meets an urgent need, and meets it very adequately; the provision of 110 tables in addition to complete catalogues of the *c*-stars and Cepheid variables reveals its character better than any verbal description could do. From one point of view the book may be regarded as the author's "Stellar Atmospheres" of 1925 brought up to date, but the metamorphosis is almost complete, for the study of spectrum line contours, then barely begun, forms the backbone of the present volume. By a star of 'high luminosity' is meant a star brighter than visual absolute magnitude -2. Such stars, although they form an almost negligible fraction of the stellar universe so far as numbers go, are extremely important—first, because they provide almost our only means of estimating the distances of remote stellar groups, and secondly, because they include at least the vast majority of variable stars and have a special significance in the theory of stellar constitution. The book is saturated with Miss Payne's own contributions to the subject, and astronomers will be grateful to her for making them available in so compact a volume.

(4) Dr. Shapley's " Flights from Chaos " is mainly a descriptive classification of material systems from the most elementary corpuscles to the " Cosmoplasma " and beyond. In this aspect it will be of interest to astronomers generally. The classification is systematic and comprehensive, and much of it will probably command general assent, although in some respects it would seem that the artistic passion for a general classification has triumphed over the scientific necessity for a fundamental one. It is doubtful, for example, if the æsthetic satisfaction of grouping diffuse nebulæ with comets and planetary nebulæ with solar systems is a sufficient compensation for separating two types of nebulæ which appear to differ only in accidental circumstances. Dr. Shapley's predilection, however, is revealed on p. 132, where he remarks of a certain classification that it " has the advantage of providing many categories without suggesting any hypothesis, evolutionary or otherwise ". We know that a classification may deceive, but is the best remedy to strike it dumb ?

The appeal of the book, as exemplified by the opening, is directed towards the general public, and readers of that class who scan the first chapter will certainly be tempted to proceed. The author's enthusiasm for his subject, however, soon takes charge of his pen, and by the time the reader has reached, say, the chapter on " Double and Multiple Stars ", he finds himself expected to know by instinct the meaning of such terms as ' spectroscopic binary ' and ' optical double '.

Dr. Shapley is never dull, however, and the book would be very pleasant to read were it not for the appearance on almost every page of a minute, undescribed sketch of some astronomical phenomenon or diagram which, as often as not, bears no relation to the subject there discussed, and is frequently woven into the initial letter of a word. Possibly this way of presenting things is familiar to trans-Atlantic readers, but to us it suggests that the flight from chaos has been less successful than might otherwise have been imagined.

(5) Prof. Stetson's book is like a very nice picture badly bespattered with mud. It is as elementary as Sir James Jeans's book, but it has a wider purpose inasmuch as it aims at tracing the influence of astronomical discoveries on man's reactions to his environment. On the whole, it satisfies very well the fundamental requirements of such a purpose. It creates the right atmosphere, and, occasionally, one experiences the shock of pleasant surprise, so rarely received from scientific books, which accompanies the reading of just the right word or phrase. More often, however, the surprise is unpleasant. The book abounds in blemishes of almost every kind—faults of expression such as the excessive colloquialism of " hiding in jest a prayer to God, he (Galileo) shoved off together those two iron masses ", or the errant metaphor in " I have sought to convey some viewpoints which I have often embodied . . ." ; errors of scientific fact, such as the account of the spectrum of the strontium flame, which suggests that the author has not seen what he attempts to describe ; errors of history, such as the ascription of the scurrilous " Ye men of Galilee " sermon to Scheiner instead of to Caccini, of the pioneer work in radial velocities to Vogel instead of to Huggins, and of the discovery of the cosmic rays, and even the electron, to Dr. R. A. Millikan of California. The printing shows the same qualities as the writing, for while it is clear and pleasant to read, it contains far too many mistakes. If another edition is called for, we hope the book will be thoroughly revised ; it is so good that it is a thousand pities it is not better. H. D.

Strength of Materials.

Materials and Structures: a Text-book for Engineering Students. By Dr. E. H. Salmon. Vol. 1 : *The Elasticity and Strength of Materials.* Pp. x + 638. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1931.) 15*s.* net.

Strength of Materials. By Prof. S. Timoshenko. Part 1 : *Elementary Theory and Problems.* Pp. xii + 368. 15*s.* net. Part 2 : *Advanced Theory and Problems.* Pp. xi + 401-735. 18*s.* net. (London : Macmillan and Co., Ltd., 1931.)

NO section of engineering science has been so frequently dealt with in treatise or textbook as that which provides the title common to both publications before us. Within the past decade there have been several notable efforts along similar lines and with equally ambitious aims. Yet the older textbooks on the subject did not fail to reach high standards. There must clearly be special reasons for these newer and repeated attempts. These reasons are not far to seek. Methods of analysis have been enriched by fresh contributions ; applications to practical matters have been widely extended ; advances of great value have been made in experimental technique ; and new lines of research have been rapidly developed. On every score the somewhat stereotyped forms and standardised treatment of the older books have been superseded.

Modern engineering makes a demand upon knowledge of the properties of materials which shows up the methods of design of a generation ago as processes requiring, relatively, neither great skill nor nerve. A few simple values, a little theory, and a large factor of safety dealt effectively with most cases. The advent of the high speed rotor, the internal combustion engine, the high pressure, high temperature boiler, and the countless problems which have advanced in their train, have altered all this. The few simple values have been subject to forced growth by the development of more subtle methods of testing; the somewhat casual use of simple theory has had to give way to more exact methods of calculation; and the factor of safety has shrunk in size and lost flexibility. The continued development, experimental use, and establishment of a host of new materials, and the treatment and testing thereof, complicate all issues and confuse the factors of applicable knowledge. Any author facing an adequate treatment of such a subject in such a condition is confronted with serious problems of matter and classification. The former is formidable in quantity; the latter difficult to order. A comprehensive knowledge is an essential; but a clear idea of values and courage in selection are equally so, if range, balance, and conciseness are to be achieved. The adequate and yet not too cumbrous textbook is probably more difficult to produce than the treatise; which perhaps explains an observable tendency in publications of the kind.

Dr. Salmon's book is the first volume of a treatment of materials and structures, to be completed with a second volume mainly on the latter subject. The present volume deals wholly with what is understood technically by strength of materials, and the treatment occupies more than 600 pages of well-packed text. Prof. Timoshenko takes fully 700 pages, in two volumes, to deal with the subject. The relative loading per page is such that probably Dr. Salmon's book contains the greater total length of text. In addition to extensive analytical developments, both authors give sections on the experimental and empirical aspects of the subject; but whereas in Dr. Salmon's volume more than a third of the space is devoted to this, Prof. Timoshenko has not much more than a tenth set apart for the purpose. These relative spaces provide a clue to the main points of contrast. The first author is presenting a comprehensive textbook, showing both sides of the subject with reasonably equal thoroughness; the second provides an example of the analytical expert who adds a chapter on experimental aspects for completeness. It must be added, however, that Prof. Timoshenko enriches a great many of his analytical discussions with clear and valuable summaries of the appropriate experimental facts and conclusions.

The chapter divisions of Dr. Salmon's analytical section and of Prof. Timoshenko's first volume (elementary theory and problems) are very similar in headings and reflect the usual order of development through simple stress, complex stress, bending theory, combined bending and direct stress, combined bending and twisting, etc., and strain energy. Within each chapter the first author deals with both the elementary and advanced problems appropriate thereto, so far as his intentions go; whereas the second author postpones the most difficult lines of development to the second volume. Prof. Timoshenko's advanced volume contains, in addition, some special chapters, such as that on buckling of bars, plates, and shells, and that on stress concentration. Dr. Salmon gives a chapter on vibrations and actual speeds, and two others dealing with formal mathematical theory and its applications. He treats the standard lines of work with great clearness, and develops all essential matter with that degree of detail which is desirable if a book is to be of real value to students. His development of bending theory is useful and concise, although full value is scarcely extracted from the Mohr method of treating deflections; and it is something of a fault not to present the Macaulay method. There is a useful resurrection of the Claxton-Fidler procedure of characteristic points. Prof. Timoshenko handles general processes with great power and brevity, the latter quality, to some extent, telling against ease of reading from the student's point of view; but there is that individuality in the methods and wide range in the problems that marked the previous publication on applied elasticity (by Timoshenko and Lessels) and still more notably characterises these new volumes.

It might be contended that the subject of strain energy should be treated earlier than either author has arranged. The idea should be made to thread the whole subject, and the Castigliano theorem—which Dr. Salmon presents, but does not so designate—could be put to greater service in the earlier parts. It is also open to question whether vibrations and critical speeds should now be looked upon as a theme for one chapter of a book on materials. The subject has grown in extent and importance to such a degree that it deserves special treatment. Prof. Timoshenko has a separate book on this topic.

In treating the experimental side of the subject of materials, one of two principles of attack may be adopted. A general report of testing methods and mechanical properties may be compiled, or a general essay on the significance in design of modern materials testing and properties may be attempted. On the whole, the former is Dr. Salmon's method and the latter represents the attitude taken up by Prof. Timoshenko in his shorter discussion. Both treatments are very readable and give due and accurate weight to such lines as fatigue and high temperature effects. Dr. Salmon has a final chapter introductory to the study of metallography, which should be of distinct service and does for the experimental side what his equally interesting chapter on general mathematical method does for the analytical, namely, stimulates interest in the more profound processes of study.

These volumes are all copious in references to original papers and other sources of information. Dr. Salmon has adopted an exceedingly valuable plan of arranging a full and classified bibliography at the end of each chapter, which compares very favourably with the more usual footnote method followed in Prof. Timoshenko's volumes. But adequate reference is a strong feature of both works and, in conjunction with the wide range and the excellence of treatment, should render them of distinct service to advanced students and technical engineers.

Extinct Volcanoes of Western Scotland.

Memoirs of the Geological Survey, Scotland. The Geology of Ardnamurchan, North-west Mull and Coll. By J. E. Richey and Dr. H. H. Thomas; with Contributions by E. B. Bailey, J. B. Simpson, V. A. Eyles and the late Dr. G. W. Lee; with Chemical Analyses by E. G. Radley and B. E. Dixon. Pp. viii + 393 + 7 plates. 10*s.* net. Sheet 51: *Coll.* Scale of one Inch to a statute Mile. Third edition. Colour printed. $30\frac{1}{2}$ in. $\times 22\frac{1}{2}$ in. 3*s.* net. (Edinburgh and London: H.M. Stationery Office, 1930.)

ARDNAMURCHAN, the most western point on the mainland of Scotland, is a peninsula of gneiss capped by the remains of extinct volcanoes. It projects into the gap between Mull and Skye and is exposed to the full force of Atlantic gales. Its battered cliffs and the landmark formed by its ancient volcanoes are familiar to all who pass by sea along the Western Isles. The geology of the peninsula is now for the first time adequately described in a well-illustrated and excellently compiled memoir of the Scottish Geological Survey, and is accompanied by sheet 51 of its one-inch maps. The sheet, in addition to western Ardnamurchan, includes the island of Coll and north-western Mull. Each of these areas has a very different geological history. Coll is one of the islands composed of Lewisian gneiss. North-western Mull consists of basalt lava-flows from the vents in the central part of the island; and western Ardnamurchan has as its chief feature the dissected base of a huge volcano.

One interesting feature of Coll is the occurrence of numerous glassy rocks due to fusion by crushing, for which, as is remarked in the present memoir (p. 25), " the term flinty crush-rock has come into general use among Scottish geologists ". The adoption of this term in Scotland in regrettable. Flint is formed of organic silica, deposited from solution. These glassy rocks are of far more complex composition than flint and have solidified from a molten state. Prof. Shand's name of pseudotachylyte is more appropriate. The description of these rocks as flinty, instead of as glassy, is one of those illogical usages which have done so much to prejudice geology as a subject in general education. The vitrification of these rocks in Coll is shown to be pre-Torridonian; it is not, as may be possible elsewhere in Scotland, due to movements of the age of the Moine thrusts.

The main interest in this volume is its important contribution to the Kainozoic volcanic history of Scotland, with its repeated testimony to the truth of Judd's conclusion that the igneous masses of the Western Isles and of Ardnamurchan are the remains of a series of great central volcanoes like those of Hawaii and Etna. This view was for long, as the authors remark, generally rejected in favour of Sir Archibald Geikie's theory that the volcanic rocks were discharged by fissure eruptions and not from isolated vents. The fissure eruption theory was shown to be inapplicable in the main to Mull in a former Survey memoir, which held that it might still play a minor rôle: Mr. Richey and Dr. Thomas remark in the present volume that even the supposed minor share rests on slight evidence. There is said to be very little positive support to the origin of plateau basalts by fissure eruptions: and there are many features that require a different explanation (p. 52), and it is pointed out that in spite of the clearness of the cliff sections, " no undoubted case of a dyke feeding a lava flow has been recorded " (p. 52). The Ardnamurchan volcanoes are surrounded by circular dykes rising from the lava basin below. These ring cone dykes were first recognised in Glencoe by Messrs. Clough, Maufe, and Bailey, and have since been found in

Mull and Arran. The same structure is shown to be well developed in Ardnamurchan, which throws further light on this type of volcanic eruption. The intensely dissected volcanoes of western Scotland doubtless reveal the structure of the foundations of such great cone-volcanoes as Etna, in which the central crater is surrounded by a zone of large secondary craters that may be the outlets from ring dykes.

A second topic on which earlier views are vindicated by the present memoir is the extent to which rocks of different composition are combined by the absorption of material by a molten rock or the mixture of different rock magmas. Such composite rocks are known as hybrids and were described by Dr. Harker in his memoirs on Skye and the adjacent islands. The importance of these rocks was discredited by the survey of Mull. Dr. Thomas reaffirms the formation of true rock hybrids, and though his statements are cautious, they suggest that he regards these rocks as more important than has been recognised in some Survey memoirs.

Western Scotland is traversed by innumerable parallel dykes in groups known as swarms. The distribution of the four or five swarms in northern Britain and Ireland is shown in an instructive diagram (p. 52). The dykes in Coll belong to the Mull swarm and those east of Ardnamurchan to the Skye swarm. The dykes trend from north-west to south-east, except in the Southern Uplands of Scotland and the north of England, where they curve round to approximately west to east. Their number is so large that Dr. Tyrrell's measurements in Arran prove that the fissures into which these dykes were injected amounted to an eighth of the width of the area.

These dykes belong to all stages in the last Scottish volcanic period, though they were most numerous towards its end. Their distribution must have been controlled by some process that acted on a continental scale, and was probably due to the tensional rifting of the crust during the last great subsidence of the North Atlantic. Their parallelism to the Scottish sea lochs, as in Skye, indicates that those fiord-like valleys are due to the same process. The volume says little, however, about the physiography and glacial history of the area.

The Mesozoic sedimentary rocks of Ardnamurchan, the importance of which was first recognised by Judd, are fully described. Unfortunately, there is little such material associated with the lavas. A thin mudstone below them contains a shark's tooth derived from the Chalk, which probably once existed in the area. The few coaly beds add nothing to the evidence from Mull as to the age of the eruptions.

The Memoir contains many excellent illustrations and a geological map of the whole of Ardnamurchan, of which the eastern part lies in sheet 52 and has not yet been completely surveyed. This map, being somewhat diagrammatic, is more convenient in reference to the general history than sheet 51, which is more crowded and less clear. The Geological Survey and the authors are to be congratulated on the volume, which completes the series of monographs on the main Kainozoic volcanic centres of the Western Isles. J. W. G.

Formal Logic.

The Foundations of Mathematics : and other Logical Essays. By Frank Plumpton Ramsey. Edited by R. B. Braithwaite. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xviii + 292. (London : Kegan Paul and Co., Ltd. ; New York : Harcourt, Brace and Co., 1931.) 15*s.* net.

FRANK PLUMPTON RAMSEY, recognised as a leader of Cambridge thought at the age of sixteen, died at the age of twenty-six. This volume contains his chief writings on logic and philosophy, about half of them unpublished, with a short appreciation by Prof. Moore and a longer one by the editor ; his work on economics, a secondary interest, is represented only by a letter from Mr. Keynes to the editor. To those who knew him, the book will serve in some measure as a fitting memorial to his brilliant intellect and vivid personality ; those of us who did not must judge it primarily as a contribution to learning.

Any attempted estimate by the number and importance of conclusions established would be quite misleading. In the field of very abstract thought in which Ramsey lived, to travel magnificently is more important than to arrive ; the works of Ramsey's masters, of Whitehead and Russell and of Keynes, are universally acclaimed, although nobody — certainly not Ramsey — accepts their main conclusions. Moreover, Ramsey at his death was still in the stage when " calmness in infanticide " (to quote the editor) is a merit, and the certainties of to-day are the fallacies of to-morrow. The quality of the thought is what really matters.

Nevertheless, a brief summary of his work must be attempted. He was concerned in the main with two great classical problems, of which the first is indicated in the title. As is well known, Whitehead and Russell, following Frege, tried to exhibit pure mathematics as a branch of formal logic, and to show that all its results flow from the axioms that make consistent thought possible. They encountered two chief obstacles, one arising out of the nature of 'implication', the other represented by the famous contradictions. Ramsey, using the ideas of Wittgenstein, surmounts the first obstacle to his own satisfaction; but he can find no way of surmounting the second, except by introducing assumptions that are not completely self-evident. Since he rejects the view, dominant on the Continent, that another satisfactory basis for mathematics can be found, he seems driven to the conclusion that the part of mathematics in which the contradictions arise is not true. This conclusion, the editor tells us, he finally accepted, although acceptance would have involved much recantation. Since the rejected part is that involving the conception of infinite aggregates, he finds himself at last in accord with common sense.

The second problem is to find a meaning for 'probability', as a degree of belief, such that the mathematical theory of probability can be interpreted as a 'logic of consistency', related to partial knowledge as ordinary logic is to full knowledge. This problem inevitably leads to that of the relation between belief and truth. Ramsey's solution is to define a method of measuring belief by means of the odds accepted in betting; he can then show that the mathematical theory states rules that must be obeyed if betting is not to lead to certain loss, just as logic gives rules that must be obeyed if even true premises are not to lead to false conclusions. This view is less in accord with common sense; but it is wholly consistent with, and indeed inspires, his general philosophy, which is extremely pragmatic. Logic, he holds, is concerned only with consistency; it can lead to nothing not contained in the premises. Truth is determined by value in action; consistency in thought is a form of truth because it leads to consistency in action.

Ramsey admits that probability in this sense is not the probability of statistics or science; the paper on "Probability in Science", in which the connexion would have been described, was never written. But it is unlikely that it would have satisfied scientists; for Ramsey's philosophy, like that of most formal logicians, seems to leave no room for any distinctively scientific reasoning. He leaves to science the task of discovering truth; but induction, the process of discovering it, is not deduction, and is therefore nothing but a good habit. As for theories, his extremely difficult paper on this topic begins with the assumption that a theory is merely a new language. He seems to deny that there is any difference between scientific truth and falsity other than value in action.

This refusal to recognise any form of reasoning other than that of formal logic makes Ramsey's work curiously uneven. When he is discussing any problem amenable to formal logical treatment, he is extremely subtle and profound. But when he is not—and books about logic are mainly non-logical—his 'arguments' are chiefly an appeal to prejudice. He makes no real attempt to meet the views of those who differ from him fundamentally; he cannot have believed that Hilbert would have been seriously perturbed by his reasons for rejecting 'formalism'; and when he attempts a *reductio ad absurdum*, his absurdity usually seems to me the plain and sober truth. It is curious that modern logic, arising from the discovery that the Aristotelian syllogism is too narrow, should have stopped so short in removing its limitations. The difficulties that Ramsey discusses in the expression of facts by propositions are closely similar to those that puzzled the medieval logicians when they tried to express all arguments as syllogisms. But it never seems to occur to him that the limitation of reasoning to ordered propositions may be too narrow, and that his difficulties would vanish if he would investigate more closely the nature of 'facts'.

It is unlikely, therefore, that Ramsey's work will change the opinion of those who regard formal logic as an entertaining game, of value only to those who find interest in it. Even as an exponent of a game, he is not so attractive to amateurs as many of his predecessors. He lacks the graceful lucidity of the earlier Cambridge school. He was brought up to think in terms of the new symbolism; it is his natural language; between his formal logic and that of Russell there is all the difference between the French of the schoolroom and of the Parisian streets. Yet even those who cannot truly appreciate the importance of his work may join with those who can in deploring his early death as a great blow to British learning.

Norman R. Campbell.

Plant Biochemistry.

The Principles of Plant Biochemistry. By Muriel Wheldale Onslow. Part 1. Pp. vii + 326. (Cambridge: At the University Press, 1931.) 16*s.* net.

THAT recently named branch of science, biochemistry, has grown within the last few years to such dimensions that no single worker can embrace the subject as a whole. Hence subdivision has become necessary. The two great branches of the subject are those devoted to plant and animal physiology. They are complementary, and one could not continue its existence without the other. The present volume, written by an investigator who has established a reputation by her researches in the subject, is the first part of a textbook intended for the student and for the beginner in research.

The book is divided into six chapters. That dealing with the sugars gives a useful summary of our knowledge, and the work of the leading authorities who have contributed to the biochemistry of the subject is cited. The statement on p. 59 that "sucrose is probably the chief sugar of translocation" is one that cannot be accepted. Sucrose is an intracellular reserve sugar. The hexoses are the translocation sugars. Numerous investigators are mentioned as having reported that maltose exists in foliage leaves, but their methods of estimating that sugar are open to criticism. Mrs. Onslow doubts the existence of maltose in the leaf and assimilating organs. Probably no reducing sugars of higher molecular weight than the monosaccharides occur in such organs of plants.

The belief is growing of the presence of the so-called γ-sugars in Nature, and the observation of F. F. Blackman is quoted that the sugars concerned in respiration are the γ-forms. Mrs. Onslow suggests that these labile forms are the first products of photosynthesis. She also suggests that starch and inulin may contain residues of these γ-sugars, and indeed there is some evidence that this is the case.

In the chapter on the "Cell Wall", celluloses, hemicelluloses, gums, mucilages, pectic substances, cutin, and suberin are dealt with. A scheme is outlined to explain the formation of the structural and reserve polysaccharides from the monosaccharides. Under gums and mucilages the greater part of the text is taken up with a description of the recent work of Norman. Spoehr's work, suggesting that in the formation of gums the high pentosan content is due to the oxidation of the hexoses, is referred to. It has long been known that some moulds growing parasitically on certain trees induce the formation of gums, and the late Marshall Ward in 1901 pointed out that the so-called 'gummosis' is a pathological phenomenon. The bacterial origin of gums was demonstrated by R. Grieg Smith in 1904. Reference to this work might have been expected.

No mention is made of the physics of the cell wall, but perhaps the author regarded this as extraneous. Overton's work, however, suggesting that the semipermeable character of the cell membrane is due to a lining of lipoid, might perhaps have been referred to. A concise account is given of our knowledge of oxidising and reducing systems and of respiration. The chapter on nitrogen metabolism is a well-written summary of our knowledge of a difficult and obscure branch of science.

A useful feature of the work is the very complete bibliography attached to each chapter. There can be no doubt that the author has achieved her object, and that she has produced a valuable and concise work on the principles of plant biochemistry.

ARTHUR R. LING.

The Chemical Engineer.

Elements of Chemical Engineering. By Prof. Walter L. Badger and Prof. Warren L. McCabe. (Chemical Engineering Series.) Pp. xvii+625. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 25*s*. net.

WE believe the engineer began as a person responsible for the construction of engines of war; the profession has prospered and to-day there are all sorts of engineers, of which the latest is the chemical variety. For a time opinions differed as to his utility, his function, and his training, but clarity on these points seems to be forthcoming with the very rapid development of chemical industry, and the chemical engineer is settling down to become a very useful member of society. It has been recognised that there are many unit operations common to all chemical processes and even vital to many industries not ordinarily considered chemical. Such are the transportation of liquids, the flow of heat, evaporation, diffusion, distillation, humidifying, drying, gas absorption, extraction, filtration, and a few more.

In many manufactures it may be that not a single chemical reaction occurs; they consist of a series of unit operations such as the above. An engineer thoroughly trained and versed in all these unit operations will be of considerable value in industry. In this way a more definite line of demarcation of the chemical engineer from both the chemist and the engineer has been arrived at, and there is a movement on foot to train the student on the lines indicated. Industrial chemistry, which is concerned with individual processes as entities, is thus clearly differentiated from chemical engineering.

A committee of the American Institute of Chemical Engineering has attempted to set out the relative weighting of the several major subjects which should be taught; it is of interest that in a four-year course it gives 28 per cent to chemistry, 12 per cent to chemical engineering, and 14 per cent to other engineering. The book before us aims at teaching the 'elements' of chemical engineering along the lines indicated. It overlaps to some extent the pioneer work on the "Principles" by Walker, Lewis, and McAdams, which, however, is too advanced for beginners; so there is ample room for the work of Badger and McCabe. Both authors are so well known in their profession that there is no fear that they will have shirked their task. The book is blessed by A. D. Little, who contributes a very practical introduction containing much sound advice. If the chemical engineer will teach manufacturers, as Dr. Baekeland puts it, to "make their blunders on the small scale and make their profits on the large scale", then new inventions will be more often a source of profit to those who finance them.

E. F. A.

Modern Views on Magnetism.

Magnetic Phenomena: an Elementary Treatise. By Prof. Samuel Robinson Williams. (International Series in Physics.) Pp. xxii + 230. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 15*s*. net.

THIS is the fourth volume of the series. The three which preceded it dealt with subjects in advanced physics. In the first of these, which discussed the most recent of the recent advances, it was a matter for thankfulness to find that the title "The New Physics" never once appeared. It is probably due to the much greater popular interest which is taken in scientific subjects in the present century, as compared with that taken in the past century, that the phrase has now come into very frequent use. Yet in the past century great and even revolutionary advances, without which the now recent advances could scarcely have matured, were made in physics. Nevertheless, these were spoken of with reticence as 'recent advances in physical science', though time has placed them as the greatest at that date since Newton's day. There is only one physics developing continuously as time progresses. Had Newton been asked if his Laws were observed in sub-atomic dynamics, he would very certainly have said that he had no data on which to found an answer.

The universe of molar physics is entirely untouched by the discovery of the electron, and that is the main subject matter of elementary physics. Similarly, it is untouched by the quantum and by relativity. But the supposed inversion of all physics, which has been impressed on the popular mind, has induced an expectation of inverted textbooks.

A glance at Prof. Williams's textbook dispels fear on this point. The electron appears in a few sentences only; the magneton, even, in a page or two only; the quantum in one paragraph; and relativity not at all. Yet the book is thoroughly up to date and modern. The treatment is fresh. This appears even in the titles of chapters, and in their arrangement. 'Magneto-magnetics' instead of 'magnetism' may seem peculiar. That chapter occupies, as it ought, about half the book. 'Magneto-mechanics', 'magneto-thermics', etc., are expressive. The student who uses the book will find fresh breezes blowing through it, and will be led up to the mountain tops, or at least see them temptingly in the distance. It is a book for a learner who wishes to go far.

One sentence may be quoted: "There is no physical existence of these [magnetic] lines of force" (p. 6). Here the author is pointing out, quite necessarily, that there is no terminal magnetic charge corresponding to electric charge in the case of electric lines of force. But reference to the closed electric lines of force which surround the line of motion of a magnetic pole would be useful. Faraday and Maxwell regarded both sets as having real physical existence in the ether. Probably the author does so also; and so would Newton have done. Yet those mathematicians who pay attention to formalism alone, and those philosophers who pay attention to idealism alone, deny physical existence to the ether itself because it is not required for the expression of the formal relationships given in the modern physical equations. Newton's famous dictum, given by him as an *experimentalist*, *Hypotheses non fingo*, tends to be regarded as an absolute dictum applicable even to modern physical theory, and the abolishment of the ether. But Newton's dictum, given by him as a *theorist*, was this, "that one body may act upon another at a distance through a *vacuum*, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking, can ever fall into it".

W. PEDDIE.

Short Reviews.

Anthropology and Ethnology.

Ethnos: or the Problem of Race considered from a New Point of View. By Sir Arthur Keith. (To-day and To-morrow Series.) Pp. 92. (London: Kegan Paul and Co., Ltd., 1931.) 2*s.* 6*d.* net.

AVOWEDLY and of intention, Sir Arthur Keith in this little book has departed from the tacit understanding among anthropologists that they should not in any way trespass on politics; but, as he says, it is impossible to write about human races without touching upon matters which concern statesmen just as much as anthropologists. In fact, Sir Arthur, in hoping that he may induce politically-minded people to study the problems of race from an anthropological point of view, is doing no more than extend to international affairs that practical application of anthropology for which we have pressed in the administration of the dependent races of the British Empire.

In this essay, Sir Arthur has carried a little further the ideas he put forward in his Huxley Lecture to the Royal Anthropological Institute in 1928 and a subsequent public lecture before the Institute in 1929, and has applied them in principle to the problem of internationalism, in its relation to the future peace of the world. In Sir Arthur's opinion, every nation is a potential race, and a sense of nationality, or patriotism, has been one of the most potent of factors in the evolution of the races of mankind as they exist to-day. As race-consciousness is held to be largely responsible for our present troubles, this conclusion may seem pessimistic in so convinced an evolutionist as Sir Arthur; but he sees two possible solutions in either deracialisation by fusion into one race throughout the world, or a continuance of the evolutionary process through race, but under rational control. While Sir Arthur's views, therefore, are not without some comfort for struggling humanity, his more recent pronouncements suggest the inference that only the federally-minded are to survive.

Matriarchy in the Malay Peninsula and neighbouring Countries. By G. A. de C. de Moubray. Pp. ix + 292. (London: George Routledge and Sons, Ltd., 1931.) 15*s.* net.

MR. DE MOUBRAY'S book on the matriarchate in the Malay Peninsula illustrates a serious difficulty. Changes are taking place with such rapidity in modern conditions of contact between European and non-European civilisations that it is almost impossible for the inquirer to ascertain the truth in respect of many customs. The apparent inconsistency or inaccuracy may be due merely to recent changes; it is even possible that this statement of custom may never have been more than a semblance of the truth—in fact, it may resemble the idea laid up in Heaven in the Platonic sense. Thus, among the people of Negri Sembilan, with whom the author was more intimately concerned, inheritance was in the female line, and no male could hold land. Now, however, owing to the development of the rubber industry, land cleared and cultivated by the individual has come to be regarded as in the nature of any other form of personal property, and so may be held by the male.

Mr. de Moubray, in his inquiry into Malayan matriarchy, has obtained a great deal of evidence at first hand, valuable material, which is here printed in full. With the view of arriving at the underlying principles of the custom, he has been led to compare it with the matriarchal system in Menangkabau, the place of origin of part at least of the population of Negri Sembilan, Canara, and Malabar, where the Nayars still hold to it. His discussion of the social value of the matriarchal system in present conditions serves to emphasise once more the practical value of an inquiry of this nature for the work of administration.

Leitfaden der Anthropologie. Von Dr. K. Saller. Pp. iv + 284. (Berlin: Julius Springer, 1930.) 25·80 gold marks.

A BRIEF note must suffice to direct attention to this excellent and much-needed textbook of physical anthropology. The treatment is comprehensive, each aspect, biological, morphological, palæontological, evolutionary, and so forth, being covered. Methods are fully explained, the exposition being accompanied by numerous diagrams, and the present position of our knowledge on the main questions outlined. The section on race is well illustrated by distinctive types, and some attention is given to the neglected question of cross-breeds and hybrids.

Biology.

One Touch of Nature: a Literary Nature Study Reader for Boys and Girls. Arranged by Dr. F. W. Tickner. Pp. viii + 187 + 7 plates. (London: University of London Press, Ltd., 1931.) 2*s.* 6*d.*

IN these days of mechanism, when school books and teaching deal so much with the mechanical, it is a refreshing change to find such a book for children as "One Touch of Nature", written and compiled as it is from a varied selection of well-known, well-tried, and well-read Nature writers.

In arranging a volume of this type, for boys and girls, one must not overlook the fact that the average modern boy and girl is often more intrigued by, and interested in, the mechanical side of life. The importance of encouraging the younger generation in a closer and more intimate study of Nature is clearly described by William Warde Fowler on p. 137. In view of the delicacy with which a child's interest in Nature should be captivated and retained, to include such portions from the extracts of John Richard Jefferies as "Bevis and the

Wind " is to risk courting ridicule from the average schoolboy, whose interest in this book would centre rather round its nature study than its literary study.

The value of the book as a helping hand to readers would undoubtedly be greatly enhanced by illustrations and more photographs, and one is sorry to find so little reference to the commoner birds, such as the robin, thrush, and blackbird, which may usually be seen even by the city or town child.

Dr. Tickner wisely discloses the fallibility of Nature writers, a point which will tend to inspire the child with a desire to find out for himself. In passing, attention might be directed to the inferred contradiction as to the behaviour of the tortoise in rain.

" One Touch of Nature ", though in places a little advanced for the average child-mind, is on the whole a delightful book, and should go far in helping its readers to observe things in the right way and then to describe concisely and clearly what has been observed and noted.

Fifty-two Years of Research, Observation and Publication, 1877–1920 : a Life Adventure in Breadth and Depth. By Prof. Henry Fairfield Osborn. Edited by Florence Milligan. With Complete Bibliography, Chronologic and Classified by Subject, 1877–1929. Pp. xii + 160 + 9 plates. (New York and London : Charles Scribner's Sons, 1930.) 1.50 dollars.

Here is a most impressive monument to the accomplishment of a great scientific worker. Osborn early found that " research is work of the hardest kind, requiring persistence, intelligence, and imagination ", and all those qualities are necessary for a proper understanding of this skeleton of a life's work. Its main bulk is made up of a chronological and a classified list of the author's publications, 801 of them ; of the share he has taken in the work of learned academies, revealed by lists of awards, degrees, and fellowships ; and little space is left for a personal or intimate account of the great adventure. But the outstanding facts are clear.

The application of a two-edged discipline of detailed, intensive investigation, illumined by broad generalisations or hypotheses, has resulted, on one hand, in monographic researches on the rhinoceroses, horses, titanotheres, proboscideans, and reptilian sauropods, as well as in hundreds of lesser investigations. On the other hand, from the details have sprung a crop of ' principles ', such as adaptive radiation or divergence, coincident selection, rectigradation or the predeterminate origin of new characters, allometrons or the adaptation of proportions in skull and skeleton. Osborn frankly admits that several of his principles have " gained no acceptance in the current realm of either biologic or palæontologic thought ", but he is content to bide his time, believing that sound principles will finally gain universal acceptance, and that the less widely unsound ones are accepted the better.

J. R.

Chemistry.

Handbuch der anorganischen Chemie. Herausgegeben von Prof. Dr. R. Abegg, Dr. Fr. Auerbach und Prof. Dr. I. Koppel. In vier Bänden. Band 4, Abteilung 3 : *Die Elemente der achten Gruppe des periodischen Systems.* Teil 2 : *Eisen und seine Verbindungen.* A Lieferung 1. Pp. Axvi + A336. (Leipzig : S. Hirzel, 1931.) 40 gold marks.

The present volume of this well-known treatise deals mainly with the physical properties of metallic iron. The atomic weight is also discussed. The spectrum, magnetic properties, crystalline form, thermal properties, electrical resistance, etc., are treated very fully, the numerical data being given in great detail. The preparation of pure iron, including electrolysis, and colloidal iron form the chemical part of the volume. The physical side is more prominently dealt with than in most of the preceding volumes of the series, and, for example in the sections on magnetism, it seems as though this aspect has been given too much prominence in a treatise on chemistry. It would probably be wiser in succeeding volumes to stress the chemistry more and to avoid expanding the series too much in the direction of pure physics, thereby adding to the size and expense to an unnecessary degree. The volume is a welcome step towards the completion of the excellent series and should be in all chemical libraries. The printing and paper are of the best quality.

The Modern Soap and Detergent Industry : a Complete Practical Treatise in Two Volumes on the Manufacture of Laundry, Toilet, Pharmaceutical, Textile, Abrasive, Scouring and Powdered Soaps. By Dr. Geoffrey Martin. Second edition, revised and enlarged. Vol. 1 : *Theory and Practice of Soap Making.* Pp. xii + 76 + 37 + 34 + 53 + 13 + 100 + 64 + 4. Vol. 2 : *The Manufacture of Special Soaps and Detergent Compositions.* Pp. xii + 102 + 40 + 26 + 50 + 16 + 35 + 38 + 6 + 37 + 31 + 51. (London : Crosby Lockwood and Son, 1931.) 36*s.* each vol.

This very practical and detailed treatise has been brought up to date by the author, and contains an account of all important recent advances and new patents in the soap industry. It covers British, American, and Continental practice and deals also with analysis and laboratory control. Dr. Martin's work is authoritative and will be welcomed by those interested in the soap and allied industries. It is fully illustrated and indexed.

A Life of Joseph Priestley. By Anne Holt. Pp. xviii + 221. (London : Oxford University Press, 1931.) 8*s.* 6*d.* net.

Although a good account of Priestley's scientific work has been given by Sir Edward Thorpe, there has been no adequate biography dealing with his many other activities. This need is, to some extent, supplied by the present work. The chapter on Priestley's chemical investigations is inadequate, but the author's intention was evidently to discuss in greater detail the personal life and the political and theological activities of Priestley, and she has made good use of the material available, some unpublished. The book covers the whole of Priestley's life, and in addition to making clear the great disadvantages under which Priestley carried out his scientific work, it provides a clear picture of the social life of his time. There is a useful bibliography.

Mathematics.

The Elementary Theory of Tensors: with Applications to Geometry and Mechanics. By Prof. Tracy Yerkes Thomas. Pp. ix + 122. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 10*s.* net.

THE difficulties of the theory of relativity are much increased by the combination of unfamiliar physical ideas with the unfamiliar mathematical notation of the theory of tensors. Some universities are trying the experiment of separating these difficulties by giving an elementary course in tensors to undergraduates, with applications to ordinary geometry and dynamics.

Prof. Thomas's book is based on such a course given at Princeton University. After an introductory chapter recapitulating properties of determinants, it gives a brief chapter on the pure theory of tensors. Then follow three longer chapters, dealing respectively with the application to Euclidean geometry (emphasising the invariant point of view), kinematics (especially of the displacements and accelerations of a rigid body), and Newtonian dynamics (with a good deal about Lagrange's equations). The treatment throughout is such as to prepare the way for a study of Einstein's theory.

H. T. H. P.

Vorlesungen über Grundlagen der Geometrie. Von Prof. Kurt Reidemeister. (*Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete*, herausgegeben von R. Courant, Band 32.) Pp. x + 147. (Berlin: Julius Springer, 1930.) 11 gold marks.

THIS book is a comprehensive survey of the present conditions of the foundations of geometry. In the first part, the author follows Klein's programme of Erlangen, and discusses the notions of congruence and invariance, using freely the theory of groups, and giving an analytical treatment of generalised vectors without, however, employing determinants. But algebra is scarcely sufficient for an adequate description of the implications of space: geometry is more than a combination of numbers. So, in the second part of the monograph, the author gives an exposition of geometry as an autonomous axiomatic construction, discussing single systems of axioms with their logical characteristics.

The whole work is limited to plane geometry. On a point of method, however, it seems that a more rational presentation of such a difficult subject could be obtained by starting with axiomatic geometry.

T. G.

Introduction to Vector Analysis: with many Fully Worked Examples and some Applications to Dynamics and Physics. By L. R. Shorter. Pp. xiv + 356. (London: Macmillan and Co., Ltd., 1931.) 8*s.* 6*d.* net.

THERE is still considerable diversity of opinion concerning what amount of time students of mathematics and physics should devote to vector analysis, and at what stage it should be introduced. No one can doubt its value in advanced work such as differential geometry or electrodynamics, but it is still an open question whether it should be introduced to students of elementary geometry, mechanics, and physics. Many years ago, intermediate science students at the University of London were given a fairly full course in vectors, but now it is more usual to give only a very brief treatment, such as an introductory chapter to a textbook of physics. Mr. Shorter has come to the conclusion that this is unsatisfactory, as it does not give the grasp necessary to enable one to use the method with confidence. He therefore reverts to the older idea of supplying a complete elementary course. The distinctive feature of the book is the large number of fully worked examples. Those who can afford the time to study these should have a good grip of the subject.

H. T. H. P.

Metallurgy.

The Elements of Ferrous Metallurgy. By Dr. Joseph L. Rosenholtz. Pp. vii + 248. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 15*s.* net.

IN view of the importance of the iron and steel industry to Great Britain, it is remarkable that so few textbooks are available to metallurgical students. One or two which formerly enjoyed a well-deserved reputation are now hopelessly out of date. The present volume comes from America, and the descriptions of plant relate to American works, but there is little which is not also applicable to English practice, and it is convenient to have the blast furnace, steel furnaces, and rolling mills well described and illustrated in a single volume of small size, whilst clear accounts are also given of such processes as tube-making.

The second part of the volume is occupied by an account of metallographic methods of study and of the constitution of iron and steel. This is excellently done, and the volume is to be recommended to students of engineering as well as of metallurgy. The chemistry of the various processes is simply and accurately explained. There are a few slips; the experiments suggested to the student on p. 15 could not be actually performed, and it will surprise Sheffield cutlery manufacturers to learn that shear steel cannot keep a cutting edge on account of its slag inclusions—these being the cause of the known great superiority of such steel for cutting. The illustrations have been drawn from other sources with good judgment, and well portray present practice.

The Metallurgy of Bronze. By H. C. Dews. (The Specialists' Series.) Pp. ix + 147. (London: Sir Isaac Pitman and Sons, Ltd., 1930.) 12*s.* 6*d.* net.

In 1903, Heycock and Neville published their study of the copper-tin alloys, one of the classics of metallurgy, and the work of later investigators, which has filled in the gaps in their account, has only confirmed the accuracy of their diagram and their foresight in adopting long periods of annealing as a means of obtaining equilibrium. The bronzes are of great technical importance, and an account of their composition and uses, by a metallurgist accustomed to handling them in industry, is therefore to be welcomed.

This little book, high in price for its size, is well printed and contains the information most necessary to those who have to use bronzes for casting and other purposes. The term 'bronze' is taken in its proper sense, as meaning copper alloys in which tin is the principal added metal, but including complex bronzes, of which many now exist. There are some misprints, and the theoretical treatment of the subject is weak, the account of the iron-copper equilibrium on p. 84 being quite inaccurate. Most of the illustrations are good, but Figs. 9, 13, 14, 15, and 22 are merely black smudges, which is the more remarkable since these alloys give very clear structures when properly etched. The book will be of special use to foundrymen.

Impurities in Metals: their Influence on Structure and Properties. By Dr. Colin J. Smithells. Second edition, revised. Pp. xiii + 190 + 26 plates. (London: Chapman and Hall, Ltd., 1930.) 18*s.* net.

The first edition of this book was well received by metallurgists, and a second has been called for. In addition to general revision, which has much improved the work, the subject of gases in metals has now been discussed in detail, mainly, however, in connexion with the non-ferrous metals. A fuller account of the state of knowledge concerning gases in steels, admittedly a controversial subject, would have been useful. The subject being the effect of impurities on the properties of metals, the section on magnetic properties might well have been expanded, in view of the enormous influence of even very minute quantities of impurity, of great theoretical significance as well as practical importance. Should another edition be required, the section on corrosion will also need expansion. The author's special acquaintance with tungsten enables him to illustrate several points by reference to that metal.

Metallurgists whose interest is in steel will be disappointed by the omission of many matters of importance to them which might have been included, but on the whole this attractively produced work will be found to contain a large amount of valuable information on a variety of metallurgical subjects.

Miscellany.

The Scientific Journal of the Royal College of Science. Vol. 1: containing Papers read during the Session 1930–31, before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 158. (London: Imperial College Union, 1931.) 3*s.* 6*d.* net.

This publication, which appears as a result of collaboration between the three student societies named, may conceivably meet with criticism from some readers on the ground of redundancy, seeing that the substance of its most important papers can probably be found in print elsewhere. Others will discern in it a token of the vitality of the societies concerned. Moreover, it is apparent that a student journal of this type can fulfil an important service in broadening the interests of the members of each of the contributing societies. This result can only follow, however, if a judicious selection of the published papers is maintained: besides the more specialised papers, each section of the journal should contain at least one paper of general interest.

The first issue conforms to this criterion through the inclusion of instructive lectures on "The Life and Work of W. H. Perkin, Jun." (Prof. J. F. Thorpe), "Plant-Breeding" (Prof. F. L. Engledow), and "The Nature of Vowel and Consonant Sounds" (Sir Richard Paget). The biographical sketch of England's greatest organic chemist is full of interesting detail; and we cannot refrain from quoting a neat expression of a reflection which must occur frequently to all who experience the joys and sorrows of supervising organic chemical research: "It would appear, in fact, that these great manipulators possess some power which ordinary beings lack—some radiation from the eye, or some force which passes from them to the reaction vessel and compels the material to behave in the desired manner. Otherwise it seems impossible to account for the fact that compounds which in the hands of the ordinary research student remained, and would always remain, as an intractable gum, in Perkin's hands rapidly assumed the form of splendid crystals of undoubted homogeneity and purity." J. R.

An Outline of the Universe. By J. G. Crowther. Pp. xvii + 376 + 24 plates. (London: Kegan Paul and Co., Ltd., 1931.) 12*s.* 6*d.* net.

This brilliant and useful book deserves a warm welcome. The author describes it as the first attempt he knows in a new and necessary craft—"the conveyance of the atmosphere and facts of recent scientific research to the public, the conveyance of atmosphere being the more important part". He has certainly managed to compress into a smaller space the latest results in astronomical, physical, and biological science than any other writer we know; in fact, there is nothing quite like it, and Lord Rutherford's commendation is well deserved.

Mr. Crowther has divided the field into three approximately equal areas—the universe (in the astronomical sense), the atom, and life. On each of these he collects the latest and most striking scientific observations or theories, and ends with a short exhortation to mankind to emulate Nature and try to organise society as efficiently as Nature has organised the community of cells in his own body. That is the philosophy or moral of the book, so far as it has one, but the author certainly did not start with any philosophic purpose in mind. He is intensely interested in all the recent discoveries and is anxious that the educated public should share his interest.

Of the three main sections, that on life is the fuller and bears more trace of intimate personal knowledge and research. The astronomical section mostly follows the lines with which Sir James Jeans has made us familiar.

A word should be added on the abundant and most ingenious and suggestive illustrations. They could scarcely be better for the purpose in view.

F. S. M.

The Girdle of Chastity: a Medico-Historical Study. By Eric John Dingwall. Pp. x + 171 + 10 plates. (London: George Routledge and Sons, Ltd., 1931.) 10*s.* 6*d.* net.

In this work, which forms an interesting companion volume to the author's study of male infibulation reviewed in these columns some years ago (Nature, **97**, 150; 1926), Dr. E. J. Dingwall makes a survey of the history and use of the girdle of chastity from the twelfth century down to the present day. Evidence is brought forward to show that the idea of the girdle of chastity is derived from that of female infibulation which originated in the East.

Seven types of girdles are discussed, the earliest being that described by Kyeser von Eichstadt in his military encyclopædia entitled "Bellifortis", of which the MS. in the library at Göttingen is dated 1405, and the latest that devised by John Moodie, a Scottish doctor, as a means of preventing masturbation and seduction, and described by him in a work published at Edinburgh in 1848. A special chapter is devoted to the forensic aspects of the subject, and is followed by one dealing with the references to the girdle of chastity in belletristic literature from the fifteenth to the twentieth century. The text is illustrated by photographs and drawings of various girdles in different museums in Europe.

The author is to be congratulated not only for having produced a richly documented and very readable work, but also for continuing his valuable researches in the sexuological department of anthropology, which is still taboo to the great majority of the medical profession in Great Britain.

Philosophy.

Cosmic Problems: an Essay on Speculative Philosophy. By Prof. J. S. Mackenzie. Pp. ix + 122. (London: Macmillan and Co., Ltd., 1931.) 6*s.* net.

The author of this book is not only a distinguished figure in the philosophical world, but also a teacher honoured by many hundreds of his former students. His power as a teacher, as well as a thinker, is manifest in all that he writes. He has the gift of making difficult matters seem at least not hopelessly incomprehensible. Indeed, he seems in some danger of sharing the philosophic fate of J. S. Mill, of whom it has been said that he made the mistake of writing clearly enough to be found out.

Throughout his career, Prof. Mackenzie has, as is well known, followed the line of idealistic speculation, and during that time there has not been, on the whole, much commerce between science and philosophy. But in these days, science has become philosophical, and some men of science, such as Whitehead and Russell, have become philosophers. Modern theories of evolution and of the spatio-temporal system are bound to be taken into account by speculative philosophy. In a series of short chapters, Prof. Mackenzie takes up one after another of the problems so raised, and tries to remove some of the difficulties in the way of a solution. For their complete removal, he says, the co-operation of the special sciences is required, and "happily there is now no real opposition between the results of the special sciences and the demands of speculative thought".

Orpheus: a History of Religions. By Salomon Reinach. Revised and partly rewritten. Translated by Florence Simmonds. Pp. ix + 487. (London: George Routledge and Sons, Ltd., 1931.) 15*s.* net.

This new and revised Anglo-American edition of M. Salomon Reinach's well-known history of religions, which in France has now reached its thirty-eighth edition, brings the survey of the religious movement in the modern world fully up to date. Here M. Reinach is amusing as well as instructive. In dealing with earlier times and other types of religion, the chapter on Christian origins has been almost entirely rewritten in the light of the fresh evidence furnished by the Emperor Claudian's letter to the Alexandrian community and by the Slavonic text of Josephus relating to Jesus, discovered some years ago and brought to the notice of the learned world in 1925. M. Reinach's interpretation of these two documents gives an entirely new conception of the course of events in Jerusalem leading up to the Crucifixion; for he concludes that the unnamed leader of the insurrection, which the text of Josephus states was in contemplation, was, in fact, Jesus.

Physics.

A Survey of Physics. By Prof. Frederick A. Saunders. Pp. x + 635 + 8. (London: G. Bell and Sons, Ltd.; New York: Henry Holt and Co., n.d.) 14*s.* net.

The title of this volume is attractive, for it suggests a more interesting and readable account of physical phenomena and theories than is given in the ordinary textbook. This anticipation is realised in full measure, for Prof. Saunders of Harvard has been markedly successful in collecting novel illustrations of physical principles and in instilling the spirit of the scientific investigator. The gyroscopic ship-stabiliser, the diffusion or condensation pump, the Shortt clock, the internal combustion engine, the phonodeik and architectural acoustics, are a few of the titles attracting attention in the first half of the volume, and in the second half, dealing with electricity and light, the author revels in up-to-date applications of physical methods. Of particular interest and merit are the biographical notes scattered throughout the volume. These brief records of the leaders in physics, both ancient and modern, are well conceived and admirably executed ; they are remarkably accurate, and our only regret is that they are not more numerous.

The book is designed for college students but " no great store of mathematical knowledge is required ". In words which possibly reflect his own experience as a teacher, the author adds : " Beyond this the reader's equipment is supposed to include an inquiring mind, ordinary human powers of observation, and an average acquaintance with modern civilisation." Prof. Saunders is not afraid to introduce " the newer, and presumably better, conceptions usually referred to as ' modern ' physics. These will prove useful and stimulating, perhaps at times even irritating." Towards the end of the book the reader is informed as to the emission of light in quanta, Bohr's theory of the hydrogen atom, wave mechanics, and finally the theory of relativity.

The book is well produced and well illustrated, and in its freshness and completeness can be confidently recommended to the general reader as well as to the teacher in search of new material. It is one of the best college textbooks yet provided by our American colleagues. H. S. A.

Wilhelm Conrad Röntgen und die Geschichte der Röntgenstrahlen. Von Dr. Otto Glasser. Mit einem Beitrag : *Persönliches über W. C. Röntgen*, von Margret Boveri. (Röntgenkunde in Einzeldarstellungen, herausgegeben von H. H. Berg und H. Frik, Band 3.) Pp. xi + 337. (Berlin : Julius Springer, 1931.) 29·60 gold marks.

In the autumn of 1895, Prof. Wilhelm Conrad Röntgen of Würzburg, Bavaria, discovered the rays which he called the ' unknown ' or ' X ' rays, but which are now frequently known by his name. In this book, Dr. Otto Glasser gives much miscellaneous information about his work, and Miss Margret Boveri, who was a friend of the great physicist, gives many interesting personal details of his life. An excellent photograph, signed ' Dr. W. C. Röntgen ', forms the frontispiece, and there are many photographs of historic letters, documents, and skiagrams. A picture is given of the modest but attractive laboratory in the Physical Institute in Würzburg where Röntgen rays were first discovered. An excellent skiagram of a hand taken by Röntgen himself in Hamburg on Jan. 17, 1896, is shown. The development of Röntgen photography was extraordinarily rapid. Other skiagrams, taken in January 1896, are shown, including one by Campbell Swinton. In the appendix a list of 1044 communications to the press on the subject, published in 1896, is tabulated. Of these, twenty were written by Campbell Swinton, eight being published in NATURE. Lodge published fifteen and S. P. Thompson seven, several of which were in NATURE. A picture published in *Punch* on Jan. 25, 1896, shows that the new photography has its humorous side. A long list, but far from complete, of the well-deserved honours received by this great physicist in his lifetime is given. It includes the Rumford Medal of the Royal Society in 1896 and the Nobel Prize in 1901. His letters show that in his private life he was a modest and lovable man. The book would be improved if it had an index.

Electricity and Magnetism : an Advanced Text-book for Colleges. By Prof. Charles A. Culver. Pp. viii + 383. (New York : The Macmillan Co., 1930.) 14*s*. net.

THIS book sets out to give a reasonably complete presentation of the fundamental principles upon which rest the everyday applications of electricity and magnetism. Its standard is somewhat higher than that styled ' intermediate ' in Great Britain, clear accounts of the elementary principles of alternating currents and thermionics being included. The author has also made an attempt to give an up-to-date and simple description of the earth's magnetic field, and throughout the book emphasis has been placed on the practical applications of physics. The diagrams are very good, but some of the photographic reproductions could be improved. Why is it that nearly all publishers appear content to reproduce X-ray photographs in a manner which gives an utterly false impression of the radiographer's work with modern apparatus ? When a new edition is called for, the exceedingly poor skiagraph of a human skull should be omitted, if not replaced by a more satisfactory picture.

La synthèse des ondes et des corpuscules. Par Karl K. Darrow. Exposé élémentaire publié avec une introduction et des notes par Marcel Boll. Pp. 54. (Paris : Hermann et Cie, 1931.) 10 francs.

THIS booklet is a translation of one of the admirable articles contributed to the *Bell System Technical Journal* by Karl K. Darrow. The fact that foreign publishers consider these articles sufficiently important to warrant translation, indicates that English readers would do well to consult them. The article before us is an extremely instructive explanation of certain simple optical and electron phenomena, such as diffraction by a grating, on the basis of the corpuscular and undulatory theories. In it, the author shows how recent work has so modified our conceptions that we now look upon corpuscles and waves, not as two alternatives between which we must choose, but as complementary aspects of the truth.

Physiology.

Ephedrine and related Substances. By K. K. Chen and Carl F. Schmidt. (Medicine Monographs, Vol. 17.) Pp. v + 121. (London : Baillière, Tindall and Cox ; Baltimore, Md. : Williams and Wilkins Co., 1930.) 11*s*. 6*d*. net.

IN the course of the last few years numerous papers have been published on the clinical use of ephedrine and it now has a definite place in therapeutics.

Although it may be considered by some a modern drug, yet the clinical use of the plant from which it is isolated dates back some 5000 years ; and thirty-five years elapsed between its isolation and the discovery of its real value.

Ma Huang has been used in China by native physicians for thousands of years, and similar species of *Ephedra* have been employed as medicines in many other parts of the world since remote antiquity. It was not until 1885, however, that Yamanashi obtained an impure crystalline substance from the plant. Two years later, Nagai and Hori isolated the alkaloid in pure form. Miura found that the alkaloid was toxic in large doses, but advocated its use as a mydriatic. Its clinical value was not appreciated until 1917, when Amatsu and Kubota reinvestigated its properties ; but their work passed unnoticed by the western world until 1923, when Chen and Schmidt began their researches.

The alkaloid ephedrine finds its chief use as a substitute for adrenalin, to which it is related in chemical structure ; it is not so potent a substance, but it has the great advantage that it can be given by mouth. The authors describe in detail the actions of the drug on animals and its uses in the treatment of a variety of diseases in man. They also include a section on synthetic ephedrine and other related compounds.

The monograph gives a good though brief account of the work which has been carried out on the alkaloid during the past six years. Its perusal raises the question whether other valuable drugs may not be awaiting extraction from the herbs used by native physicians of the East.

The Metabolism of Tumours : Investigations from the Kaiser Wilhelm Institute for Biology, Berlin-Dahlem. Edited by Otto Warburg. Translated from the German edition, with accounts of Additional Recent Researches, by Dr. Frank Dickens. Pp. xxix + 327 + 5 plates. (London: Constable and Co., Ltd., 1930.) 40*s.* net.

THE work of Otto Warburg on the metabolism of tumours is so well known that it needs no introduction ; but for investigators working on the metabolism of isolated tissues, frequent reference to his methods and results is a necessity, so that the publication of an English translation will be widely welcomed.

Apart from a short introduction on the technical details of methods, the book consists of reprints of papers published since 1908 by Warburg and his co-workers. The earlier papers deal with the oxidation process in sea urchin eggs and red blood cells ; from 1923 onwards the researches deal chiefly with tumour tissues. The metabolism of a tumour cell is characterised by the production of lactic acid in the presence of oxygen or aerobic glycolysis; normal tissues produce the acid in the absence of oxygen, but in its presence it is further oxidised ; in other words, normal tissues obtain their energy by respiration, tumour tissues by the conversion of carbohydrate to lactic acid. The distinction between the two types, however, is not absolute : thus, tumours respire as well as showing aerobic glycolysis, whilst normal tissues can be made to develop the abnormal form of metabolism by interfering with their respiration. If a normal growing cell glycolyses aerobically, it usually dies ; if it lives, a tumour results : hence, interference with the respiration in growing cells is the cause to tumours.

The English edition has been brought up to date by the inclusion of a few recent papers which were not in the German edition; it should prove of interest to a wide circle of readers.

Psychology.

Alcohol and Behaviour. By Prof. Sydney Smith. (The Henderson Trust Lectures, No. 10, delivered at the University of Edinburgh, 28th November 1930.) Pp. 37. (London and Edinburgh : Oliver and Boyd, 1930.) 6*d.*

IT is very refreshing to read a lecture on alcohol without finding any bias or the influence of vested interest as is so often the case in articles of this kind. Prof. Smith, in " Alcohol and Behaviour ", the Henderson Trust Lecture for 1930, has presented as impartial a study of the subject as we could wish for. There are some most interesting, and at the same time most surprising, statements. We would scarcely expect to find that there is no relation between alcohol and the murder rate, that, despite the fact that drunkenness has diminished to such an extent, yet there is an increase in offences of a sexual nature up to twice the 1909 level, and that offences against property have considerably increased in the same period. It is also surprising to read that the expectation of life in those more than thirty years of age is not in any degree impaired by the moderate consumption of alcohol. The author concludes by reminding us that as a nation we are becoming year by year more sober, but at the same time more dishonest and less moral.

Crime as Destiny : a Study of Criminal Twins. By Prof. Dr. Johannes Lange. Translated by Charlotte Haldane. Pp. 199. (London : George Allen and Unwin, Ltd., 1931.) 6*s.* net.

PROF. LANGE attempts to show that in monozygotic twins there is a very strong tendency for one child to be a criminal if the other one is. We are not inclined to agree necessarily as to the " dreadful influence " of alcohol in creating criminals, nor do we agree that criminal tendencies are so largely the result of hereditary factors. The influence of bad environment and evil influence in childhood is of so much more importance. Much more can be done with problems of the young delinquent by means of child guidance than by any questions of sterilisation or the prevention of cross-breeding of inferior or criminal types.

Forthcoming Books of Science.

Agriculture, Forestry and Horticulture.

Baillière, Tindall and Cox.—Baillière's Encyclopædia of Scientific Agriculture, edited by S. H. Hunter, 2 vols. *Oxford University Press.*—Forestry Memoirs, No. 13: Regional Survey and its Relation to Stock-taking of the Agricultural and Forest Resources of the British Empire, R. Bourne; Historic Farms of South Africa. The Wool, the Wheat, and the Wine of the Seventeenth Century, Dorothea Fairbridge.

Anthropology and Archæology.

George Allen and Unwin, Ltd.—A Handbook of Classical Mythology, G. Howe and G. A. Harrer; The Evolution of Culture, J. Lippert, translated and edited by G. P. Murdock. *Edward Arnold and Co.*—The Psychology of a Primitive People: a Study of the Australian Aborigine, Prof. S. D. Porteous. *Macmillan and Co., Ltd.*—The Lakhers, N. E. Parry, with an Introduction and Supplementary Notes by Dr. J. H. Hutton. *Methuen and Co., Ltd.*—Egyptian Antiquities in the Nile Valley: a Descriptive Handbook, Dr. J. Baikie. *Oxford University Press.*—Roman Britain, R. G. Collingwood. *G. Routledge and Sons, Ltd.*—The History of World Civilization, from Prehistoric Times to the Middle Ages, Prof. H. Schneider; Sorcerers of Dobu: the Social Anthropology of the Dobu Islanders of the Western Pacific, R. F. Fortune, with an Introduction by Prof. B. Malinowski; Growing up in New Guinea: a Comparative Study of Primitive Education, Margaret Mead; Sexual Life in Ancient Greece, H. Licht; A Bibliography of Sex Rites and Customs, R. Goodland. *Charles Scribner's Sons.*—Tara: the Pagan Sanctuary of Ancient Ireland, Prof. R. A. S. Macalister; The Temple of the Warriors, E. H. Morris; The History of the Maya, from the Earliest Times to the Present Day, T. Gann and J. E. Thompson.

Biology.

George Allen and Unwin, Ltd.—The Life of Mendel, H. Iltis, translated by Eden and Cedar Paul; The Life of the Butterfly, F. Schnack, translated by Winifred Katzin; The Experimental Analysis of Development, Prof. B. Dürken, translated by H. G. and A. M. Newth. *D. Appleton and Co.*—The Insect Menace, Dr. L. O. Howard. *Baillière, Tindall and Cox.*—International Address Book of Botanists: being a Directory of Individuals and Scientific Institutions, Universities, Societies, etc., in all parts of the world interested in the study of botany. *Ernest Benn, Ltd.*—A History of Fishes, J. R. Norman. *A. and C. Black, Ltd.*—The Birds of the Air, or, British Birds in their Haunts, A. W. Seaby. *Cambridge University Press.*—Chemical Embryology, Dr. J. Needham, 3 vols.; Invertebrata: a Manual for Students, Dr. L. A. Borradaile, F. A. Potts and J. T. Saunders. *Chapman and Hall, Ltd.*—Oceanography, Dr. H. B. Bigelow. *J. and A. Churchill.*—Recent Advances in Botany, E. C. Barton-Wright. *W. Heffer and Sons, Ltd.*—Emigration, Migration and Nomadism, by the late Walter Heape, edited, with a Preface, by Dr. F. H. A. Marshall. *Methuen and Co., Ltd.*—Problems of Relative Growth, Prof. Julian S. Huxley; Microbes and Ultramicrobes: being an Account of the Bacteriophage in its Relations to Bacterial Variation and the Invisible Viruses, A. D. Gardner; Mendelism and Evolution, E. B. Ford; The Great Biologists, Sir J. Arthur Thomson; Plant and Animal Life: an Introduction to the Study of Biology, Rosamond F. Shove; The Teaching of Biology: a Handbook for Teachers of Junior Classes, Ethel M. Poulton. *Oxford University Press.*—Selecta Fungorum Carpologia of the Brothers L. R. and C. Tulasne, translated into English by W. B. Grove, edited by Prof. A. H. R. Buller and C. L. Shear, 3 vols.; Iconum Botanicarum Index Londinensis, G. A. Pritzel, Vol. 6: Saponaria-Zymum, with Emendanda; an Introduction to the Study of Vertebrate Zoology, based chiefly on the titles in the Blacker Library of Zoology, The Emma Shearer Wood Library of Ornithology, the Bibliotheca Osleriana, and other Zoological Collections of McGill University, Montreal, Canada, compiled and edited by C. A. Wood; West African Botany, F. R. Irvine. *Sidgwick and Jackson, Ltd.*—The Biology of Mammals, Prof. J. Ritchie (Biological Handbooks); The Principles of Animal Genetics, E. B. Ford; Experimental Zoology, Prof. Julian S. Huxley; Invertebrate Zoology, Prof. W. Garstang (Text-Books of Animal Biology). *University Press of Liverpool.*—L.M.B.C. Memoirs, No. XXX.: Manx Algæ: an Algal Survey of the South End of the Isle of Man, Dr. Margery Knight and Mary W. Parke. *Williams and Norgate, Ltd.*—Genetic Principles in Medicine and Social Science, Prof. L. T. Hogben; The Essentials of Bacteriological Technique, F. R. Hunwicke; Scientific Riddles, Sir J. Arthur Thomson. *H. F. and G. Witherby.*—The Art of Bird-Watching: a Practical Guide to Field Observation, E. M. Nicholson; Practical Handbook of British Beetles, N. H. Joy, 2 vols.

Chemistry.

D. Appleton and Co.—How to Understand Chemistry, A. F. Collis; Smith's Introductory College Chemistry, Prof. J. Kendall. *G. Bell and Sons, Ltd.*—Groundwork of Biophysics, Dr. G. M. Wishart. *Cambridge University Press.*—Molecular Rays, R. Fraser (Cambridge Series of Physical Chemistry). *Chapman and Hall, Ltd.*—Chemistry, Life and Civilisation, Dr. H. T. S. Britton. *J. and A. Churchill.*—Recent Advances in Physical Chemistry, Dr. S. Glasstone; The Colloid Aspects of Food Chemistry and Technology, Dr. W. Clayton. *Constable and Co., Ltd.*—Text Book of Physical Chemistry, Prof. Eggert, translated by Dr. S. J. Gregg, edited by Dr. W. A. Caspari; Systematic Organic Chemistry: Modern Methods of Preparation and Estimation, Dr. W. M. Cumming, Dr. I. V. Hopper and Dr. T. S. Wheeler, new edition revised by Drs. Cumming and Hopper. *C. Griffin and Co., Ltd.*—Friend's Inorganic Chemistry, Vol. 11, Part 3, Organometallic Compounds: Derivatives of the Elements of Groups V. to VIII. (excluding Arsenic), A. E. Goddard; The Analysis of Textile Fibres, S. R. Trotman. *Longmans and Co., Ltd.*—A Comprehensive Treatise on Inorganic and Theoretical Chemistry, Dr. J. W. Mellor, Vol. XII.; Monograph on the Sulphur Bacteria, Prof. D. Ellis; The Glycosides, Dr. E. F. Armstrong and K. F. Armstrong (Monographs on Biochemistry); Alcoholic Fermentation, Prof. A. Harden, new edition. *Methuen and Co., Ltd.*—The Biochemistry of Muscle, Dr. Dorothy Moyle Needham; Surface Tension, Dr. A. Ferguson. *Oxford University Press.*—Elementary Chemistry for Technical Students, W. R. C. Coode-Adams. *G. Routledge and Sons, Ltd.*—The Sorption of Gases and Vapours by Solids, Prof. J. W. McBain.

Engineering.

Edward Arnold and Co.—Heat Engines (for technical students—3rd Year National Certificate book), S. H. Moorfield and H. H. Winstanley. *Cambridge University Press.*—Photo-Elasticity, Prof. E. G. Coker and Prof. L. N. G. Filon. *Chapman and Hall, Ltd.*—The Supply of Water, T. H. P. Veal; The Automatic Stabilisation of Ships, T. W. Chalmers; Photogrammetry: Collected Lectures and Essays, edited by O. von Gruber, translated by G. T. McCaw and F. A. Cazalet; Steel Structures: Examples of Modern Competitive Design, P. Russell and G. Dowell; Airless Injection Heavy-Oil Engines, revised translation by J. Calderwood and G. R. Hutchinson, from the German of Dr. F. Sass; The Wireless Valve: Its Design and Manufacture, A. C. Bartlett and M. Thompson. *Crosby Lockwood and Son.*—Chemical Engineering as Applied to the Cement Rotary Kiln, Dr. G. Martin; Electricity for Coal Mining Students, J. Stevenson and W. Miller; Central Heating and Hot Water Supply, G. C. Sanford; Angles on Practical Flying, P. W. F. Mills. *Longmans and Co., Ltd.*—Modern Practice in Mining, Vol. 5: Colliery Machinery and its Application, Sir Richard Redmayne; The Elements of Machine Design, Prof. W. C.

Unwin and Prof. A. L. Mellanby, Part 2, new edition. *Oxford University Press.*—The Internal Combustion Engine, D. R. Pye. *Sir Isaac Pitman and Sons, Ltd.*—Gliding and Motorless Flight, C. F. Carr and L. Howard-Flanders.

Geography and Travel.

George Allen and Unwin, Ltd.—Thirty Years in the Golden North, J. Welzl, translated by P. Selver. *Edward Arnold and Co.*—Himalaya, Karakorum and Eastern Turkestan (complete Account of the Expedition of 1913–14, with additions from the latest data), Filippo de Filippi, translated by H. T. Lowe-Porter. *Kegan Paul and Co., Ltd.*—The Travels of Marco Polo, translated from the text of L. F. Benedetto by Prof. A. Ricci, with an Introduction by Sir Denison Ross (Broadway Travellers). *G. Routledge and Sons, Ltd.*—Across the Gobi Desert, Sven Hedin. *Charles Scribner's Sons.*—Paradise Quest, L. S. Crandall.

Geology, Mineralogy and Mining.

Chapman and Hall, Ltd.—A Key to Mineral Groups, Species and Varieties, Dr. E. S. Simpson. *Methuen and Co., Ltd.*—Dalradian Geology: The Dalradian Rocks of Scotland and their Equivalents in other Countries, Prof. J. W. Gregory (Methuen's Geological Series). *Oxford University Press.*—Firedamp Explosions and their Prevention, W. Payman and Prof. I. C. F. Statham.

Mathematical and Physical Sciences.

Cambridge University Press.—An Introduction to the Mathematics of Map Projections, R. K. Melluish; Partial Differential Equations of Mathematical Physics, Dr. H. Bateman; Cartesian Tensors, Dr. H. Jeffreys; The Teaching of Mathematics, planned by C. Godfrey and A. W. Siddons; A Higher Course Geometry, H. G. Forder, 2 parts. *J. and A. Churchill.*—Recent Advances in Physics (except Atomic), Prof. F. H. Newman. *Longmans and Co., Ltd.*—Vision and Colour Vision, Dr. R. A. Houstoun; Elementary Calculus, F. Bowman, Part 1; Elementary Trigonometry, Dr. J. Prescott and H. V. Lowry. *Methuen and Co., Ltd.*—The Theory of Groups and Quantum Mechanics, Prof. H. Weyl, translated by Prof. H. P. Robertson; The Elements of the New Quantum Mechanics, O. Halpern and H. Thirring, translated by Dr. H. L. Brose; Thermionic Vacuum Tubes, Prof. E. V. Appleton. *Oxford University Press.*—An Introduction to the Theory of Functions of a Complex Variable (Taylor Series), P. Dienes; Constitution of Atomic Nuclei and Radioactivity, G. Gamow; The Theory of Electric and Magnetic Susceptibilities, Prof. J. H. Van Vleck. *Charles Scribner's Sons.*—Signals from the Sun, Dr. G. E. Hale.

Medical Science.

A. and C. Black, Ltd.—A Text-Book of X-ray Therapeutics, Dr. R. Knox, new edition, completed and edited by Dr. W. M. Levitt. *Cassell and Co., Ltd.*—The Cause of Cancer, Drs. W. E. Gye and W. J. Purdy. *J. and A. Churchill.*—Recent Advances in Materia Medica, Dr. J. H. Burn; Practical Pharmacognosy, T. E. Wallis, new edition; Clinical Lectures in Physiological Medicine, Dr. H. Yellowlees; Surgical Pathology, Dr. C. F. W. Illingworth and Dr. B. M. Dick. *Longmans and Co., Ltd.*—Biology for Medical Students, C. C. Hentschel and Dr. W. R. I. Cook; Dental Surgery and Pathology, Sir J. F. Colyer and E. Sprawson, new edition. *Oxford University Press.*—Dynamic Retinoscopy, M. Dobson; Fundus of the Human Eye, E. Clarke. *Kegan Paul and Co., Ltd.*—The Genesis of Cancer, W. S. Handley.

Metallurgy.

Chapman and Hall, Ltd.—Faraday and his Metallurgical Researches, with special reference to their influence on the Development of Alloy Steels, Sir Robert A. Hadfield, Bart.; Protective Films on Metals, Dr. E. S. Hedges; An Outline of the Heat-Treatment of Aluminium and its Alloys, N. F. Budgen; Electro Deposition of Chromium, D. J. Macnaughton.

Meteorology.

Cambridge University Press.—Manual of Meteorology, Vol. 4, Meteorological Calculus: Pressure and Wind, Sir Napier Shaw, with the assistance of Elaine Austin.

Miscellany.

G. Bell and Sons, Ltd.—Water Diviners and their Methods, H. Mager, translated from the French. *John Murray.*—The Science Master's Book of Experiments, general editor, G. H. J. Adlam, 2 vols., Part 1: Physics; Part 2: Chemistry and Biology. *Williams and Norgate, Ltd.*—The Methods of Statistics, L. H. Tippett; Science and Human Experience, Prof. H. Dingle; Science To-day and To-morrow (compiled from a Series of Lectures delivered at Morley College).

Philosophy and Psychology.

George Allen and Unwin, Ltd.—The Six Ways of Knowing, D. M. Datta. *Cambridge University Press.*—A History of Indian Philosophy, Surendranath Dasgupta, Vol. 2. *Methuen and Co., Ltd.*—Contemporary Schools of Psychology, Prof. R. S. Woodworth; Abnormal Psychology: Its Concepts and Theories, Prof. H. L. Hollingworth; An Introduction to Social Psychology, Prof. W. McDougall, new edition; The Use of the Self, in Relation to Functioning, Diagnosis and Human Reaction, F. M. Alexander. *Oxford University Press.*—Philosophies of Beauty from Socrates to Robert Bridges, being the Sources of Æsthetic Theory, selected and edited by E. F. Carritt; Proceedings of the Seventh International Congress of Philosophy: The Emergence of Life, J. B. Burke; A History of Psychology in Autobiography, edited by Prof. C. Murchison, Vol. 2. *Kegan Paul and Co., Ltd.*—The Psychology of Men of Genius, Prof. E. Kretschmer; Outlines of the History of Greek Philosophy, E. Zeller, new edition, rewritten by Dr. W. Nestle and translated by L. R. Palmer; The Psychology of Children's Drawings, H. Eng; Invention and the Unconscious, J. M. Montmarson; The Development of the Sexual Impulses, R. E. Money-Kyrle.

Technology.

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"momentum of the system" to explain his observations on the behaviour of the motor neurones of spinal reflexes.

Rumours have persisted that a remnant of the once large herd of European bison which inhabited the Caucasus had survived the period of the War and the succeeding days when the herd proper was slaughtered for food by the distressed people of the district. In the early part of 1931, according to a bulletin issued by Science Service (Washington, D.C.), a Russian zoologist, M. Schaposnikov, set out to discover the truth or otherwise of these rumours, and his failure to report progress or to return has suggested that he may have fallen a victim to bandits. In the absence of any wild representatives of the European bison (or wisent), the only survivors consist of specimens in zoological gardens, and these at the beginning of the present year numbered sixty-one—thirty-two cows and twenty-nine bulls, including six calves born during 1930. During 1931, one bull calf and two heifers were born, but one of the heifers died. In addition, there exist a number of hybrid animals, the results of crosses with the American bison, but these, of course, cannot be reckoned in a wisent count.

In many districts in England and Scotland the national grid of high-tension wires is now very conspicuous. In the Faraday centenary number of the *Times*, published on Sept. 21, Mr. P. V. Hunter points out that soon the subsidiary systems connected with it, operating at 30,000, 11,000, and 400 volts, will, so far as capital cost and magnitude of operations are concerned, be even more important than the grid itself. The British grid operates at 132,000 volts, and differs from similar networks abroad mainly by its very high factor of safety mechanically and the unusually high lattice towers used when it spans navigable estuaries. Mr. Hunter points out that there would be many advantages if underground cables were used for the subsidiary systems operating in agricultural and rural districts. These cables would not need to be armoured or otherwise carefully protected against accidental damage by other excavators, as they have to be in cities and in urban districts. He computes that if their cost does not exceed fifty per cent that of overhead conductors, then from the commercial point of view they would be more desirable. The better service, the better voltage distribution, the longer life, and the lower maintenance cost of the cables will more than offset their increased capital cost. The oil-filled cable which is being tried in certain situations is, at least as at present developed, of limited application, on account of the difficulties and expense of the necessary auxiliary equipment, especially where parts of the cables are at different levels. With our present knowledge it should not be difficult to make a cheap cable suitable for rural districts. As the great bulk of the lower pressure distribution systems have yet to be constructed, it is to be hoped that such cables will soon be forthcoming.

The fortieth Annual Report of the Royal Society for the Protection of Birds makes an appeal for the clearing off of the debt still remaining upon the Romney Marsh Sanctuary. The step taken in the purchase of 140 acres of Romney Marsh was the direct answer—the only practical answer from England so far as is apparent—to the findings of the International Conference for the Protection of Migratory Wildfowl, held in 1927. At this conference a recommendation was made that there should be established in all countries winter sanctuaries where wildfowl might obtain a respite from constant pursuit and persecution. The Society, inspired by the recommendation, secured an excellent and varied area in Romney Marsh, the nucleus of which was purchased in 1928, but expenditure is required for the preparation of the land, for the provision of further cover for the birds, and for protecting boundaries. Up to the end of 1930, £1455 had been contributed in special donations, a considerable sum has been allocated from the general account (shown in the Report as £1995), but a sum of £639 is still required to meet the overdraft at the bank. The Society carries on an inestimable work on behalf of British bird life—its expenditure for 1930 on behalf of watching, lighthouse protection, oil pollution, and education amounted to £2230—and we commend the final appeal for the Romney Marsh Sanctuary to all bird-lovers.

In the *Westinghouse International* for August, H. E. Dralle points out that there is great scope for the use of electricity as a motive power in the development of the Rumanian oilfields. Owing to the lack of transport facilities, development there was very slow before 1900. Many of the wells are thousands of feet deep, and so, although labour is very cheap, the cost of drilling them is high. Owing to the sandy nature of the soil, a successful method of pumping has not yet been invented and bailing is in general use. At some of the wells either flowing or being bailed, it is a common sight to see from four to sixteen people (men and women) standing up to their knees in pits of oil and cleaning away the huge quantities of sand that are brought up with the oil. When electric power is used for the drilling systems, it is necessary, owing to the presence of large quantities of inflammable gas, to use apparatus that makes no sparks or has been made gas-proof. For this reason also, the boilers which supply the wells with steam are located at least 2000 feet away from the nearest well. Transmitting steam at this distance at a pressure of 100 lb. per sq. in. presents many difficulties. At the present time the oil transportation is mainly by tank motor-car. Owing to the cost of the necessary electric pumping stations, it is doubtful whether pipe lines would be economical.

The weather in England is a perpetual subject of interest, but nothing can give such substance to its consideration as the scientific correlation of its vagaries with the progress of plant and animal life in these islands. The Phenological Report for 1930 of the Royal Meteorological Society, therefore, is a very welcome document. The official verdict of 1930 is that it was a "wet year", and vegetation in general was a little later than the average for the past thirty-five years.

Apparently similar climatic conditions spread beyond the British Isles, else how can we account, to take one of the sets of phenomena discussed in the Report, for the late arrival of spring immigrants amongst birds, which cannot be seriously affected by conditions at the end of their migratory journey. A comparison of the lines of equal arrival dates of twenty species of birds in 1930 with those of the preceding year, shows that on the south coast of England arrival was delayed for three days, and that this delay affected the movements of the birds even to the north-east of Scotland, where a delay of the same period was noted. In both years, therefore, the progress of migration within these islands, from the Channel coasts to northern Aberdeenshire, occupied fifteen days, although it was almost a week later before the migrants penetrated to the inland districts. A new chart appears in the Report, showing the autumnal isophenes of the departure of the swift, swallow, and house-martin and arrival of the fieldfare and redwing, and this indicates a slower through-country movement, covering thirty days. Thus definite records substantiate a distinction which has been recognised in a general way between the characters of the spring and autumn migrations of birds.

In a series of five illustrated articles in the *Engineer* from July 31 to Aug. 28, a review is given of modern methods of geophysical surveying. The subject is dealt with under the headings: the magnetic method, the gravitational method, electrical methods, and the seismic method. The theory of each method is discussed, the instruments used are described and illustrated, and some examples are given of successful geophysical surveys. Discussing the relative uses and application of the various methods and the place that they must take in physics and geology, the writer says the magnetic method finds a place in the equipment for any kind of geophysical surveying owing to its rapidity, but used alone the results obtained are sometimes of doubtful value, largely owing to the fact that the magnetic properties of materials are not so completely understood as are the properties made use of in other methods. The gravitational method suffers more than any other from the influence of topographical features, but it has the advantage that its theory is well understood. Electrical methods suffer from the disadvantage that the strength of the electrical indications falls off with disconcerting rapidity with increase of the depth explored, and are suitable for detailed investigations rather than large-scale surveys. On the other hand, the seismic method is well suited for large-scale survey, and is particularly valuable where stratification exists. It has been used with great success for the discovery of salt domes in the neighbourhood of which oil is to be found, and has been used extensively in America and by the Anglo-Persian Oil Company, Ltd.

In ancient Indian carvings may be found represented a beast called by Sanskrit writers the water-elephant; this is depicted as a creature with the fore-parts of an elephant and the hind-parts of a fish, and might pass as a purely imaginary creature were it not for the fact that there are no tusks or ears, that the dentition given is that of a carnivore, with the characteristic canines, and that the trunk is abnormally short. These peculiarities suggest that the carvings are a rude attempt to portray the sea-elephant or elephant seal, which may once have ranged, if only occasionally, as far north in the Indian Ocean as it does in the Pacific to-day. At any rate, one of the diving-petrels—southern ocean birds which are not long-distance flyers—was believed to have been seen in Indian waters a century ago by Sundevall, and in our time by the writer of the present note; and in the *Field* for Aug. 22 (p. 300), G. Dickson, of Cape Town, publishes a photograph of what the editor very properly says is a young sea-elephant, taken at Cape Point. The suggestion is made that it had escaped from captivity, but the species is very rare in that condition, and, in view of the archæological evidence given above, a natural occurrence is at least possible.

Prof. Willem de Sitter, director of the Leyden Observatory, was elected an honorary member of the American Astronomical Society at the recent meeting at the Perkins Observatory, Delaware, Ohio. The Society has elected the following new officers: *President*, W. S. Adams; *Vice-President*, C. G. Abbot; *Councillors*, J. C. Hammond, P. W. Merrill, H. H. Plaskett. Benjamin Boss was re-elected treasurer, and R. S. Dugan, secretary.

Having reached the statutory age for retirement, Mr. H. A. Hunt has retired from the position of meteorologist to the Commonwealth of Australia. Mr. W. S. Watt has been appointed his successor as from April 23, 1931.

Dr. C. B. Bridges, of the California Institute of Technology, Pasadena, will give an address on "Genic Balance and Related Problems" at a meeting of the Genetical Society, to be held in the rooms of the Linnean Society at Burlington House at 3.30 p.m. on Oct. 19.

The R.R.S. *Discovery II*, which was visited by many members of the British Association while she lay at St. Katherine's Dock, Tower Bridge, left on Oct. 3 for the Antarctic. The cruise is expected to last two years, and the work to be carried out will be mainly a continuation of the scientific investigation of the whaling industry.

On Oct. 5, two American airmen, Mr. Herndon and Mr. Pangborn, completed a flight of 4465 miles across the Pacific Ocean from Sabushiro Beach, Japan, to Wenatchee, Washington. This is the first non-stop flight from Japan to the United States, and was accomplished in 41 hours 13 minutes.

The opening meeting of the session of the Institution of Automobile Engineers took place at the Royal Society of Arts on Oct. 1. After Sir Herbert Austin had introduced Mr. W. A. Tookey, the president for the session 1931–32, to the chair, he was presented by Mr. Tookey with a commemorative certificate and badge. Mr. Tookey then delivered his presidential address, entitled "The Internal Combustion Engine and its Performance ". The Crompton Medal, which is awarded annually by the Council of the Institution of Automobile Engineers for the best paper read before the Institution during the session, has been awarded for the session 1930–31 to Dr. S. J. Davies and Mr. E. Giffen, of King's College Engineering Department, for their paper entitled "Injection, Ignition, and Combustion in High Speed, Heavy-Oil Engines ".

Sir Wilfred Grenfell, in an article in the *Times* for Sept. 14, directs attention to the uncharted state of the greater part of the coast of Labrador. The coastal waters have been frequented by fishing boats for cod for many years, and, nevertheless, the charts are so inadequate that north of Cape Harrison they are, according to Sir Wilfred Grenfell, no use whatever to the navigator who has no personal knowledge of the coast. An aerial survey is now in progress, and the American Geographical Society is bearing the cost of constructing the map from the negatives. The British Admiralty is to begin surveying the coastal waters next year, so that before long this gap in the survey of the Empire will have been filled.

Mr. H. V. Garner, guide demonstrator of the Rothamsted Experimental Station, and other members of the staff of the institution are offering their services during the forthcoming winter in giving lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. No fee will be charged for such lectures; but any association arranging such engagements must defray all expenses of the lecturer. Mr. Garner is offering several subjects, dealing chiefly with various forms of manuring. Subjects offered by other lecturers are: soil micro-organisms, Dr. H. G. Thornton, Mr. D. W. Cutler; agricultural botany, Dr. Winifred Brenchley; agricultural chemistry, Dr. E. M. Crowther, Dr. H. L. Richardson; soil physics, Dr. R. K. Schofield, Mr. G. W. Scott Blair; entomology, Dr. H. F. Barnes, Mr. D. M. T. Morland; mycology, Dr. W. B. Brierley, Dr. J. Henderson Smith, Dr. J. Caldwell, Mr. R. H. Stoughton. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

The Society of Glass Technology, with the support of the Glass Research Delegacy, is arranging an exhibition to illustrate the development of glass technological research in modern times. The exhibition, which is being accommodated in the Science Museum, South Kensington, London, will be opened by Sir Richard Gregory on Oct. 21, and will probably remain open until at least the end of November, and if possible, until the close of the year. Glass demonstrating the best chemical and physical properties for optical, illumination, electrical, mechanical, and artistic purposes will be shown. Processes in glass-works will be illustrated by photographs and specimens. A series of lectures on various kinds of glass is being arranged for Thursday evenings.

The *Proceedings of the South London Entomological and Natural History Society* for 1931–32 contain, as usual, besides the reports of meetings, several articles of interest. Mr. H. M. Edelsten writes on the British species of *Nonagria* and their habitats, while Mr. A. E. Tonge contributes an article on the ova of many of the British Lepidoptera, illustrated by three excellent photographic plates. In his address, as retiring president of the Society, Mr. C. N. Hawkins deals with numerical variation in the ecdyses of lepidopterous larvæ, and collects together in convenient compass a good deal of data on the subject. We note from the treasurer's report for 1930 that the financial position of the Society is sound, with a substantial balance carried forward.

Two years ago the Division of Plant Industry of the Australian Council for Scientific and Industrial Research commenced a compilation of known Australian fungi (pathogenic and saprophytic), the work being carried out by Mr. C. C. Brittlebank, formerly mycologist to the Victoria Department of Agriculture. No systematic list had been prepared since 1895, when Mr. D. McAlpine recorded 2284 species and 415 hosts. The new catalogue contains more than 56,000 references to literature recording 6078 distinct species (with nearly 5000 synonyms) and 1343 hosts. State Government departments and universities in Australia have co-operated in its preparation, and material assistance has been given by the Imperial Institute of Mycology, Kew. The catalogue will now be kept up to date and should prove very useful to mycological investigators.

The chapter on plant virus diseases from vol. 7 of "A System of Bacteriology in relation to Medicine ", published by the Medical Research Council of the Privy Council (see Nature of Feb. 21, 1931), has been issued in pamphlet form. The article is by Dr. J. Henderson Smith, of the Rothamsted Experimental Station, and although only twelve pages in extent, it gives a remarkably full account of our present knowledge of these maladies. The economic damage caused by virus diseases is mentioned, and a comprehensive description of symptoms is given. Cytology, ætiology, and the various characteristics of virus extracts are dealt with, and considerable space is devoted to descriptions of transmission and specificity. It is interesting to note that even at the end of 1928, virus diseases had been reported on 264 species of plants. Many new diseases have been described since then, and it seems that the science of ' virology ', as some workers term it, will eventually rank with bacteriology and plant pathology.

Mr. R. S. Frampton, 37 Fonthill Road, N.4, has sent us a copy of his catalogue (No. 65) of books, nearly a thousand in all, on natural history subjects. The prices asked appear very reasonable.

A list (No. 188) of some 432 second-hand works dealing mainly with floras of Europe, Asia, Africa, America, and Australia has just been issued by Messrs. Dulau and Co., Ltd., 32 Old Bond Street, W.1, and is worthy of perusal.

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.]*

Doppler Effect in Light-Scattering.

IT is a problem of great interest to consider the changes in spectral character of monochromatic radiation resulting from the thermal agitation of a medium in which it is scattered. If we regard the subject classically, the result to be expected is obvious: there should be a Doppler broadening of the incident spectral line, varying with the angle of observation, and determined by the Maxwellian distribution of velocities of the molecules which scatter the light. It can readily be shown that, except in respect of the total intensity of scattered light, it would make no difference to the argument by which this result is deduced whether the molecules are loosely distributed as in a gas or are closely packed together as in a dense vapour or liquid.

It is very remarkable, however, that a wholly different result was deduced by L. Brillouin,[1] following the idea that the medium which scatters the radiation can be treated as a continuum filled with moving sound-waves of various wave-lengths which reflect the light-waves much in the same way that a moving crystal would give Bragg's reflection of X-rays. Brillouin's theory indicates that in the spectrum of the scattered rays the single line which represents the incident light should be replaced by a close doublet, the frequency shifts of which are given by the formula $\Delta\nu/\nu = \pm 2a/c \sin \frac{1}{2}\theta$, where a and c are the velocities of sound and light respectively, and θ is the angle of observation; the incident line itself would be missing in the scattered light. Brillouin's deduction of this formula has outwardly the appearance of being based on classical ideas. Actually, however, the argument ignores the existence of discrete molecules in the medium, and the results to which it leads cannot be reconciled with the classical point of view, according to which the incident line should persist in the scattered light in the same position with no change except a Doppler broadening.

The paradox presented above is resolved if we adopt the following view of the matter based on quantum principles. In a medium scattering light we are dealing with an assemblage of photons having energy $h\nu$ and momentum $h\nu/c$, material particles having translatory energy $\frac{1}{2}Mv^2$ and linear momentum Mv and also associated with the latter, quanta of sound, having energy $h\nu_s$ and linear momentum $h\nu_{s/a}$. The result of an individual encounter must satisfy the equations of the Compton type:

$$\tfrac{1}{2}Mv^2 + h\nu_s + h\nu_l = \tfrac{1}{2}Mv'^2 + h\nu'_s + h\nu'_l$$

$$\overrightarrow{Mv} + \overrightarrow{h\nu_{s/a}} + \overrightarrow{h\nu_{l/c}} = \overrightarrow{Mv'} + \overrightarrow{h\nu'_{s/a}} + \overrightarrow{h\nu'_{l/c}}.$$

The first is a scalar and the second is a vector equation. We obtain Brillouin's result immediately, if the energy and momenta of the material particles are ignored, and the equations are solved. If, on the other hand, the energy and momenta of the sound quanta are ignored, and the equations are solved, the classical Doppler broadening results. These are, however, two extreme cases, and in general both types of phenomena may be expected to be present and to influence each other.

It must here suffice to remark very briefly that the considerations set out above enable us readily to offer a satisfactory interpretation of the experimental results recently reported by Gross[2] on the modification of the fine structure of spectral lines produced by scattering in liquids and solids.

C. V. RAMAN.

210 Bowbazar Street,
Calcutta, Sept. 5.

[1] *Annales de Physique*, vol. 17, p. 88; 1922.
[2] NATURE, vol. 126, pp. 201, 400, 603; 1930; and *Zeit. für Physik*, vol. 63, p. 685; 1930.

Activated Adsorption of Hydrogen by Zinc and Chromium Oxides.

THE adsorption of hydrogen by zinc oxide has been the subject of investigation[1] by one of my students, Mr. D. V. Sickman, on a so much more comprehensive scale than that recently recorded by Garner and Kingman[2] that it seems desirable to state the results in outline prior to their publication some months hence.

A slow adsorption of hydrogen on zinc oxide (from the oxalate by ignition at 400° C.) occurs from 0° C. upwards. On 20 grams of material at *circa* 400 mm. pressure adsorption reached 2·9 c.c. in 1345 minutes at 0° C.; at 110° C. the velocity of adsorption increased so that 7·25 c.c. were adsorbed in 1200 minutes; at 184° C. this same amount was adsorbed in 45 minutes and as much as 14 c.c. were adsorbed in the longer time interval. The adsorption is reversible, *all* the hydrogen being recoverable by evacuation at 450° C. The activation energy of the adsorption amounts to 14 kgm. cal. for the main surface covered, with smaller values on the more active areas. By a new mathematical analysis of the velocity measurements Sickman has deduced[1] a heat of adsorption of 21 kgm. cal. per mol, a more trustworthy figure than a value of 16 kgm. cal. deduced from isotherms at high temperatures on a partially deactivated surface. The higher value is in excellent agreement with the value recorded by Garner and Kingman for the heat of adsorption of hydrogen on their $ZnO - Cr_2O_3$ catalyst. This would indicate, as they conclude with respect to carbon monoxide, that the hydrogen is adsorbed on the zinc oxide of the mixed material.

Below 0° C. another type of adsorption occurs which attains equilibrium practically instantaneously with no activation energy. The heat of this adsorption is only 1100 calories per mol. As much as 21 c.c. at −190° C. and 3 c.c. at −78° C. are adsorbed on 20 grams of oxide at 400 mm. From the data cited it can readily be calculated that this type of adsorption is negligible at 0° C.

We are inclined to ascribe the minute adsorption of hydrogen found by Garner and Kingman on the single oxides of zinc and of chromium to the slowness with which activated adsorption occurs at ordinary temperatures on the single oxides in comparison with the rate of adsorption on the mixture.[3] That hydrogen is markedly adsorbed in an activated form by chromium oxide is evident from work by Sherman and the writer in which precipitated chromium oxide (ex nitrate) has been shown to be effective in producing the change from para to ortho-hydrogen at ordinary temperatures. This, as we have already shown,[4] is intimately associated with activated adsorption of hydrogen at such surfaces.

HUGH S. TAYLOR.

The University, Manchester,
Sept. 14.

[1] Thesis, Princeton, (1931).
[2] Garner and Kingman, *Trans. Farad. Soc.*, **37**, 322; 1931.
[3] Cf. Taylor and Williamson, *J. Am. Chem. Soc.*, **53**, 813, 2168; 1931.
[4] Taylor and Sherman, *J. Am. Chem. Soc.*, **53**, 1614; 1931.

Origin of Chromosome Linkage in *Œnothera*.

SEVERAL years ago the hypothesis was put forward that in *Œnothera* new species have arisen through crossing and been perpetuated by the chromosome linkage which, it was assumed, had arisen as a result of crossing between unrelated species (Gates, 1928).[1] It has recently been possible to test this hypothesis experimentally, with results which show that chromosome linkage (catenation)[2] can arise when species or mutants showing no catenation are crossed together.

It is known from previous work that *Œ. deserens* and *Œ. blandina*, both of which are secondary mutant derivatives from *Œ. Lamarckiana*, have seven free pairs of chromosomes in meiosis, and that the same condition exists in *Œ. purpurata*, a species described from Germany by Klebahn.[3] Reciprocal crosses were made between these three forms, which thus furnish us with a triangle of species in which the bivalent chromosomes were all unlinked in meiosis.

A preliminary examination of some of the F_1 hybrids shows the following catenations: *deserens* × *blandina*, ring of 6 and 4 pairs; *deserens* × *purpurata*, ring of 4 and 5 pairs; *blandina* × *purpurata*, ring of 4 and 5 pairs. In all three crosses catenation has thus arisen through hybridisation between forms having only paired chromosomes.

The view is thus experimentally confirmed that the species of *Œnothera*, most of which show catenation, have arisen through crossing between previous species and breed true because of the genetic linkage resulting from that catenation. That heterozygous species can breed true because of apogamous reproduction is a familiar conception. That they can breed true because of catenation (linkage) of the chromosomes in meiosis is not generally recognised, but is now well known in *Œnothera*.

Without going into details, it seems clear that the chromosome-complexes of *deserens* and *blandina* have become different by two chromosome segmental interchanges, involving three non-homologous chromosomes. The results of crossing these forms with *Œ. purpurata* may be explained on the assumption that *purpurata* differs from *blandina* by one of these segmental exchanges and from *deserens* by the other.

A full account of this work and its bearing on problems of chromosome linkage will be published later.

R. RUGGLES GATES.
D. G. CATCHESIDE.
King's College, London,
Sept. 22.

[1] *Zeit. für Abst. u. Vererb.* Suppt. Vol., p. 752. *Bibliographia Genetica*, vol. 4, p. 480.
[2] Gates, "The Cytological Basis of Mutations", *Amer. Naturalist*, vol. 65, p. 97; 1931.
[3] See Gates and Goodwin, *Proc. Roy. Soc.*, B, in press.

Magnetic Resolution and Nuclear Moment of Rhenium.

FOR some time the spectrum of rhenium has been the subject of investigation in the Amsterdam Laboratory "Physica". With the Hilger E_1 quartz spectrograph we have studied the spectrum of the arc and of the underwater spark. The hyperfine structure and the magnetic resolution have been investigated with the 20-ft. grating in an Eagle mounting.

The following strong complex arc lines: λλ3465; 3460; 3452; 3424; 3399 A., which give absorption in the underwater spark and therefore should be considered as combinations with the ground-level ($d^5 s^2\,{}^6S_{5/2}$), are of special interest. Meggers[1] has identified the first three lines as the combinations ${}^6S_{5/2} - {}^6P_{5/2\,7/2\,3/2}$.

From the number of satellites and from the interval rule we conclude that the hyperfine structure originates from the $d^5 sp\,{}^6P$-term, and that the nuclear moment of rhenium is $\frac{5}{2}$, as was suspected by Gremmer and Ritschl.[2]

The hyperfine structure in the Zeeman components of the line λ3460 ${}^6S_{5/2} - {}^6P_{7/2}$ has been resolved. The strongest σ component is split up into six nearly equidistant hyperfine structure components, which indicate also that the nuclear moment is $\frac{5}{2}$. The mean distance of these components is 0·334 cm.$^{-1}$ and gives an interval constant a of 0·095 cm.$^{-1}$ in accordance with the value 0·096 cm.$^{-1}$ obtained from the hyperfine structure without magnetic field. On these six components are partly superposed more feeble groups of non-resolved σ-components.

It seems that the ${}^6P$-term has a slightly anomalous g-value, 1·76 (normal value, 1·714). The observed values for the six subcomponents of the strongest σ-components and the values calculated with $g = 1·76$ and the interval constant of the hyperfine structure without magnetic field are given below. Magnetic field: 38,900 gauss.

Obs.	+2·91	+2·62	+2·24	+1·95	+1·60	+1·25
Calc.	+2·94	+2·60	+2·26	+1·93	+1·59	+1·26
Obs.	−2·90	−2·60	−2·28	−1·93	−1·61	−1·24
Calc.	−2·94	−2·60	−2·26	−1·93	−1·59	−1·26

We are expecting to make a further report as soon as the investigation can be completed.

P. ZEEMAN.
J. H. GISOLF.
T. L. DE BRUIN.
Laboratory "Physica",
University of Amsterdam,
Sept. 16.

[1] Meggers, *Phys. Rev.*, 37, 219; 1931.
[2] Gremmer und Ritschl: *Zeit. für Instrumentenkunde*, 51, 170; 1931.

Infra-Red Absorption Spectrum of Carbonyl Sulphide.

RECENT developments in the theory of band spectra in the infra-red[1] lend particular interest to all new experimental results for triatomic molecules. We have recently examined the absorption spectrum of carbonyl sulphide, making use of a monochromator method in order to avoid the photochemical decomposition to be expected on exposure of this substance to the full energy of a Nernst filament. We find a complicated spectrum—a fact which in itself demonstrates the lack of symmetry in the molecule: the results are summarised in Fig. 1. In the few cases in which the bands have been resolved, the separation between the P and R branches is given.

In assigning observed bands to certain fundamental frequencies with their corresponding overtones and combinations, due consideration has to be paid to their relative intensities, which are dependent upon the magnitude and orientation of the effective electric doublets concerned. The latter will be governed by the configuration of the molecule; when this is known, the deduced moments of inertia, the interatomic angles and separations must agree with those obtained by other physical methods, such as X-ray analysis or electron diffraction. Finally, the molecular structure must tally with known chemical and thermochemical data.

We have explored at some length the mechanical possibilities of a system of three different masses having various force constants with (*a*) covalent and (*b*) ionic linkings; the tedious calculations involved have at least enabled us to discard certain forms, but we believe we are justified in directing attention to this particular piece of work, inasmuch as it illustrates the need for cautious statements on such matters.

In spite of the experimental detail available, we find ourselves unable to pronounce definitely for either a rectilinear or a triangular structure: if the latter, our results and deductions are more consistent within themselves, but they seem to require two modifications of the substance; if the former, agreement is obtained with Vegard's recent X-ray analysis at the temperature of liquid air,[2] which demands a straight line molecule. Furthermore, thermochemical data indicate that the types of binding in carbon dioxide and carbon disulphide are probably those which exist in carbonyl sulphide.

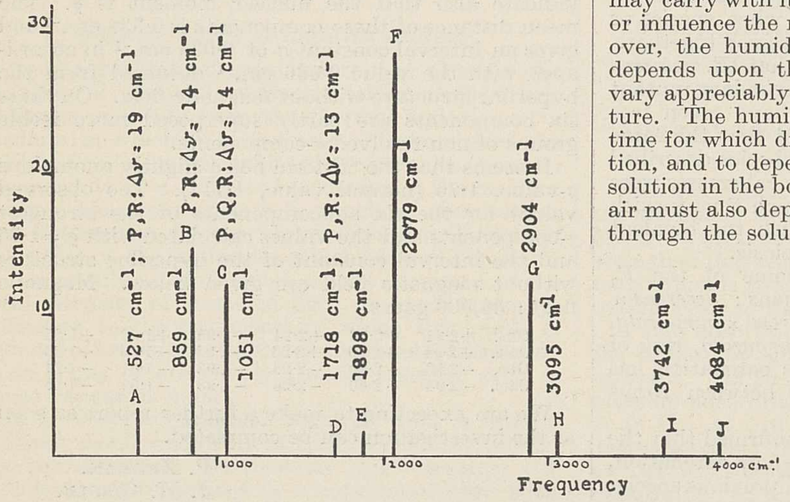


Fig. 1.—The near infra-red absorption spectrum of carbonyl sulphide.

It is unfortunate that no determination of the Raman spectrum has been attempted; this is probably a consequence of the ready photochemical decomposition, but perhaps something might be done by examining the light scattered from the crystals at low temperatures.

C. R. Bailey.
A. B. D. Cassie.

The Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College, London,
Aug. 29.

[1] Dennison, *Reviews of Modern Physics*, vol. 3, p. 280; 1931.
[2] *Zeit. Krist.*, vol. 77, p. 411; 1931.

A Method of Obtaining Air Currents of Different Humidities.

For various experiments in which the change of a physical property with the humidity of the surrounding air has to be studied, for example, the calibration of a hair hygrometer, it is necessary to have some means of producing currents of air of different relative humidities. The usual method of attaining this in practice is to bubble air through wash bottles containing solutions of water and sulphuric acid of suitable strengths. A certain percentage of the acid in the solution gives rise to a certain definite humidity to the air in contact with it, and the bubbles of air through the solution are supposed to acquire this humidity.[1]

For some time past experiments have been in progress in this laboratory to investigate the changes in the electrical resistance of pencil lines due to varying humidities of the air to which they are exposed, with the view, ultimately, of evolving an electric hygrometer.[2] In these experiments air currents of different humidities were obtained in the above-mentioned manner. It was found, however, that changes in the resistance when exposed to varying humidities, though regular enough to encourage further experimentation for hygrometric purposes, were not as regular and reliable as one could wish. While investigating causes for such irregularities, they were traced, among other things, to the currents of moist air having been produced by bubbling it through sulphuric acid water mixtures.

It is not unlikely that the current of air so produced may carry with it traces of the acid, which may act on or influence the material under investigation. Moreover, the humidity imparted by a certain solution depends upon the temperature, and therefore may vary appreciably if there are large changes of temperature. The humidity also seemed to change with the time for which dry air was bubbled through the solution, and to depend on the 'empty' space above the solution in the bottle. The humidity of the outgoing air must also depend on the rate at which it is passed through the solution, and so may not always be the same as that which the strength of the solution indicates. Then, again, fresh solutions must be made for each experiment, and even then its strength may alter appreciably towards the end of an experiment if the bubbling has been continued long enough.

In order to get over these difficulties, a method has been devised of obtaining air currents of any required humidities without the above drawbacks. The principle is to mix a current of dry air, dried by any of the usual means, with a current of air saturated with moisture obtained by bubbling air through a bottle full of water. By regulating the strengths of the two currents, any desired humidity can be produced. The strength is regulated by turning a stop-cock or a pinchcock suitably placed in each of the two branches. Each of the two streams is then made to pass through a small, equal length of a capillary tube, whence it passes into a wider tube where the two mix before passing over the resistance. The two branches are also connected to two U-shaped oil manometers, the other ends of the manometers being connected together and to the wide 'mixing' tube.

From calibration curves giving the relationship between the pressure difference as indicated by the manometer when one of the branches is gradually opened, the other remaining closed, and the rate of flow of air as obtained from the volume, collected during a certain time, of water escaping from the aspirator or any other arrangement used to draw air through the apparatus, the humidity of the air in the mixer when both branches are working at any given rate of flow can be calculated. Production of different humidities is obtained by the regulation of the two cocks until, for the rate of flow in progress, the two manometers indicate the requisite pressure differences. An example will make this clear. Suppose the rate of flow is 60 c.c./min. and a 40 per cent relative humidity is sought. Evidently this can be brought about if the rate of flow of the saturated stream is 24 c.c./min. while that of the dry current is 36. Now from our calibration curves we find that a pressure difference of 5·75 cm. of the oil used corresponds with the rate of flow of 24 c.c./min. in the humid air branch and a pressure difference of 8·10 cm. with 36 c.c./min. in the other, dry air, branch. All that would be necessary then to get a 40 per cent humidity in the above case would be to regulate the two cocks so that the two manometers indicate the above-mentioned pressure differences respectively.

None of the disadvantages of the old method affects the new one, which also does away with the large number of wash bottles and attendant laborious manipulations which are needed in the old method, and which constitute yet another drawback to be added to the list given above. Credit for this new device and working out various details in connexion therewith is due to one of my students, Mr. Abdul Basir Pal.

It seems worth while to mention, before concluding, that by working with moist air obtained in this new way and at the same time arranging that the flow of air over the resistance took place at a constant rate, the changes in the resistance due to varying humidities were found by Mr. Pal to be much more regular, reliable, and repeatable than in previous experiments, and thus more helpful and encouraging towards the devising of our electric hygrometer. Full details will be published elsewhere.

J. B. SETH.

Physics Laboratory,
Government College, Lahore.

[1] *Proc. Phys. Soc.*, vol. 34, Discussion on Hygrometry.
[2] *Proc. Phys. Soc.*, vol. 41, p. 29, and *Phil. Mag.*, March 1930, p. 415.

Structure of the Azides, from their Electric Dipole Moments.

As is well known, the chemical evidence regarding the structure of the azides is far from being unambiguous, and four formulæ have been proposed,[1, 2, 3]

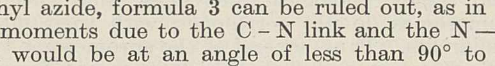
$$R-N\langle{}^{N}_{N}\|,\quad R-N=N\equiv N,\quad R-N=N\rightarrow N,\quad R-N\leftarrow N\equiv N.$$

1 2 3 4

Of these, 2 is ruled out because the central nitrogen atom would have a shared decet of valency electrons, which, for an element in the first short period, is impossible.

Lindemann and Thiele concluded from parachor measurements that the ring structure was the correct one, and it seemed to be of interest to apply other physical measurements to the solution of the problem. Accordingly, the electric dipole moments of phenyl azide, *p*-chlorphenyl azide, and *p*-tolyl azide have been determined and found to be 1·55, 0·35, and $1{\cdot}96 \times 10^{-18}$ e.s.u., respectively.

From the comparative smallness of the moment of phenyl azide, formula 3 can be ruled out, as in this the moments due to the C – N link and the N ⟶ N link would be at an angle of less than 90° to one another and would probably give a resultant moment of $3-4 \times 10^{-18}$ e.s.u. (compare nitrobenzene $M = 3{\cdot}9$ and di-phenyl-sulphoxide $M = 4{\cdot}1 \times 10^{-18}$ e.s.u.). It is possible to discriminate between the two remaining formulæ, because in 1 the negative pole of the group dipole would be farther from the benzene ring than the positive one,[4] while in 4 the reverse would be the case because of the direction of the co-ordinate link. From the moments of *p*-chlorphenyl azide and *p*-tolyl azide it is clear that actually the negative pole is farther from the benzene ring :[5]



Phenyl azide	$M = 1{\cdot}55 \times 10^{-18}$
Chlorbenzene	$M = 1{\cdot}56 \times 10^{-18}$
Toluene	$M = 0{\cdot}45 \times 10^{-18}$

and therefore the ring structure is the most probable of the three. There is, however, a still stronger argument in its favour.

It will be noticed that the moments of *p*-chlorphenyl azide and *p*-tolyl azide are almost exactly equal to the difference and to the sum, respectively, of the single group moments (the moment $0{\cdot}35 \times 10^{-18}$ of the *p*-chlor derivative corresponds to a polarisation of only 2·5 c.c. and by the method of measurement used it is impossible to distinguish this from zero, owing to the possible atom polarisation).[6] This indicates that the moment of the azide group lies almost exactly along the direction of the valency linking it to the benzene ring. Now, neither formula 3 nor formula 4 could lead to this, since the main moment would be in that part of the group which is inclined at an angle, not equal to 180°, to the C – N link. In the ring formula, however, the moment of the N = N link would be zero, and that of each N – N link, though the nitrogen atoms are not in exactly the same state of combination, would be almost zero. Therefore the only appreciable moment would be that of the C – N link itself, and this would explain the fact observed.

It is therefore fair to say that the evidence of the dipole moments is strongly in favour of the original ring structure.

L. E. SUTTON.

The Dyson Perrins Laboratory,
Oxford, Aug. 11.

[1] Curtius, *Ber.*, **23**, 3023; 1890.
[2] Thiele, *Ber.*, **44**, 2524; 1911.
[3] Lindemann and Thiele, *Ber.*, **61**, 1529; 1928.
[4] Hammick, New, Sidgwick, and Sutton, *Jour. Chem. Soc.*, p. 1876; 1930.
[5] J. J. Thomson, *Phil. Mag.*, **46**, p. 497; 1923: J. W. Williams, *Physikal. Zeit.*, **29**, p. 174 and p. 683; 1928: Hammick, New, Sidgwick, and Sutton, *Jour. Chem. Soc.*, p. 1876; 1930.
[6] Debye, "Polare Molekeln", Leipzig, 1929, p. 43.

Raman Spectra of Liquid Mixtures.

IT is well known that mixtures of polar liquids often exhibit marked deviations from the additive law in respect of such properties as density, vapour pressure, viscosity, and refractive index. Such changes taking place in aqueous solutions are usually attributed to the formation of definite hydrates. Important evidence concerning the constitution of liquid mixtures is furnished by a study of their Raman spectra. I have made a careful examination of the spectra of aqueous solutions of methyl alcohol, acetic acid, and pyridine over a series of concentrations, and have shown that marked variations occur in the spectra. The phenomena noticed include cases in which some Raman lines of the solute suffer displacements, or broaden or split up into components, or undergo changes in relative intensity.

It must suffice here to mention only the effects observed in acetic acid–water mixtures. These refer principally to the behaviour of the broad line of wave-number displacement 1667 found in the spectrum of pure acetic acid and usually attributed to the C = O bond in the molecule. Slight dilution of the acid to 95 per cent strength introduces a new faint component to this line at 1712 cm.$^{-1}$. The latter is observed to increase in intensity relatively to the first on further dilution to 90 per cent and 85 per cent concentrations. Finally, at 75 per cent, which corresponds nearly to the composition $CH_3 . COOH, H_2O$, only one broad line at 1712 cm.$^{-1}$ is present. Further dilution produced no change, except for a slight sharpening of the 1712 line.

From these observations, it would appear that a hydrate is formed of the composition mentioned. It may be remarked that the acetic acid solutions exhibit a point of maximum density at about the same concentration (77 per cent) at 25° C.

P. KRISHNAMURTI.

210 Bowbazar Street,
Calcutta, July 31.

Research Items.

An Archaic Egyptian Figurine.—M. G. Loukianoff describes and figures in *Ancient Egypt* for June 1930 a rare type of small figurine of ivory, purchased in Cairo in 1927. The figure is one and a half inches high, almost entirely black and remarkably heavy for its size, weighing 12·6 grains. It represents a seated infant with legs doubled back, and, as may be inferred from the inclination of the right arm, which is broken, and a mark on the lips, sucking its finger. The lips are a little twisted, as owing to the position of the finger in front of the mouth, the artist was unable to fashion them with an unbroken stroke. The left hand lies extended along the knee. The head is crowned by a little cap fitting close to the cranium. From the artistic point of view the minute accuracy of the work is to be remarked; while equally characteristic is the cast of the features, which is not Egyptian, the nose being large and the cheek-bones prominent. The attitude of the figure is that which was traditional for the infant Horus from the early dynasties to the decline of Egyptian civilisation. It is the same as that of the lapis lazuli figurines recently found in the tomb of Tutankamen, in which the Pharaoh is represented as the infant Horus. The motive of the present example is so exactly repeated in the alabaster figurine of Pepy II., found last year at Saqqara, that it would suggest an identity of date, if it were not that there is a still closer resemblance to the ivory statuettes of pre-dynastic date discovered by Petrie at Abydos and Ballas. The type is, indeed, very different from that of the early dynasties—a fact which immediately suggested its attribution to the archaic epoch of Egyptian art. It has been examined by Dr. Reisner, who pronounces it authentic and assigns it to Dynasties 0-2.

A Sea-lion Census.—In 1930 a census of the sea-lions off the coast of California was made, in view of the possibility that recommendations to the legislature might be desirable. It was made at the height of the breeding season, from mid-June to mid-July, and although no census was made in 1929, the figures made an interesting comparison with the censuses of the two previous years (Paul Bonnet, *California Fish and Game*, vol. 17, p. 150; 1931). Of Steller's sea-lion, with twelve rookeries the largest containing 2500 individuals, the grand total in 1930 was 6360, against 4593 in 1928 and 5781 in 1927. The California sea-lion, with eleven rookeries of which the largest had 340 individuals, numbered 968 in 1930, 1338 in 1928, and 892 in 1927. The presence of more Stellers in 1930 than in 1928 is attributed to migrations from the north, where the animals are still hunted under a bounty system; while the decreasing population of the California sea-lion is due to the unrestricted collecting and hunting of the previous two years. The casual shooting by fishermen of sea-lions in the neighbourhood of fishing operations does not seem to lower the population to any great extent, but the slaughter due to professional trimming hunters and to collectors who capture living specimens for zoos and circuses is a serious menace, and has brought about the material reduction and even the abandonment of several of the larger rookeries.

***Blepharoceridæ* of Japan.**—This small family of dipterous insects has a very wide distribution, and is remarkable on account of the peculiar morphological characters exhibited in the different post-embryonic stages. The larvæ and pupæ are particularly interesting in that they are aquatic and confined to rapid mountain streams. Until recently, only four species of the family were known from Japan, but neither their larvæ nor pupæ had been discovered. In *Memoirs of the College of Science*, Kyoto Imperial University (Series B, vol. 6, 1931), Mr. Sirô Kitakami describes the results of his researches on this family. His discoveries have led to the recognition of five genera and eighteen species in Japan. Of these, one genus, *Parablepharocera*, and fourteen species are described as being new, the largest number of species belonging to the genus *Philorus*. In the new genus *Parablepharocera*, the adult is distinguished from *Blepharocera* by the much longer vein Rs, and its larva bears a pair of finger-like processes on each side of the first six abdominal segments, together with a pair of caudal appendages. In *Blepharocera*, it may be added, neither type of organ is evident. In the pupal stage the two genera are scarcely separable from each other. The paper is well illustrated with ten plates of carefully drawn figures portraying structural characters of the different stages of the species described.

Chromosome Homologies in Wheat, Rye, and Aegilops.—In a paper on chromosome homologies in wheat, rye, and *Aegilops*, Prof. W. P. Thompson (*Canadian Jour. Research*, vol. 4, p. 624) summarises in a series of tables the results of crosses among members of these three related genera, as regards chromosome pairing in the hybrids. A number of workers have drawn various conclusions regarding the relationships of species from the way in which the chromosomes pair in their F_1 hybrids. In this way it has been concluded that the einkorn (diploid) wheats have an A set of seven chromosomes, the emmer (tetraploid) $A+B$ and the vulgares $A+B+C$; similarly that *Aegilops cylindrica* has $C+D$ sets and *A. ovata* $D+E$ sets. There are, however, difficulties and inconsistencies in the application of these conceptions of chromosome homology, for the cytological results (pairing) do not always agree with the genetical ones. Thus, rye chromosomes are D as judged by their mating in hybrids with *A. triuncialis*, but the genetic characters are not those associated with D. Again, the morphological differences found within the chromosomes do not correspond with their mating peculiarities. Thus, several of the chromosome types in *T. dicoccum* and *T. polonicum* are not found in *T. vulgare*, although every chromosome in these two species finds a mate in crosses with *vulgare*. It is believed that with further work these anomalies will be cleared up, and that the cytological behaviour will throw further light on evolutionary divergence in these forms.

Gyromagnetic Effect for Salts of the Iron Group.—The small spin which a body acquires when it is magnetised is connected closely with the behaviour of the electrons in the atoms in the magnetic field, and it is theoretically possible to decide in certain cases between theories of the action of the field from the *gyromagnetic* effect. This has been done for certain ions of chromium, cobalt, and iron by W. Sucksmith, in an investigation of extreme delicacy which is described in the issue of the *Proceedings of the Royal Society* for September. The salts used have an even smaller susceptibility than dysprosium oxide, the only non-ferromagnetic body which had been studied hitherto, and the angular momenta generated were correspondingly more difficult to measure. The method employed was again that in which a resonant angular movement was set up in an alternating field. The results show that of the various theories which have been advanced, that which supposes the angular momenta of the effective electrons due to their intrinsic spins and their orbital motions to be separately quantised relative to the field axis is the most nearly correct, and further, that the orbital moments may be wholly or partially suppressed by the fields of neighbouring ions. Measurements were also made upon manganese ions, but in this case the conflicting theories all predicted the same result, which was actually obtained.

Reflection of X-Rays.—Some results of much interest in connexion with long X-rays are contained in three papers from Prof. T. H. Laby's laboratory, which appear in the September number of the *Proceedings of the Royal Society*. The first of these, by R. T. W. Bingham, contains a description of the construction and use of a compact vacuum spectrometer; this is of the Seeman single slit type, and was specially designed to give a high intensity of radiation at the photographic plate, together with accurate angular measurements. In the second paper, Mr. Bingham and Prof. Laby describe some investigations on the reflection and diffraction of soft X-rays. They find that these are reflected from surfaces of glass, quartz, and stainless steel at angles very much greater than the critical angle that would be expected theoretically. This fact increases considerably the range of angles for which gratings can be used with this radiation, and has been employed in some new determinations of relative wavelengths. It also permits of focusing of long radiation by a spherical mirror at large angles of incidence. The last paper, by Mr. Mohr, deals with certain details of the total reflection of long X-rays. Within the limits of experimental error, agreement was found between the observed and calculated values of the critical angle, and for the rate of fall of intensity near the critical angle, for the light substances quartz, calcite, and glass, but not for the denser bodies steel, silver, and gold, it being found that increasingly large discrepancies occur with increasing density of the reflector.

Inertia of Loud-Speaker Vibrating Diaphragm.—In addition to the theoretical difficulties of treating the many variable factors involved in loud-speaker design, there are also numerous experimental difficulties concerned in the laboratory measurement of the quantities. Following a treatment (*Phil. Mag.*, **11**, 1-54) of the theory and performance of certain types of modern acoustic apparatus for reproducing speech and music, Dr. N. W. McLachlan has now given an account (*Phil. Mag.*, **11**, 1137-1152) of five methods, each necessitating the measurement of the inductance of a coil situated in a magnetic field, of measuring the accession to inertia of a vibrating diaphragm driven by the reaction between the magnetic field and that of the alternating current in the coil. Three measurements of the inductance are made respectively with the coil fixed, free to move in air of known density and free to move *in vacuo*. In the free condition the value of the inductance depends on the effective mass of the moving system. When vacuum equipment is not available, the necessary conditions for the third measurement can be simulated by removing the diaphragm from the moving coil. Experimental arrangements and precautions necessary to attain accuracy are discussed in detail, and the importance of ensuring that the diaphragm move as a whole is emphasised. The results obtained for a conical diaphragm are in good agreement with those computed from Rayleigh's formula for a rigid disc. It is shown that with a limited size of baffle the accession to inertia decreases with frequency.

Astronomical Topics.

An Interesting New Minor Planet.—On the average three new minor planets are discovered every week, so such announcements are received with equanimity. But when the new object has an unusual rate of motion the case is a little different, for it implies either proximity to the earth or that the body lies on the outer fringe of the asteroid region. *Circular* No. 465 of the Berlin Rechen-Institut announces that a new planet designated 1931 *RA* was found by Herr Reinmuth at Königstuhl, which had the remarkably slow motion of -20^{sec} per day in R.A., and 1′ south in declination; this is slower than the usual rate of the Trojan planets when near opposition, as the new planet was. The motion was verified by another observation two days later. The slow motion may arise either from great distance or from the linear velocity of the planet being nearly the same as that of the earth. In either case the body is deserving of careful observation, so the positions are given as a guide to observers:

	U.T.	R.A.	N. Decl.	Mag.
1931. Sept.	$7^d\ 23^h\ 49{\cdot}1^m$	$23^h\ 38{\cdot}9^m$	6° 34′	13·7
	9 21 59·5	23 38·2	6 32	

The second observation was a visual one, made by M. Mündler. The observation of minor planets is one of the principal lines of work at Königstuhl; the earliest image of Pluto that has yet been identified was found on a plate exposed there on Jan. 23, 1914.

Van Gent's Short Period Variable.—Reference has been made in this column to the variable discovered by Mr. H. van Gent in R.A. $8^h\ 10{\cdot}6^m$, S. Decl. 18° 45′, with a period of 100 minutes. It was noted that photographic study of the light changes was difficult, owing to the considerable variation during the time of exposure. Mr. Harold L. Alden contributes a paper on the star to *Astr. Jour.* No. 958: the star can be photographed at maximum with 2 minutes' exposure with the Yale 26-inch refractor at Johannesburg. Fifteen plates were taken on 11 nights, giving 56 exposures of the variable. The light range is from 14·05 to 15·12. The light-curve shows an extremely rapid fall after maximum (about 1 magnitude in 7 minutes). The curve is then nearly horizontal for about 40 minutes; the increase of light is fairly uniform for the remaining 53 minutes. In Cepheid variables the increase of light is usually more rapid than the decrease, so that this star differs notably from them.

A New Cluster of Faint Nebulæ.—Quite a number of clusters of faint spiral nebulæ have been detected in recent years. *Astr. Nach.* No. 5815 contains an account by Dr. W. Baade of a new one that he detected on plates taken with the large reflector at Bergedorf Observatory, Hamburg. Its position for the equinox of 1925·0 is R.A. $10^h 54{\cdot}7^m$, N. Decl. 57° 11′, about half a degree from the star Beta Ursæ Majoris. It extends over a region some 24′ by 17′; the southern part of the region is filled by a densely packed cluster of very faint nebulæ (probably fainter than mag. 17). They are on the limit of visibility, and no structure can be detected. Dr Baade concludes that the nebulæ are considerably more distant than those of the other cluster, also in Ursa Major, that he announced a few years ago.

International Illumination Congress.*

On Sept. 8 the International Illumination Congress proceeded to Buxton, where, on the evening of arrival, there was a demonstration of railway light signals and railway coach lighting at the Buxton railway station. The following day was occupied by a visit to Sheffield, in the course of which numerous local steel works and other places of interest were seen, and an opportunity was afforded of inspecting the Corporation Public Lighting Department, under the supervision of Mr. J. F. Colquhoun. While most of the factories were of considerable technical interest, members were dismayed at the very unsatisfactory lighting conditions prevailing in some of them.

The following day was devoted to sessions at which series of papers on industrial lighting, architectural lighting, the lighting of railways and mines, farm and horticultural lighting, and light sources were read. In the Industrial Lighting Section, Dr. H. Lux (Germany) presented the recommendations of the German Illuminating Engineering Society on this subject, and Herr N. Goldstein and Herr F. Putnoky discussed the lighting of textile mills. A bulky review of current practice in the lighting of factories by gas was presented by the Society of British Gas Industries. Perhaps the most interesting contribution in this section was that by Dr. M. Luckiesh and Mr. F. K. Moss (United States), who made a plea for 'humanitarian foot-candles', that is, the provision of an intensity of illumination beyond the requirements of safety and in excess of demands from the point of view of production.

The section which aroused most interest was possibly that dealing with architectural lighting, on which seven papers were read. Developments in Great Britain were surveyed by Mr. R. W. Maitland and Mr. W. J. Jones, and decorative lighting in France by MM. H. Maisonneuve and J. Wetzel. A paper on "Illumination and Architecture" by Mr. L. Kaeff (Holland) contained some interesting speculations on the influence of climatic conditions on architectural design, and the effect of varied conditions of natural and artificial lighting on shadows cast by embellishments on buildings. The engineering aspects of architectural lighting were dealt with by Mr. W. J. Jones, and researches of a mathematical character were reported by MM. Dourgnon and P. Waguet. These papers gave rise to an interesting discussion, in the course of which the application of laws relating to the illumination derived from a luminous point, a line, and illuminated surfaces were analysed, and views on the best methods of securing the co-operation of the architectural profession in illuminating engineering considered. Interesting information on procedure in the United States, where courses of instruction for architectural students in illumination and, conversely, lectures on architecture for illuminating engineers have been arranged, was forthcoming.

The other papers covered a wide variety of topics. Mr. A. Cunningham outlined the development of lighting on British railways, and discussed such problems as the lighting of platforms, goods sheds, and goods yards, for which tentative standards were suggested and reference made to the use of floodlighting in connexion with shunting operations. Convenient designs for illuminated station name-plates were illustrated. This paper was supplemented by a similar one by M. J. W. Partridge outlining practice on the French railways: in this, further information on the use of floodlighting for the illumination of large open spaces was furnished. Papers on the lighting of mines deplored the very low standard of illumination prevailing and advocated the use of miners' lamps of higher candle-power. The possibility of floodlighting the coal face, by the aid of electric light, was considered. In this connexion data illustrating the influence of conditions of illumination on safety and output in certain mines in Silesia were presented by Dr. L. Schneider (Germany). Mr. W. A. Villers was responsible for a paper on cinema studio lighting, in which the use of incandescent lamps for 'talking' films was illustrated. There were several papers reviewing processes in incandescent lamp manufacture, and comparative data on the qualities of sunlight and artificial daylight. Finally, there was a group of papers, "Electric Light on the Farm" (R. Borlase Matthews), "Plant Cultivation with Electric Light in Sweden", and the "Artificial Lighting of Greenhouses in Germany", all of which illustrated the important part that light may play in connexion with horticulture.

At Birmingham, where the Congress next proceeded, there were interesting visits to local works. That to the glass works of Chance Bros., Ltd., at Smethwick, was notable for some pleasing demonstrations, such as methods of tracing the rays from optical equipment by means of chemical smoke. The experimental lighting in the Hagley Road, where sections are lighted alternately by gas and electricity, was of considerable interest. The papers read at Birmingham were less varied than at Buxton, being chiefly concerned with signalling apparatus. Four papers, all from Japan, described signal systems in use on the Japanese railways and experiments on the production of coloured glasses. There was a good paper by Mr. J. P. Bowen, engineer-in-chief to Trinity House, reviewing the development of lighthouses. Informative contributions by A. V. Blake and W. M. Hampton and E. Schuppen discussed the development of traffic control signals in Great Britain and Germany respectively. The former paper showed how requirements in Great Britain chiefly demand the independent control type of signal, and discussed such technical problems as the best form of distribution curve and the elimination of 'phantom indications' of signals. Herr E. Schuppen studied the use of simultaneous and progressive systems of control in Berlin, the length of individual cycles, and the design of automatic controllers. It is stated that since automatic control has been introduced, 20 per cent more traffic is carried by the same streets in Berlin, and with very much less hindrance.

In the Section on Motor-Car Headlights there were communications from France and Great Britain reviewing recent progress in methods and design. Dr. F. Born (Germany) discussed in considerable detail the basis of an international agreement on motor-car lighting, assuming the provision of two kinds of light, a main beam and an anti-dazzle beam; 100 m. has been proposed as a minimum value for range of the main beam and 25 m. for the anti-dazzle (alternative) beam. Provisions for limiting glare are most easily based upon the illumination at the observer's eye. Suggestions for standardising the various constituent parts were also made. A report from the Japanese Committee on Motor Vehicle Headlights described experiments with the R.A.C. disc and suggested some modification in the test with this apparatus. Other papers treating light distribution and heterochromatic photometery were of a somewhat specialised character, either dealing with the details of photometric processes or recording experiments determining

* Continued from p. 589.

the order of accuracy attainable in comparing sources of different colour. The final day at Birmingham was devoted to a day-trip to Stratford-on-Avon, after which members proceeded to Cambridge.

The meeting at Cambridge was generally regarded as one of the most successful parts of the Congress, and was well attended. In the course of the visit, there were trips to Ely and Peterborough (the latter an evening visit so that the artificial lighting of the cathedral might be inspected) and an address on "The Light of the Stars" by Sir Arthur Eddington. There was also a comprehensive demonstration of anti-dazzle devices by the Royal Automobile Club, which was instructive in demonstrating recent progress in this field. A considerable amount of work was done, sessions being devoted to such matters as street lighting, daylight illumination, nomenclature, definitions and symbols, photometric test-plates, traffic signals, glare, motor-car headlights, photometric accuracy, aviation lighting, heterochromatic photometry, the lighting of schools and factories, etc. — on most of which reports reviewing progress and, in some cases, leading to definite recommendations were presented.

Amongst the numerous points on which decisions were taken the following may be noted. It was agreed that in visual photometry the most accurate measurements are possible with illuminations between 5 lux and 20 lux, and that in the laboratory a mean error of an order not exceeding 0·25 per cent is possible, whilst in commercial work a limit of 3 per cent may be attained. In regard to daylight, the 0·2 per cent daylight factor (at present applied in Great Britain legally in connexion with Ancient Lights cases) was regarded as a minimum—which would be definitely inadequate in the case of work involving much visual discrimination. It was further agreed that a committee should be set up to consider the standardisation of artificial daylight. The Section on Lighting Education formulated many recommendations, such as the inclusion of instruction in illumination at post-primary schools and in architectural colleges, and the organisation of at least one full specialised course in illuminating engineering in each country. In connexion with headlights, the distinction between the 'driving beam' and the 'passing beam' was recognised, and steps to limit glare and ensure adequate illumination were proposed. It is interesting to observe a consensus of opinion that coloured beams of light are of no material advantage in fogs.

Other resolutions related to traffic control and street lighting, a desire for fuller data in regard to the influence of traffic signals on road accidents being expressed. In connexion with street lighting, it was recommended that, in order to facilitate international comparisons, contributors should give (*a*) a description of the fitting, (*b*) particulars of spacing, and (*c*) both average and minimum illumination.

An invitation for the next meeting of the International Illumination Congress to take place in Germany was accepted for 1934, when the president will be Dr. A. R. Meyer.

International Congress for the Testing of Materials.

The New International Association for Testing Materials held its first congress at Zurich on Sept. 6–11. Although this was the first congress of the New International Association, eleven international congresses on the testing of materials have been held in the past. Ten of these were held by the original International Association which was formed more than thirty years ago under the auspices of Tetmayer and Bauschinger. This Association was broken up during the War, but a new International Association was formed at a congress in Amsterdam which had been arranged in September 1927 by the Dutch Association for Testing Materials. The new Association, although it is continuing the most valuable work of its predecessor, differs from it in many important respects, particularly by being a much simpler organisation, which avoids so far as possible the formation of numerous permanent committees, and also by entirely eliminating all questions of international standard specifications.

The Congress at Zurich was presided over by Prof. A. Mesnager, of the Conservatoire National des Arts et Métiers, Paris, and its work was carried out in four sections, namely: (*A*) Metals, under the presidency of Dr. W. Rosenhain, London; (*B*) Inorganic Materials, stone, cement, concrete, etc., under the presidency of Prof. M. Roš, director of the Swiss Federal Testing Laboratory at Zurich; (*C*) Organic Materials, bitumen, paints, rubber, etc., under the presidency of Prof. Roos af Hjelmsäter, Stockholm; (*D*) Questions of General Importance, under the presidency of Prof. Goerens, of Messrs. Krupp. Most of these sections held five sessions, each occupying a whole morning or afternoon and each devoted to the discussion of a single selected subject, upon which a number of reports by experts of international standing were first presented in brief abstract, a general discussion following. The reports were of a very high order of interest and importance, and particularly good discussions took place. The work of the Congress was, throughout, animated by the spirit of international co-operation and friendship, and by the desire of all those taking part to further the common cause of improving our methods of testing and of advancing our knowledge of the properties of materials, upon which satisfactory methods of testing must be founded.

In Section *A*, the subjects discussed were cast iron, notched-bar impact testing, fatigue, materials at high temperatures, and the progress of metallography. In regard to cast iron, considerable divergence of opinion and practice appears to exist, particularly between the French engineers and those of other countries. As a result of the discussion, however, the president of the Section hopes to issue a brief summary acceptable to all those who took part. Such a summary should serve as a guide to those bodies whose business it is to deal with standardisation, both national and international. The same applies to the notched-bar impact test, where the adoption of a standard test piece affording comparable results in different countries is particularly desirable.

In Section *B*, the importance of geological factors in the testing of stone was discussed, and new data on the resistance of road-building materials to shock were presented. Cement testing, concrete testing, and the testing of reinforced concrete were also discussed at length, the latter subject presenting a series of particularly important problems.

Section *C* dealt with the problems of asphalt or bitumen, which has attained so much importance in regard to road construction, and special attention was devoted to the question of nomenclature, upon which international agreement appears to be highly necessary. In regard to the testing of timber, the decisive importance of moisture content on all strength properties was emphasised; it is suggested that consideration of this factor clears up the existing difficulties in the relations between compression, bending, and tensile strength. Questions of ageing of materials such as oils, textiles, synthetic resins, and rubber were also discussed, the importance of temperature, oxygen, and light being considered. A discussion on viscosity brought out a consensus of opinion that the 'poise' should be adopted as the unit of dynamic viscosity and the 'stokes' as the unit of kinematic viscosity. Tables for the conversion of data expressed in other units to this system are to be prepared. Considerable attention was also paid to the question of solid fuels, particularly with regard to the sampling of coal.

In Section *D*, the subjects treated related to the determination of grain size in powdery materials, the calibration of testing machines, and the general conceptions implied by the terms 'elasticity', 'plasticity', 'toughness', and 'brittleness'. A general discussion on the latter question proved of particular interest.

At the opening meeting of the Congress, the delegates of some thirty-four nations made brief speeches in reply to the opening addresses of the president and the representatives of the Swiss Federal Government and of the Canton and City of Zurich; they paid tribute to the early work of Tetmayer at Zurich and to that of his present successor, Prof. Roš, for the great work he had done in the successful organisation of the Congress in his capacity of general secretary of the International Association. Great Britain was represented by Sir Henry Fowler and Dr. W. Rosenhain. The latter, as representative of Great Britain on the Permanent Committee of the International Association, was the bearer of an invitation from the British Committee to the International Association to hold its next Congress in London in 1935. At the final plenary session of the Congress, this invitation was accepted, and Dr. Rosenhain was elected as the next president of the New International Association. It is hoped that the sectional presidencies will be filled as follows: (*B*) Dr. Barta, Czechoslovakia; (*C*) Prof. Suenson, Denmark; (*D*) Dr. G. K. Burgess, director of the Bureau of Standards, U.S.A. The presidency of Section *A* has not yet been filled, but it is hoped that it may be accepted by Prof. Goerens, of Essen.

It is interesting to note that on this occasion, although British participation was not very numerous—some five hundred members attended the Congress, and of these not more than twenty were British—yet the British representatives took a very active and important part in the work of the Congress, and the importance of their work and influence was fully appreciated and is likely to prove of value to British technical and industrial prestige throughout the world.

Association of Special Libraries and Information Bureaux.

THE eighth annual Conference of the Association of Special Libraries and Information Bureaux was held at Lady Margaret Hall, Oxford, on Sept. 18–21, and the attendance and papers presented at the Conference, as well as the discussions, manifested a growing appreciation of the value of such a clearing house for multiplying sources of specialised information both in science and industry. Anxiety regarding the future of the Association in view of its unsatisfactory financial situation, which Dr. R. S. Hutton emphasised at the annual general meeting, appeared indeed rather to intensify the sense of the value of the Association's work, and several speakers at this and other sessions urged the importance of defining more clearly the functions of A.S.L.I.B. so as to prevent undue diffusion of effort.

The need for some such central index and pointer to sources of special information was repeatedly emphasised, and discussions on the Library and Information Departments of the Royal Institute of International Affairs and on the League of Nations and the International Labour Office as sources of information for economic affairs ultimately issued in a resolution urging the Council to promote the effective organisation of some such central index or means of co-ordination. An offer to provide clerical assistance in such a move was made by Mr. B. M. Headicar, of the London School of Economics, and the experience of the groups established during the year in Yorkshire and in Lancashire and Cheshire has indicated the value of local co-operation and contact, as well as central organisation in promoting the rapid exchange of information between members to their mutual advantage.

Special interest was supplied to the opening session of the Conference by a paper in which Prof. A. M. Carr-Saunders analysed some of the problems of professionalism, including professional training and the restriction of entry to professions to which allusion has recently been made in NATURE. State control or interference in professional matters is largely determined by the necessity of maintaining a reasonable standard of competence as in law and medicine, or of securing the public safety as in regulations relating to marine officers. When the contact between the members of a profession and the public is only indirect, as in certain professions the legal restriction of which has been attempted in recent years, it is much more difficult to establish a case for State regulation. The growth of specialisation makes the question of competence much more difficult, and even in the medical profession the question of dealing with or proving incompetence has not been entirely solved.

Prof. Carr-Saunders, pointing out the dangers inherent in registration and professionalism, suggested that as an alternative to multiplication of self-governing professional organisations a wider use might be made of powers obtained under and administered through the Privy Council as a means of maintaining high professional standards. Referring to professional training, Prof. Carr-Saunders stated that in the modern tendency for professional training to be given at the universities, the universities are reverting to their original functions. The development of the Association of Special Libraries and Information Bureaux is an indication of the importance of these questions in regard to librarians and the competent handling of information.

In the session over which Sir Charles Sherrington presided, Mr. E. N. Simon directed attention to the valuable and original scientific information which is now contained in the publications of industrial firms and frequently only available in such literature. In recent years the character of such publications has totally changed, and technical service literature now contains an increasing amount of information and data of direct practical, scientific, and technical value to scientific workers in general and not to research workers in industry alone. Other speakers who confirmed this view directed attention to the difficulty even in industry of rendering such information readily accessible, and the importance of co-operation in making it known, whether through the offices of A.S.L.I.B. or otherwise, was evident.

Sir Frederic Nathan's paper on international abstracting and indexing of scientific and technical literature was a further presentation of the scheme he outlined last year before the Chemical Engineering

Group of the Society of Chemical Industry, which has since been discussed at a special conference on abstracting convened by Mr. H. T. Tizard at the Imperial College of Science and Technology in July, as well as at the recent conference of the International Institut de Bibliographie at the Hague, at which Sir Frederic presented a similar paper. The scheme met with severe criticism on several points, particularly from representatives of industry, and it is evident that the adoption of the Universal Decimal Classification as a basis meets with serious difficulties in the more highly specialised field of industry. Whether the advantages of a universal classification designed to facilitate the correlation of all branches of knowledge outweigh such difficulties in particular and detailed applications is probably a matter for the industries concerned to determine. A system admittedly must represent a compromise. A weakness inherent in Sir Frederic Nathan's scheme is the well-known disparity in the character of the abstracts prepared by different countries, and some limitation of the principle that each country should be responsible for preparing its own abstracts is inevitable, even if only in grouping of the smaller countries. There must be general confidence in the abstracting efficiency of all participating countries if the scheme is to be acceptable generally. Furthermore, translation provides an acute practical difficulty whether the translations are provided by the abstracting country or made in other countries from the abstracts provided. It was further pointed out that it is important that the length and detail of the abstract should bear some relation to the geographical or lingual accessibility of the paper abstracted. Here again we are faced with a question of comparison and of evaluating obvious advantages against serious disadvantages which in practice may or may not outweigh the advantages.

Other papers presented at the Conference included one by Dr. A. Preeder, Director of the Library of the Technische Hochschule, Berlin, describing an ever-ready printed catalogue, and a discussion of the value of films as a medium of information in education, science, and industry by Mr. F. A. Hoare. At the concluding session of the Conference, Dr. E. Shenkman gave an account of the Russian Five-Year Plan in its special relation to British industry and commerce. An exhibition of sound films was given during the Conference by the Western Electric Co.

Birthdays and Research Centres.

Oct. 11, 1864.—Sir Henry Lyons, F.R.S., Director of the Science Museum, South Kensington, and formerly Director-General of the Survey of Egypt.

Although only a part of the new Science Museum as planned by the Committee of 1911 has yet been completed, the reorganisation and development of the collections have already occupied several years. They are now being increasingly used by technical visitors and students, as well as by the general public, in large numbers, and they are supplemented at frequent intervals by special exhibitions to illustrate recent developments in various groups.

As soon as the next block of the Museum has been constructed, the representation of current practice in all branches, which is most urgently needed, can be more adequately provided for than is now possible.

Oct. 11, 1875.—Sir Arthur W. Hill, K.C.M.G., F.R.S., director of the Royal Botanic Gardens, Kew.

The direction of the affairs of the Royal Botanic Gardens, Kew, covers so wide a range both in the realms of systematic and applied botany and also in the domain of practical horticulture that the Director is unfortunately left with very little spare time for carrying out botanical investigations himself. He is, however, able to suggest to the members of his scientific staff and visiting botanists various problems which come to his notice on which investigation is needed, and for the solution of which Kew affords such unrivalled opportunities. These relate principally to matters of systematic or economic interest which affect botanical or agricultural progress in the Empire.

My own long connexion with Kew gives me the opportunity of noticing many points of great scientific interest urgently in need of investigation, which I seldom have time to study in detail, nor is there any member of the Kew staff who can be diverted from his proper sphere to carry out the necessary research.

Kew is very much in need of the assistance of one or two research students to work in the laboratory, herbarium, and gardens on these many interesting problems: it may be in plant physiology, ecology, or general morphology; and if such posts could be suitably endowed for university graduates, there would be ample opportunity for the research students to work at these problems, since all facilities in the way of living material, laboratory accommodation, our library and herbarium collections, as well as personal direction, are available at Kew.

As an example of what has been done in the past at Kew may be cited the work of Brown and Escombe, Dr. D. H. Scott, and other voluntary research workers.

Oct. 11, 1881.—Dr. L. F. Richardson, F.R.S., Principal of Paisley Technical College and School of Art.

The mystery of the connexion between mind and matter may be approached by considering time and intensity. For time and intensity belong both to physics and to psychology, as Fechner emphasised. I have found that the variations in time of mental images can be estimated quantitatively, and that equations describing the time-changes can be fitted to the observations (*Jour. General. Psych.*, April–July 1929).

Another clue to the same problem is suggested by the behaviour of the neon lamp, which in some of its time-relations resembles human behaviour; for example, B. van der Pol's model of the heart (*Phil. Mag.* Suppl., Nov. 1928). Also, I have arranged three neon lamps so that the lighting of any one of them will extinguish any other, just as rival thoughts extinguish each other (W. McDougall's "inhibition by drainage"). Many other analogies between mental images and sparks are collected by me in the *Psychological Review* (May and July), 1930.

Another, and more natural, clue is provided by periodic electrolytic phenomena (E. S. Hedges, Nature, **128**, 398, Sept. 5, 1931).

Oct. 11, 1886.—Mr. A. C. G. Egerton, F.R.S., reader in thermodynamics in the University of Oxford.

My immediate interests lie in three directions: (1) researches at high temperatures, 3500° and above; (2) study of processes of combustion; and (3) properties of vapours. The first entails a study of gaseous reactions at high pressures and high temperatures. The second is a continuation of an investigation on the oxidation of hydrocarbons and the inhibition by various substances, such as antiknocks, and has led to a study of the behaviour of the two forms of hydrogen (ortho and para) at surfaces. The third is a continuation of researches on the thermal properties of vapours, an accurate determination of the vapour pressure of steam having recently been accomplished in an apparatus designed by the late Prof. H. L. Callendar at South Kensington.

I am interested in the application of thermodynamical studies to every branch of activity, for example, fuel conservation, heating and ventilating, economical use of heat in chemical processes, etc., and think that more attention should be paid to such studies. In Germany, within the Technische Hochschule at Munich, there is an institute under Prof. Knoblauch devoted to such work, and I should like to see something similar in Great Britain.

Oct. 14, 1891.—James Gray, F.R.S., University reader in experimental zoology, Cambridge.

A study of the metachronal rhythms of ciliated epithelia has led to an attempt to analyse similar phenomena in muscular systems, and I am at present interested in the mechanical principles underlying the propulsion of fish and of annelid worms, the muscular systems of which exhibit well-defined rhythms. By means of a suitable camera it is possible to record such movements with accuracy.

In association with others, an attempt is being made to analyse the osmotic properties of the membrane which surrounds the egg of the trout. It is now possible to define its permeability to ions with considerable accuracy, but a complete interpretation of the results must depend on the degree to which the membrane is found to be permeable to water.

Oct. 14.—Dr. Marie Carmichael Stopes, formerly lecturer in palæobotany at University College, London, and at Victoria University, Manchester, fellow of University College, London.

In conjunction with the Coal Research Club, I am continuing to probe into the ultimate nature and composition of the constituents of coal, which affords very complex problems in spite of the great increase in knowledge on all sides in recent years.

As founder and president of the Constructive Birth Control Society and Clinic, I am carrying on research and observation in various aspects of human sex-physiology, and accumulating data about very large numbers of women (approximately 15,000 to date at the Clinic).

In my holidays at Portland, while founding the Portland Island Museum, I am accumulating Cycadoidea and searching for Jurassic Angiosperms.

Societies and Academies.

Paris.

Academy of Sciences, Aug. 10.—**A. Lacroix**: The recent (June 27, 1931) fall of an asiderite meteorite in the extreme south of Tunis. The term asiderite is applied to meteorites free, or practically free, from metallic iron. The meteorite now described fell near Tatouine and is of Tschermak's diogenite type, only four of which have hitherto been observed.—**Charles Achard, Augustin Boutaric, and Arthur Arcand**: The physical properties of the serum proteins and of the hydropic serosities in lipoid nephrosis. In lipoid nephrosis the colloidal granules of the serum have lost the property of hydration on heating. The same anomaly is shown by the proteins separated from this serum. Hence in this disease there are not only quantitative modifications of the various proteins but also modifications in the physical properties of these proteins.—**D. Belorizky**: The convergence of the series in the solution of the problem of three bodies given by Sundmann.—**R. de la Boulaye and G. Balme**: The velocity of propagation of musical sounds. The velocity of musical sounds in the open air is constant and independent of the frequency, but in a tube of one metre diameter the velocity varies slightly with the frequency. Part of this work was carried out by the late Th. Vautier.—**Pierre Auger and Charles Lapicque**: Variation in the spectrum of the sensibility of cuprous oxide cells. The photoelectric cell used in this investigation consisted of a layer of cuprous oxide on a copper plate, the former being covered by a thin transparent film of metal obtained by cathode sputtering. The maximum sensibility was shown for light of $\lambda 5000$ A.—**G. Darzens and André Lévy**: The constitution of the methyl ether of butyl-*m*-cresol and of its dinitro derivative, ambrette musk.—**Jean Roche and Albert Bendrihem**: The combination of globin with hæmatins of various origins. Hæmatin extracted from helicorubin, from yeast, or from cytochrome *c* combines with globin, giving a pigment spectroscopically identical with that of blood.—**F. Rathery, Mlles. S. Gibert and Y. Laurent**: The liver and muscle glycogen in the nephrectomised dog.

Aug. 17.—**Camille Matignon**: Commercial nitrates of lime. The author in a recent paper put forward the view that calcium nitrate, now manufactured on the large scale, should not be regarded as a dangerous chemical from the point of view of storage or transport. It only becomes dangerous when heated in contact with a combustible material. An account is given of a recent fire at Oslo, involving 70 tons of calcium nitrate, confirming the author's conclusions.—**L. Blaringhem**: The experimental production of spelt wheats (*Triticum spelta*) starting with a wild plant (*Ægilops ventricosa*).—**Paul Delens**: Affine geometry of congruences of curves.—**Maurice Golaz**: A new principle of hydraulics. This is given as follows: the stable form of flow is that which, under given external conditions, develops the maximum power in the section where parallel flow is established.—**René Dubrisay and René Pallu**: The photochemical oxidation of sulphur. The results of the experiments described by the authors are consistent with the view that the primary product of the oxidation of sulphur by air under the action of ultra-violet light is pentathionic acid. This decomposes readily, giving sulphuric acid, hydrogen sulphide, sulphur dioxide, and sulphur.—**J. Giuntini**: The spectrographic study of the compounds of tartaric acid and copper. The results show that copper tartrate is a salt in which a part of the copper is present as a complex compound. This confirms the results of Darmois.—**Justin Dupont and Jean Jacques Guerlain**. The dry distillation of Peru balsam. The hydrocarbons and phenolic ethers obtained are similar to those obtained by the dry distillation of Tolu balsam.—**André Meyer and Robert Vittenet**: The azo colouring matters derived from homophthalimide.—**Marcel E. Denaeyer**: Director lines and geological evolution of French Equatorial Africa and the Cameroons.—**A. Dauvillier**: Polar auroræ and the cosmic rays.—**Paul Wintrebert and Ouang-Te-Yo**: The digestion *in vitro* of the white and of the gluten of the egg of oviparous plagiostomes (*Scylliorhinus canicula*) by the frontal gland of the embryo.

Rome.

Royal National Academy of the Lincei, March 1.—**G. Armellini**: The theory of the variability of the family of Mira Ceti. As judged by the eye, the radiation of this star varies in the proportion of 200 : 1 or 100 : 1, whereas measurements with the bolometer or thermo-electric pile indicate the ratio 3 : 1 or 2 : 1. The values generally accepted for its extreme temperatures, namely, 2300° and 1800°, involve a very marked divergence between theory and observation. To obtain calculated results in good agreement with the observations, lower values, namely, 1500° and 1100°, must be adopted for the extremes, but these may give rise to difficulties in other directions. If these values are regarded as inadmissible, the observed phenomena are explainable only by associating the temperature variations with a variation in the atmospheric transparency, in accordance with the veil theory, advanced by Merill and supported by Hopmann.—**Q. Majorana**: New photoelectric investigations. It was found previously that, when light, periodically interrupted, falls on the first triode of an amplifying group, the telephone of the amplifier repeats the sound corresponding with the frequency of interruption of the light. Various new observations, now described, throw some light on this phenomenon.—**Gian Antonio Maggi**: Demonstration of a property pertaining to the theory of the potential function of surfaces.—**G. A. Blanc**: Certain properties of the silica remaining after attacking leucite with acids. A method is described for separating, from the liquid obtained on treating leucite with an acid, the residual silica existing as a colloidal suspension, and an explanation of the phenomena accompanying such separation is advanced.—**L. Petri**: A method for detecting the exceptional presence of mercury in vegetable tissues. The use of mercury salts as an external fungicide for seeds, particularly those of cereals, is followed by absorption by the plant of traces of mercury from the soil, with the result that the functional activity of the plant is stimulated. The presence of traces of mercury in plant material may be detected by treating the plant juices with hot hydrochloric acid and afterwards leaving a piece of silver foil immersed in the solution for some hours. Any slight amalgamation of the silver which occurs is readily revealed either by exposing the foil to iodine vapour or by heating the foil gently before a spectroscope.—**T. Boggio**: Relation between the Riemannian homographs relative to two spaces in conform representation.—**Giacinta Andruetto**: Relation between Riemann's symbols relative to two varieties, one immersed in the other.—**N. Théodoresco**: Dirac's system of equations with partial derivatives.—**Ugo Broggi**: Resolution of algebraic equations.—**R. Calapso**: Synthetic studies of differential projective geometry.—**R. Serini**: Propagation of transverse vibrations in a finite string with resistance of the medium.—**M. Maggini**: A direct method for determining the interferometric λ eff.—**G. Bernardini**: The technique of magnetic spectrographs for slow electrons.—**Paolo Straneo**: The unitary theory of gravitation and electricity. (1) Physico-geometric foundations for a deduction of the equations of the field.—**M. Amadori**: Mercury derivatives of divalent bromophenols. Various mercuric compounds of the di- and tri-bromo-derivatives of pyrocatechol and resorcinol are described. These compounds are formed by the replacement of two hydrogen atoms by one mercury atom, but whether these two hydrogen atoms are both hydroxylic, or one hydroxylic and one united to a carbon atom, is as yet undecided.—**G. A. Barbieri**: Molybdo-octocyanides. On the basis of various reactions shown by the red substances obtained by treating potassium molybdo-octocyanide with hot, concentrated nitric acid, the author does not consider the formula $H[MoO_2(CN)_2 . 2H_2O]$ suggested for this substance by Bucknall and Wardlaw (1927) to be justified.—**A. Quilico and M. Freri**: Azopyrrole blacks (4). Details are given of the experiments on which the results given in note (3) are based.—**L. De Marchi**: Fridtjof Nansen. A memorial notice, containing an account of Nansen's polar expeditions and discoveries.

Official Publications Received.

BRITISH.

Proceedings of the South London Entomological and Natural History Society, 1931–32. Pp. xx+94+5 plates. (London.) 10*s*.

The Quarterly Journal of the Geological Society of London. No. 347, Vol. 87, Part 3. Pp. lxv-cviii+375-550. (London: Longmans, Green and Co., Ltd.) 7*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1376 (Ae. 501—T. 1892, T. 2084): Strength of Wooden Seaplane Hulls (Full-sized Machines—Third Series). By W. C. S. Wigley. Pp. 18+4 plates. 1*s*. net. No. 1389 (Ae. 511—T. 3048): The Pressure on the Front Generator of a Cylinder. By Dr. A. Thom. Pp. 14+8 plates. 9*d*. net. No. 1390 (M. 73—A. 65, 74, 92): The Protection of Magnesium Alloys against Corrosion. By H. Sutton and L. F. Le Brocq. Pp. 22. 1*s*. net. No. 1392 (Ae. 513—T. 3064): Accelerations on Aircraft during Manœuvres. By E. Finn and A. E. Woodward Nutt. Pp. 5+6 plates. 9*d*. net. No. 1393 (Ae. 514—T. 3003): Several Cases of Non-Circular Torsion solved by Analysis and Direct Test. By James Orr. Pp. 21+9 plates. 1*s*. 3*d*. net. (London: H.M. Stationery Office.)

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 16, Part 1, September 4. Pp. 88. (Cambridge: At the University Press.) 7*s*. 6*d*.

Twelfth Annual Report of the Ministry of Health, 1930-1931. (Cmd. 3937.) Pp. xiv+324. (London: H.M. Stationery Office.) 5*s*. net.

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 14. Pp. 53. (Hertford: Stephen Austin and Sons, Ltd.) 1*s*. 6*d*.

Proceedings of the Royal Society. Series A, Vol. 133, No. A821, September 1. Pp. 350. (London: Harrison and Sons, Ltd.) 18*s*.

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 16, Part 2, August 8th. Pp. 115-228+plates 25-42. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

Indian Journal of Physics, Vol. 6, Part 2, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 15, Part 2. Conducted by Sir C. V. Raman. Pp. 81-163. (Calcutta.) 1.8 rupees; 2*s*.

British Honduras. Report of the Forest Trust, 1930. Pp. 15. (Belize.)

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 30th July 1931. Pp. 26. (Corstorphine.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Edited by K. K. Sen Gupta. Vol. 3, No. 2, May. Pp. 29-82. (Calcutta.)

Survey of India. Geodetic Report, Vol. 6, from 1st October 1929 to 30th September 1931. Pp. vi+106+lxxiv+34 plates. (Dehra Dun.) 3 rupees; 5*s*.

FOREIGN.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 173: Latitude Redeterminations. By Frederick W. Darling. Pp. iii+19+2 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

U.S. Department of Agriculture. Circular No. 172: The Control of the Lesser Peach Borer with Paradichlorobenzene Solutions. By Oliver I. Snapp and J. R. Thomson. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 321: Volume Changes in Brick Masonry Materials. By L. A. Palmer. Pp. 1003-1026. 10 cents. Research Paper No. 326: The Freezing Point of Platinum. By Wm. F. Roeser, F. R. Caldwell, H. T. Wensel. Pp. 1119-1129. 5 cents. (Washington, D.C.: Government Printing Office.)

Ministry of Finance, Egypt: Survey of Egypt: Geological Survey. Miocene Foraminifera from the Clysmic Area of Egypt and Sinai: with an Account of the Stratigraphy and a Correlation of the Local Miocene Succession. By Dr. W. A. Macfadyen. Pp. vi.+149+4 plates. (Cairo: Government Press.) 40 P.T.

Publications of the Washburn Observatory of the University of Wisconsin. Vol. 15, Part 4: Photo-electric Studies of Five Variable Stars. By Joel Stebbins and C. M. Huffer. Pp. 177-213. (Madison, Wis.)

Publications of the Observatory of the University of Michigan. Vol. 4. No. 1; The Spectrum of Zeta Tauri. By Hazel Marie Losh. Pp. 27. Vol. 4, No. 2: The Radial Velocity of Beta Librae. By Dean B. McLaughlin. Pp. 29-36. (Ann Arbor.)

Smithsonian Miscellaneous Collections. Vol. 82, No. 11: Recently dated Pueblo Ruins in Arizona. By Emil W. Haury and Lyndon L. Hargrave. (Publication 3069.) Pp. 120+27 plates. (Washington, D.C.: Smithsonian Institution.)

University Observatory, Oslo. Publication No. 1: On the Stability of Gaseous Stars. By S. Rosseland. Pp. 50. (Oslo.)

University of California Publications in American Archaeology and Ethnology. Vol. 31, No. 1: Mexican Kinship Terms. By Paul Radin. Pp. 14. (Berkeley, Calif.: University of California Press.) 25 cents.

Meddelande från Lunds Astronomiska Observatorium. Ser. 1, No. 126: Über die Formänderungen der Sonnenkorona im Verlaufe des 11-jährigen Zyklus. By Walter E. Bernheimer. Pp. 19. Ser. 2, Nr. 59: On the Statistical Corrections in the Comparison of Magnitude Stars. By Sture Holm. Pp. 25. (Lund: C. W. K. Gleerup.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Rédigé par E. S. Russell. Vol. 6, No. 2, Août. Pp. 17+175-354. (Copenhague: Andr. Fred. Høst et fils.) 4.50 kr.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 109: The Citrus Twig Gum Disease in Egypt. By Dr. Ing. Ahmed Sirag-el-Din. Pp. ii+63. (Cairo: Government Press.) 5 P.T.

CATALOGUES.

Catalogue of Scientific Journals and Transactions of Learned Societies, including a Selected List of Scientific Works. (S.S. No. 2.) Pp. 16. (London: Oppenheim and Co., Ltd.)

Classified List of Second-hand Scientific Instruments. (No. 100, Centenary edition.) Pp. vi+58. (London: C. Baker.)

Diary of Societies.

FRIDAY, October 9.

Royal Society of Medicine (Clinical Section), at 5.30.
Malacological Society of London (at Linnean Society), at 6.—E. Ashby: Notes on Chitons from Port Alfred, South Africa, collected by Lt.-Col. W. H. Turton during 1930.—A. E. Ellis: A Reclaimed Salt-marsh.—G. C. Robson: Further Observations on the Distribution of *Cochlicella acuta*.—L. R. Cox: *Sycostoma* a renamed Genus of Lower Tertiary Gastropoda.—H. B. Moore: The Systematic Value of a Study of Molluscan Fæces.—R. Winckworth: Notes on *Nucula nitida*.—Lt.-Col. A. J. Peile: Some Notes on Radulæ.
Oil and Colour Chemists' Association (Manchester Section) (at College of Technology, Manchester), at 7.—J. Barker: The Transference of Colour Processes from Laboratory to Works (Lecture).
Manchester Association of Engineers (at Engineers' Club, Manchester), at 7.15.—C. E. Stromeyer: Presidential Address.
Junior Institution of Engineers, at 7.30.—E. D. Gill: Office Engineering.
Keighley Textile Society (jointly with Keighley Association of Engineers) (at Queen's Hotel, Keighley), at 7.30.—G. A. Rix: Faraday's Life and Work.
Institute of Metals (Sheffield Local Section) (jointly with Sheffield Society of Engineers and Metallurgists) (in Applied Science Department, Sheffield University), at 7.30.—Dr. W. Rosenhain: Gases in Metals.
Institution of Production Engineers (at Society of Motor Manufacturers and Traders, 83 Pall Mall) (Annual General Meeting), at 7.30.—J. G. Young: Distribution and Production.
Society of Chemical Industry (Chemical Engineering Group) (at Chemical Society), at 8.—D. M. Wilson: The Manufacture and Testing of Asphalt Paving Material.
Royal Society of Medicine (Ophthalmology Section), at 8.30.
Oil and Colour Chemists' Association (Manchester Section) (at College of Technology, Manchester).—J. Barker: Transference of Colour Processes from Laboratory to Works.

MONDAY, October 12.

Institute of Metals (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—L. Short: Some Random Reflections on Industrial Problems and Economics.

TUESDAY, October 13.

Society for the Study of Inebriety (at Friends' House, Euston Road), at 4.—Viscount Brentford: How the Alcohol Question concerns the Duties of the Home Office (Norman Kerr Memorial Lecture).
Institution of Petroleum Technologists (at Royal Society of Arts), at 5.30.—H. L. Allen: Sweating of Paraffin Wax.
Institute of Marine Engineers, at 6.—D. MacNicoll: Safety Valves.
Institute of Metals (Swansea Local Section) (at Y.M.C.A., Swansea), at 6.15.—A. M. Kempson: Chairman's Address.
London Natural History Society (at London School of Hygiene and Tropical Medicine), at 6.30.—H. J. Burkill: Plant Galls: More Galls to be looked for.
Institution of Heating and Ventilating Engineers (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.—E. M. Ackery: Thermal Storage for Central Heating.
Institute of Metals (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—J. W. Craggs: Chairman's Address.
Quekett Microscopical Club (at 11 Chandos Street, W.1), at 7.30.—Dr. C. D. Darlington: Microscopic Studies of the Mechanism of Heredity.
Institution of Welding Engineers (North-Western Branch) (at College of Technology, Manchester), at 7.30.—L. B. Wilson: Application of Resistance Welding.
Royal Anthropological Institute, at 8.30.—Miss Winifred Blackman: Medicine and Magic among the Egyptian Fellaheen.

WEDNESDAY, October 14.

Institution of Engineering Inspection (at Royal Society of Arts), at 5.30.—P. R. Coursey: Some Applications of Condensers to Electric Power Circuits.
Newcomen Society for the Study of the History of Engineering and Technology (at Science Museum, South Kensington), at 5.30.—H. W. Dickinson: Jolliffe and Banks, Contractors; also other Papers.

THURSDAY, October 15.

Optical Society (at Imperial College of Science), at 7.30.
Chemical Society, at 8.—E. C. S. Jones and J. Kenner: The Interaction of 2:6-dichloro-4-methylquinitrol with Methyl and Ethyl Alcohols.—H. D. K. Drew, F. W. Pinkard, W. Wardlaw, and (in part) E. G. Cox: The Structure of the Isomeric Platinous Diammino Chlorides. Discovery of a Third Isomeride.—H. D. K. Drew, F. W. Pinkard, and W. Wardlaw: The Structure of the Simple and Mixed Plato Tetrammine Dihalides.—A. P. T. Easson and Prof. F. L. Pyman: Amidines of Pharmacological Interest.
Royal Society of Medicine (Neurology Section), at 8.
Royal Society of Tropical Medicine and Hygiene (at London School of Hygiene and Tropical Medicine), at 8.15.—W. H. Gray and Dr. J. W. Trevan: Experiments on Antimony Compounds used in the Treatment of Bilharzia and Kala-azar.
Institute of Brewing (Midland Counties Section) (at White Horse Hotel, Birmingham).—S. Myer: The Season's Hops.
Institute of Brewing (North of England Section) (at Midland Hotel, Manchester).—W. J. Watkins: Notes on Enclosed Wort Refrigeration. Part II
Institute of Brewing (Yorkshire and North-Eastern Section) (at Queen's Hotel, Leeds).—E. A. Braithwaite: Stainless Steel and its Practical Application.
Royal Aeronautical Society.—H. Sutton: The Protection of Metals in Aircraft Construction.
Institution of Welding Engineers (at Institution of Mechanical Engineers).—E. B. Partington: Autogenous Welding of Lead and its Alloys, Ancient and Modern.

FRIDAY, October 16.

Physical Society (at Imperial College of Science), at 5.
Institution of Mechanical Engineers (Special General Meeting), at 6.—Approval of Draft By-Laws.
West of Scotland Iron and Steel Institute (at Royal Technical College, Glasgow), at 7.15.—J. Bird: Presidential Address.
Junior Institution of Engineers, at 7.30.—C. C. Berger: The Characteristics of Commercially Pure Iron.
Nelson Textile Society (at Nelson Technical College), at 7.30.—J. Loxham: Wonderful Products from Coal.
Royal Society of Medicine (Obstetrics and Gynæcology, Medicine, and Psychiatry Sections), at 8.15.—Discussion on Medical Indications for Premature Termination of Pregnancy.
North-East Coast Institution of Engineers and Shipbuilders (Annual General Meeting) (at Literary and Philosophical Society, Newcastle-upon-Tyne).—J. McGovern: Presidential Address.

PUBLIC LECTURES.

SATURDAY, October 10.

Royal Institute of British Architects, at 3.—C. Williams-Ellis: Architecture? What's the Use?
Horniman Museum (Forest Hill), at 3.—Miss M. A. Murray: Egyptian Beliefs in the Hereafter.

MONDAY, October 12.

University College, at 5.—Dr. R. J. Lythgoe: The Physiology of the Sense Organs. (Succeeding Lectures on Oct. 19 and 26 and Nov. 2, 9, and 16.)
Royal Anthropological Institute (at University College), at 5.30.—The Marquess of Zetland: The Races and Cultures of India: India Past and Present.
University of Leeds, at 8.—Prof. A. Gilligan: The House we Live in.

TUESDAY, October 13.

University College, at 3.—Prof. B. Ashmole: Greek Sculpture.
London School of Hygiene and Tropical Medicine, at 5.—Sir George Newman: The Rise of Preventive Medicine (Heath Clark Lectures). (Succeeding Lectures on Oct. 15, 16, 20, and 22.)
Bedford College for Women, at 5.15.—Miss Hosgood: The Geography of Cities.
University College Hospital Medical School, at 5.15.—Prof. J. C. G. Ledingham: Resistance to Infection, Natural and Induced. (Succeeding Lecture on Oct. 20.)
King's College, London, at 5.30.—Sir Bernard Pares: Russian History to 1861: Country and Peoples.
University College, at 5.30.—Prof. K. Bühler: Theory of Language and Psychology of Speech. (Succeeding Lecture on Oct. 15.)
British Institute of Philosophy (at University College), at 8.15.—Sir James Jeans: The Mathematical Aspect of the Universe.

WEDNESDAY, October 14.

Royal Institute of Public Health, at 4.—Sir Ernest Graham-Little: The Health of the London Citizen.
London School of Economics, at 5.—Dr. R. S. Williams: The Production, Distribution, and Nutritional Value of Milk. (Succeeding Lectures on Oct. 21 and 28.)
King's College, London, at 5.30.—Prof. E. V. Appleton: James Clerk Maxwell.
University College, at 5.30.—Dr. J. Needham: Speculation, Observation, and Experiment, as illustrated by the History of Embryology. (Succeeding Lectures on Oct. 21 and 28 and Nov. 4.)

THURSDAY, October 15.

London Hospital Medical College, at 4.15.—Prof. A. J. Hall: Chronic Epidemic Encephalitis (Schorstein Memorial Lecture).
King's College, London, at 5.—Dr. J. A. Hewitt: Metabolism of the Carbohydrates and Fats. (Succeeding Lectures on Oct. 22 and 29 and Nov. 5.)—At 5.30.—Dr. Eveline Martin: West Africa of To-day: The Entrance to British West Africa; the West Indies and the Gambia.
University College, at 5.—Prof. E. A. Gardner: Poet and Artist in Greece.

FRIDAY, October 16.

University College, at 5.—Dr. L. E. Bayliss: The Respiratory Functions of the Blood. (Succeeding Lectures on Oct. 23 and 30 and Nov. 6.)
Institution of Electrical Engineers, at 5.30.—E. C. Crittenden: The Measurement of Light: its Basis and its Significance. (Succeeding Lectures on Oct. 21, 23, 26, and 28.)

SATURDAY, October 17.

Royal Institute of British Architects, at 3.—H. S. Goodhart-Rendel: Some Opinions upon Furniture and Decoration.
Horniman Museum (Forest Hill), at 3.30.—H. N. Milligan: Success and Failure in the Animal World.

CENTENARY.

Friday, October 9.

Michael Faraday Centenary Celebration (in City Hall, Newcastle-upon-Tyne), at 7.—Dr. W. M. Thornton: Faraday and his Successors—the Growth of an Idea.