NATURE

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The Organisation of Research in India.

THE remarkable results that have been achieved in recent years in India by scientific plant-breeding are strikingly illustrated by a table contained in "A Review of Agricultural Operations in India," recently published by the Government of India (Calcutta: Superintendent of Government Printing, 1923).

In the season 1921-22 the area under new and improved varieties of crops was returned at nearly 3½ million acres. To this should be added a large area (particularly of wheat and cotton) laid down with seed obtained from other sources than official Seed Depots. Of the above-mentioned area, no less than approximately 1¼ million acres were under improved cottons, yielding in some cases an increased profit to the cultivators of 20*s*. per acre. But in regard to this crop, Indian administrators are still not satisfied with the progress made. An Indian Central Cotton Committee was appointed to examine the whole problem of cotton growing and marketing. This Committee reported in August last, and already the Indian Government has adopted one of its recommendations and passed an Act authorising the levy of a cess of 4d. per bale of cotton exported and consumed in mills, the money so raised to be used to create a Central Fund for Cotton Research.

It is estimated that this cess will produce about 45,000*l*. per annum (or one-and-a-half times the total amount originally set aside for agricultural research in Great Britain by the Development Commission). The greater portion of this sum will be devoted to the creation of a Cotton Breeding and Seed Distribution Institute, to be established, probably at Indore, in Central India. In addition, a definite scheme for research in technological problems has been formulated. An experimental spinning plant will be provided for this purpose. Further, an information bureau has been started for the collection and distribution of trade and agricultural information. It is probable that the central breeding station at Indore will be placed under the direction of Mr. and Mrs. Howard, whose successful work at Pusa in wheat-breeding is well known in Great Britain.

The Central Cotton Committee has also been instrumental in securing the enactment of measures designed to cope with the difficulties peculiar to the improvement of the cotton crop. Cotton being a plant which, usually, is cross-fertilised, an improved variety cannot be handled in a small way. Consequently, an Act has been passed which gives the Government power to notify a particular area (generally 2000 square miles) for protection, and so prevent, over a large region, the sowing of any variety other than that which it is

desired to introduce. The official regulation of cotton "gins" and presses is also likely to be introduced.

All these measures are an example of energetic and purposeful action taken by Government, under the inspiration of results achieved by research in the interests of agriculture. The progress already made has, no doubt, been favoured by the great field which the Indian crops provide for plant improvement. (There is no space to tell of the achievements in the breeding of sugar-cane, but the distressed agriculturists of Great Britain will read with envy of a crop of an improved variety of sugar-cane yielding 60 tons of raw cane per acre, as against a normal 20 tons, worth at a moderate estimate 60*l*.) But when favourable conditions are allowed for, there remains the fact that the Government appreciates, and has been quick to develop economically, the results of scientific work. It was not content to let these results rest at the laboratory stage.

What could be accomplished by similar methods in Great Britain it is difficult to say; some remnants of enlightened despotism still linger in India, and can be used quickly and effectively in the interests of progress; but it might be worth considering whether in the present sorry plight of agriculture some measure of action similar to that followed in India could not be taken. In particular, the idea of creating a research fund by the levy of a cess on the product that it is desired to improve may be worthy of consideration. Bacon, cheese, butter, wool, flax are examples of products that are imported into Britain in large quantities, to the detriment of the home producer. Is organised research powerless to help? There can be no doubt as to the answer, but our politicians, while ready to give lip-service to the value of "education and research," and even grants of money in aid of experimental work, have failed to show an adequate appreciation of the need of *following up* the achievements of research by administrative action, such as that so effectively taken by the Government of India.

Shield Tunnelling.

Shield and Compressed Air Tunnelling. By B. H. M. Hewett and S. Johannesson. Pp. x+465. (New York and London: McGraw-Hill Book Co. Inc., 1922.) 25*s*.

OF late years engineers have been driven more and more to find a location for railways, roadways, and large water-mains below the surface of the ground. In cities, by going underground the cost of acquiring valuable property is escaped. In crossing rivers, a tunnel may be less expensive than a bridge. A method has been devised for tunnelling in soft or water-bearing ground in which the miners work in a shield and an inrush of water is prevented by compressed air. In this method rings of cast-iron segments are erected in the shield, forming a water-tight lining, and as each section is completed the shield is driven forward by hydraulic jacks, leaving the lining to support the rock or earth. The more difficult the ground the greater is the advantage of this method of working. The number of tunnels which have been so driven in different countries is now large, but though the method is simple in principle the difficulties and dangers met with in carrying it out are among the most serious which tax the skill and experience of the engineer and contractor.

Information about shield tunnelling is scattered in the proceedings of professional societies, and the treatise of Messrs. Hewett and Johannesson is one of the first in which the data of past experience are gathered together and the attempt is made to formulate principles and rules of practice. It is an excellent treatise, full of information, well illustrated, and competently discussed.

Brunel patented the first shield, and by its help overcame the very great difficulties of driving the first tunnel under the Thames (1825–1843). In 1869, Barlow promoted the construction of the Tower Subway for foot passengers under the Thames. When contractors feared to undertake the work, a young engineer, Greathead, designed a new form of shield and completed the tunnel in a year. This was in dry London clay. Then, when such difficulty was experienced in driving the two Hudson River tunnels in water-bearing silt at New York that the work was temporarily abandoned, Greathead and Baker carried it on for 2000 feet by a shield and compressed air. Stopped again by want of capital, the tunnels were completed in 1904 by Jacobs. Later the Blackwall and Rotherhithe tunnels under the Thames and others abroad were successfully constructed by the same method. Descriptions of these and a full bibliography are given in this treatise.

The cast-iron lining for shield-driven tunnels is now in general use. The space between the lining and ground is filled by cement grout, forced by compressed air through holes in the lining, and the interior is made fair by brick or concrete. The joints of the lining are caulked with rust cement. There is a bulkhead behind the shield through which the compressed air is forced, and it contains airlocks for men and materials. The shield is driven forward by hydraulic jacks, working with pressures up to 6000 pounds per sq. in. and exerting a total force amounting to 6000 tons in some cases. Usually in the shield is a hydraulic erector for lifting and placing the cast-iron segments and mechanical excavators for removing the soil at the face. It may give an idea of the complex arrangements necessary if it is stated that among the equipment required

are a low-pressure plant for supplying air to keep back the water; a high-pressure plant to supply compressed air for working rock drills and other tools; a service water supply for grouting and washing; an electric light and power supply; and transportation plant. A useful chapter is one on the working force needed, the rate of progress in different cases, and the cost.

The authors give a theory of the stresses in the tunnel lining, a subject hitherto far too much neglected, designs having followed rule-of-thumb methods. This is not a suitable occasion for discussing a mathematical theory. The mode of treatment is unusual, but the results are interesting. The authors seem to underrate the erection stresses due to the weight. The most important external load is the earth pressure. The theory of earth pressure of Rankine is adopted, in which c depending on the angle of repose is the ratio of the "active" horizontal pressure to the vertical pressure and $1/c$ the ratio of the "passive" resistance of the earth, if the structure presses against it and is on the point of displacing it. But the statements (p. 76) that if the active horizontal pressures are not sufficiently large in relation to the vertical pressures the tunnel will have a tendency to deflect horizontally, and (p. 53) that if k lies between c and $1/c$ the tunnel lining will not be subject to a moment, require more justification.

An interesting chapter is that on compressed-air illness and the precautions to prevent it. The cause is the absorption of an excess of nitrogen by the blood—disengaged if the pressure is reduced. The cure is careful limitation of the period of work and slow decompression. If in spite of precautions cases of illness occur, the remedy is to recompress and decompress more slowly. For this a hospital lock is provided.

W. C. U.

Colour Vision and Colour Vision Theories.

(1) *Colour Vision: A Discussion of the Leading Phenomena and their Physical Laws.* By Prof. W. Peddie. Pp. xii+208. (London: E. Arnold and Co., 1922.) 12*s.* 6*d.* net.

(2) *Colour and Methods of Colour Reproduction.* By Dr. L. C. Martin. With Chapters on Colour Printing and Colour Photography, by William Gamble. Pp. xiii+187. (London, Glasgow and Bombay: Blackie and Sons, Ltd., 1923.) 12*s.* 6*d.* net.

THERE are no subjects on which discussion and demonstration are more needed than those of vision and colour vision. The trichromatic theory as presented by Helmholtz was the best theory in relation to the facts known at the time, but the difficulties of the theory were thoroughly recognised by him. That it was a theory and not a fact was stated by Helmholtz. That all colours can be matched by a mixture of three selected simple colours is a fact, but the statement that there is an underlying trichromatic basis is not only not a fact, but it is also not supported by any fact which cannot be explained in another way, and there is the most conclusive evidence that this is not the case, while another explanation is completely consistent with the facts. The state of chaos existing in many minds with regard to colour vision is due to the assumption that the trichromatic theory is a fact. If the theory be denied there is no evidence for it, and this was known to Helmholtz.

(1) Prof. Peddie's book is an uncompromising acceptance of the theory as a fact. The book is an admirable exposition of the functions of three variables, but no attempt is made to answer any of the objections to the theory or to show how the theory is consistent with known facts. In this respect the author differs from other writers, who admit that something more is required. If we regard colour perception as developed secondarily to light perception, as it undoubtedly was, we can form a series from total colour blindness to super-normal colour perception. The colours differing most physically in wave-length being first discriminated, these gradually approached each other until green was discriminated in the centre as a new colour, then yellow, then blue, then orange, and lastly indigo. The explanation, therefore, why red and green make yellow when mixed is, that yellow having replaced the red-green of a previous state of development, the colour perception is not sufficiently developed to discriminate between a mixture of red and green and simple yellow.

No two accounts of the trichromatic theory agree, and the theory is loaded with subsidiary hypotheses, many of them quite inconsistent with each other; that is to say, one will explain one set of facts but not another set of facts for which a different arrangement is required. Space will not permit of more than a few of the very long list of objections to the trichromatic theory being given here. If a mixture of spectral lights red, green, and violet be made to match a simple white, on the trichromatic theory the internal physiological processes should be identical; but if the eyes be now fatigued with a red light containing that used in the mixture, about twice as much green will be required in the mixed white, the mixture appearing bright green to a normal person with unfatigued eyes. Again, if a spectrum be viewed with an eye fatigued by looking at burning sodium, the yellow will have disappeared from the spectrum and the red and green will appear to meet, but a feeble red at the end of the spectrum will be quite visible. If, however, after looking through a

deep-red glass for the shortest possible time the terminal red be viewed, it will not be visible. On the trichromatic theory much greater fatigue of the red sensation process is obtained with the burning sodium.

When we come to colour blindness, which, according to Helmholtz, is the key of colour vision, the trichromatic theory fails completely to explain any case when it is fully and thoroughly examined. How, for example, does it explain that more than 50 per cent. of the dangerously colour blind can get through the wool test? How are the innumerable cases of dichromic vision to be explained? All see in the spectrum two simple colours and a neutral region, but one is only detected by very efficient tests, others by very rough tests: the latter are obviously much more colour blind than the first class. How are the trichromic, with their absence of the yellow sensation and wide monochromatic area in the yellow region—for example this may be from $\lambda 610\ \mu\mu$ to $\lambda 535\ \mu\mu$—to be explained? How is it that in so many cases the apex of the luminosity curve remains at the normal point and a normal white equation is made? Why, indeed, should a man who has three colour sensations be colour blind at all? As a matter of fact, there is considerable variation in colour perception without colour blindness; a man may make an anomalous white equation without being colour blind.

Finally, it can be clearly shown that, with a man having a defective terminal red, this is not due to a diminution of a hypothetical red sensation which is affected by rays corresponding to every part of the spectrum. For example, a man may have shortening of the red end of the spectrum; he may pass the wool test, or if the proper colours be there, put certain pinks and violets together as identical. Shown a bright red in the lantern corresponding to the shortened portion, he does not see it at all. It will be noticed that the pinks he puts with the violets are much lighter than the latter, but when viewed through a blue-green glass both appear identical in colour and shade to the normal-sighted. The blue-green glass has cut off the red rays. How, according to Prof. Peddie's construction, can a man with shortening of the red end of the spectrum pick out yellow at the normal point and have a luminosity curve with the normal apex?

The valuable work of Shelford Bidwell, which is so inimical to the trichromatic theory, is not mentioned. Bidwell showed that the phenomena of intermittent light are quite inconsistent with the compound character of the yellow sensation. If the image of a white object be formed suddenly on a portion of the retina which was previously occupied by the image of a black object, this image is surrounded by a red border. Bidwell states: "Though the image of the needle was colourless when the patch was illuminated by the greenish-yellow rays of the spectrum, it appeared red when the same hue was formed by combining red and green rays." The fact that the red border is not found with the pure greenish-yellow spectral light and is found with the compound light is strong evidence against the compound nature of the yellow sensation when caused by simple yellow light.

(2) The valuable book by Martin and Gamble should be read by all interested in colour. It is very well written, and gives an admirable account of the facts and views of different writers, without bias towards any particular theory. Dr. Martin states in the preface: "It is now more than ever necessary that the limitations of the trichromatic theory shall be explored, still by physically sound methods but by men who are fitted to understand the psychological and physiological view points. Furthermore, there is a great deal of work which needs the most careful verification and checking."

The book is divided into three sections. Part one deals with the nature of light and colour, colour analysis and synthesis, the colours of material objects, their nomenclature and measurement, colour in regard to illumination, colour in human experience, and colouring materials. This part is so clearly written that it can be easily understood by any one who has not much knowledge of physics and mathematics. Part two deals with the eye and its reactions to light, photometry, instruments for colour measurement, colour vision with an account of the principal theories, and colour blindness. Part three is written by Mr. Gamble, and deals with colour printing and photography in colours. A number of useful tables are given in an appendix.

Nature Knowledge and Pastime.

(1) *Great and Small Things.* By Sir Ray Lankester. Pp. xi+246. (London: Methuen and Co., Ltd., 1923.) 7*s.* 6*d.* net.

(2) *The Badger: Afield and Underground.* By H. Mortimer Batten. Pp. 159+12 plates. (London: H. F. and G. Witherby, 1923.) 8*s.* 6*d.* net.

(3) *A Perthshire Naturalist: Charles Macintosh of Inver.* By H. Coates. With a chapter on Scottish Folk-music by H. Wiseman. Pp. xx+244+32 plates. (London: T. Fisher Unwin, 1923.) 18*s.* net.

(4) *The Highlands with Rope and Rucksack.* By Dr. E. A. Baker. Pp. 253+19 plates. (London: H. F. and G. Witherby, 1923.) 12*s.* 6*d.* net.

(1) THE volume before us is the fifth, if we are not mistaken, in a series of volumes whereby Sir Ray Lankester has rendered notable service to those persons who, though debarred by circumstance from undertaking sustained research, deeply sympathise with advance in natural science, are eager for sound informa-

tion, and grateful to a competent showman, so to speak. In the present volume the author ranges wide—from the gorilla which, having spent its childhood in devoted attachment to a lady in Sloane Street, sickened and died when she was obliged to part with him, to the parasites of a pond snail and Metchnikoff's investigation of the means of making old age still older. The title of the book is well chosen, for it contains the conclusions of a trained intellect upon such great problems as the suffering inseparable from the existence of all animals, and upon such small ones as the relative advantage (or otherwise) of the different ways of using tobacco. Even those smokers who display little interest in chemical science, though rightly regarding nicotine as the chief toxic agent in tobacco, may feel relieved in learning that "it is a colourless volatile liquid, which is vaporised and carried along with the smoke," and not the malodorous oily juice that collects in the stem of a foul pipe or the stump of a cigar.

Elderly folk who were reared in the belief that they had to work their way through life equipped with only five senses—sight, hearing, smell, taste, and touch—may be surprised to learn that all the time they have been served by double that number. Increased knowledge of physiology has revealed the existence in the human frame of a distinct apparatus and separate nerve-threads for the perception of heat, cold, and pain, for muscular contraction and for the maintenance of equilibrium, all of which—except the last, which escaped consideration—were of old roughly assigned as functions of the sense of touch.

Sir Ray Lankester points out that the most salient anatomical difference between man and the gorilla is in the structure of the foot. In man the axial line of the posterior limb passes straight down the shin-bone to the hallux or great toe; whereas in plantigrades, such as bears and anthropoid apes, it is directed between the third and fourth digits, leaving the hallux to be deflected and developed into a powerful grasping organ. The importance of this difference consists in the absence of any trace of a form of foot intermediate between that of man and the ape.

This volume, like its predecessors in the series, is written with lucid fluency, is admirably illustrated, and many readers will pass a hearty vote of thanks to the author for having devoted his well-earned leisure to their profit.

(2) In his great work on British and Irish mammals, Mr. J. G. Millais apologised for having quoted at so great length from Sir Alfred Pease's treatise on the badger, which had rendered it scarcely possible to write anything new upon that subject. While Mr. Mortimer Batten can scarcely claim to have made fresh addition to our knowledge of the habits of this most cryptic creature, he has recorded in very readable form his own patient observation thereof, confirming much that has been written by other naturalists and giving his own views upon points whereon these have differed. He considers the badger to be "the most abused and misunderstood of British wild beasts," quoting the sickening treatment of the animal prescribed by Nicholas Cox in the sixteenth century before baiting it with terriers. "Cut away the nether jaw, but meddle not with the other, leaving the other to show the fury of the beast, although it can do no harm therewith." Drawing the badger, a so-called sport which it is to be feared is still in vogue as a clandestine pastime, was made illegal by the Act of 1850; but unfortunately there is no law against "trying" terriers on a captive badger.

Sir Alfred Pease stated that the badger had become rare in Scotland and had "entirely vanished" from the north-east of that country. Mr. Mortimer Batten, however, has satisfied himself that the race survives in far greater numbers than most people think, founding his opinions not only on the badgers which he has himself found, with his terriers, in cairns, but also on the great preponderance in some hill districts of the tracks of badgers in snow over those of foxes.

Naturalists have differed widely in estimating the period of the sow badger's gestation. Mr. Millais accepted fifteen months as possible, at least for a badger in captivity; Sir Alfred Pease put it at nine months, Tom Speedy at seven, Sir Harry Johnston at six; but Mr. Batten gives good grounds for agreeing with Capt. Salvin that the normal term is eleven or twelve months. He rejects the supposed analogy with the roe, which has been credited with the power of postponing parturition until circumstances are suitable for her.

"What really does happen in the case of the roe is this—the embryo does not develop, or at least develops very slowly, during the first four months of pregnancy, so that she carries her young close upon four months longer than is normal. This peculiarity of the roe is probably owing to a total change of environment—that is, the animal originated under semi-tropical conditions, and migration northward during [? after] the glacial age led to a postponement in the operation of parturition."

This may pass for speculation on an obscure problem; the value of Mr. Mortimer Batten's book consists in the convenient manner in which he has summarised all that is known of one of our larger wild animals, subject to critical light from his own observation, and has supplied excellent photographs and explanatory cuts.

(3) Charles Macintosh was of a type not infrequent among the Scottish peasantry—men self-taught in some branch of natural history; keen observers but ill-equipped with appliances and books of reference,

patiently accumulating facts until, in middle life or past it, some happy accident brings their work to the knowledge of those whose scientific standing enables them to advise and assist. Probably there are and have been many "mute, inglorious" Tyndalls and Huxleys to whom such chance never came; but just as the labours of Robert Dick of Thurso on the Old Red Sandstone were recognised and redeemed from oblivion by Hugh Miller and Sir Roderick Murchison, so when Dr. Buchanan White started in 1872 to investigate the mycology of Perthshire he found that Macintosh, a humble rural postman on a weekly wage of 12*s*., had gone far to make a complete collection of the Basidiomycetæ, and straightway enlisted him as an auxiliary and correspondent of the Perthshire Society of Natural Science.

Charles Macintosh was born in 1839, the son of a handloom weaver in the village of Inver, near Dunkeld. When he was sixteen years old he obtained employment in a sawmill, and two years later met with an accident that deprived him of all the fingers and the thumb of his left hand. In 1858 he was appointed post-runner in the district between Dunkeld and Ballinluig—a sylvan and riparian region most congenial to one with his bent for botany and natural history. His daily round afoot was about 16 miles, enough, it might be thought, to abate inclination for serious work when off duty; but

"ingenium res
Adversae nudare solent,"

and Macintosh's appetite for knowledge was insatiable. With the aid of a very imperfect microscope and a few antiquated works on botany, by the time he became acquainted with Dr. Buchanan White in 1872 he had made a very extensive collection, not only of the flowering plants, but also of the ferns and other cryptogams of Strathtay. After that, having supplied himself out of his savings with better instruments and modern books, he contributed several additions to the flora of Perthshire, including seventeen species of fungus hitherto unrecorded in Britain, of which four were new to science, namely, *Curreyella aucupariæ*, *Melogramma elongatum*, *Ascobolus Carletoni*, and *Ombrophila megalospora*. He finished 32 years' service under the Post Office in 1890, and died in 1922.

Mr. Coates has done full justice to the subject of this memoir, which is very fully illustrated, the frontispiece being an exceptionally interesting photograph of Macintosh. We have noted very few slips: the great oak at Birnam may possibly be a survival of the primeval forest, but not so the sycamore (p. 60), for that is not an indigenous species. Both trees are well known to the present writer, and to estimate their age at one thousand years is to disregard what is obviously their vigorous prime. To describe a family bible as "a human document" (p. 11) is grievously to misapply a metaphorical phrase. Lastly, widely as the spurious adjective "phenomenal" has come into use in the sense of "extraordinary," to describe the Tay as having been reduced by drought to "almost phenomenally small proportions" (p. 221) is surely neither sense nor English!

(4) A certain German philosopher is credited with the doctrine that every object of interest should be inspected from its proper point of view—a church from the outside, a tavern from the inside, and a mountain from the bottom. Whatever may be Dr. Ernest Baker's opinion about churches and taverns, he holds emphatically that the worst aspect of a mountain is from the bottom. Its only legitimate purpose is to be climbed on its most difficult side. The first fifty pages of his treatise on "the excellent sport of rock-climbing" are applied to a denunciation of Highland landowners for putting difficulties in the way of tourists and trippers, but for which he is confident that the Scottish Highlands would attract as many holiday folk as Switzerland does.

Dr. Baker's own narrative testifies to the fact that the summer climate of the Highlands is scarcely so serene as that of Switzerland. In his adventures among the Highland hills he encountered many spells of dismal weather.

"We were awake betimes, but rain was falling, and for three long days the weather remained too bad for serious climbing. Stob Dearg was continuously swathed in mist; and the gullies, as we could see afar off by the tracks of white, were spouting water amain" (p. 78).

As for landowners, there are no doubt surly ones as well as others of milder mood; but the powers of both in preventing access to their estates are more strictly limited than Dr. Baker explains. They can only proceed against trespass by obtaining interdict against individuals. "Trespassers will be prosecuted" is *brutum fulmen* unless damage can be proved. It may be doubtful whether a judge would decide that damage had been done in the incident described as follows; but the immediate consequences might have been serious if the Highland glens had been as full of holiday-makers as the author would like to have them.

"As usual on a new climb, we found many splinters hanging in dangerous places, and the worst of them we cleared away. One big lump of porphyry, caught in unstable equipoise on the bevel-end of a ledge, gave rise to a memorable incident. I was held from above by the rope while I gave the rock a final shove that released it. Thirty feet below, a pinnacle stood out from the face, a squarish mass some twenty-five feet in height and about sixteen in girth. It is discernible in the photo taken near the foot of the climb, but its place knows it no more. . . . We calculated afterwards

that it would weigh 80 or 90 tons. . . . The falling rock hit the top of it. The pinnacle shook in its socket, lurched forward, bowed majestically over, and, almost before we knew what was happening, went hurtling down the cliffs and gullies. It cleared some hundreds of feet at a leap; then striking a projection, bounded off, leaving an ugly scar behind, and thundered on down the crags, smashing off corners, crashing into the screes in the gullies and splashing up the snow like water. . . . The whole ridge vibrated like a bridge with a heavy express rushing over."

Pretty pastime! yet landowners are but human after all, and might not unreasonably demur to much of this kind of thing. There is no evidence that in his scrambles Dr. Baker took any notice of geology, botany, or anything except the opportunity for hazardous athletics. His book is illustrated with many good photographs of hill scenery. HERBERT MAXWELL.

Psychotherapy.

Suggestion and Mental Analysis: An Outline of the Theory and Practice of Mind Cure. By Dr. William Brown. Third edition, with Index. Pp. 176. (London: University of London Press, Ltd., 1923.) 3*s*. 6*d*. net.

AS implied by the title, Dr. Brown's "Suggestion and Mental Analysis" brings together the widely divergent views of the two principal schools of psychotherapy. It is an attempt to harmonise the theory and practice of the hypnotists, suggestionists, and autosuggestionists, on one hand, and of the psycho-analysts on the other. It is generally claimed by the partisans of each school that its method is exclusively the best suited for the treatment of those forms of psychoneuroses in which mental therapy is indicated. Indeed, as Dr. Brown points out, extremists of both schools agree in disclaiming any possibility of a synthesis of their methods. In practice, however, it not seldom works out that such disclaimers are ignored, even by the purists. Dr. Brown argues that the various methods of psychotherapy can be advantageously employed in combination. He bases his views upon a very large number of typical clinical cases which have passed through his hands both in civilian practice and as a result of the special conditions due to the War. With regard to the latter cases, Dr. Brown worked mainly by suggestion and hypnosis, and with marked success. He now advocates a judicious use of all the methods, some of which are more especially adapted to one type of case and some to others. He thus, on empirical grounds, declares himself to be an eclectic.

The book is elementary—even popular—but it touches upon most of the points which are treated at length in the large and continually growing literature of psychotherapy. The first chapters deal with generalities on suggestion and the subconscious, and sketch briefly the theories and methods of the analysts. Several interesting case-histories are given in some detail to illustrate the dissociation due to hysteria and hysterical epilepsy. Hypnosis is contrasted with suggestion, and is itself declared to be a form of dissociation; in consequence of which the conclusion is—rightly—drawn that frequent hypnotising of a patient is dangerous. Nevertheless, hypnosis is a valuable procedure to employ in certain cases. Indeed, all proved methods are valuable. This is the general conclusion of the book, in which such divergent views as those of Charcot, Bernheim, Freud, Jung, Coué, and others are considered.

The more scientific and therapeutic part of the volume is supplemented by three chapters on the "philosophical background," which consist of a summary exposition and criticism of the philosophy of M. Bergson. It is true, as Dr. Brown remarks, that "every revolution in scientific theory synchronises closely with the development of new ideas, and even new systems, within the domain of philosophy"; and no doubt Bergson's philosophy synchronises to some extent with the rise and growth of recent psychotherapeutic theory and practice. There are obvious similarities in both. But it is not obvious why these chapters should have been included in a book on psychotherapy; and their inclusion makes it appear rather overweighted with speculation. The present is the third edition of the book; and it is clear that this excellent elementary presentation of the theory and practice of "mind cure" meets the good reception it deserves at the hands of the public. There is a good index.

Our Bookshelf.

Cements and Artificial Stone: a Descriptive Catalogue of the Specimens in the Sedgwick Museum, Cambridge. By the late John Watson. Edited by Dr. R. H. Rastall. Pp. xii+131. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1922.) 6*s*. net.

THE collections brought together by the zealous care of Mr. Watson in the Sedgwick Museum have been of great service in technical geology. Probably much may still be added to the samples of cement and artificial stone described in the present volume, as these materials become still more favoured by architects and engineers. The labour and art of the mason may decline, but the production of durable cements for covering walls, the colouring of them until they surpass in brilliance the painted surfaces of Roman times, and the imparting of increased delicacy to moulded work in stucco, are alike honourable and artistic occupations. The materials of artificial slabs are largely natural

rock, brecciated or pulverised, but otherwise untreated, and the pride of their makers lies in the production of monolithic blocks of more uniform texture and more free from cracks than can be obtained from ordinary quarries. Mr. Watson (p. 76) gives an impressive account of the hollow blocks of reinforced concrete, each weighing 2464 tons, and measuring 66 by 53 by 50 feet, used in harbour-construction at Valparaiso in 1917. It seems as if a house of considerable size, with staircases and passage-ways, could now be moulded round a light steel framework as a single piece, and transported by flotation to any quarter of the globe.

The author shows (p. 94) how well-known building-stones, with their pleasing colours, are already successfully imitated, and how a great field lies open before the manufacturer of light roofing-tiles that may compete in our towns with the monotonous grey tints of slate. Nothing is likely to oust polished granite from its supreme place as a decorative stone for towns; but those who would decry the use of artificial stone must remember that the glories of Verona, the Hansa Towns, and Hampton Court are largely due to the manipulation and moulding of detrital clay. Mr. Watson gives a long and interesting history of the Portland cement industry, which his specimens fully illustrate. He directs attention (pp. 101 and 114) to the good acoustic properties of selenitic cement for lining walls; but we cannot find a mention of the remarkable cement now formed from magnesite and used for floors. The early use of the Italian *pozzolana* (which even the "Encyclopædia Britannica" spells in places *pozzuolana*) is well mentioned; but we doubt if (p. 2) Puteoli was also known to the Romans as "Putevolano." G. A. J. C.

Special Steels: a Concise Treatise on the Constitution, Manufacture, Working, Heat Treatment, and Applications of Alloy Steels, for Students, Operators, and Users of Special Steels. Chiefly founded on the Researches regarding Alloy Steels of Sir Robert Hadfield. By Thos. H. Burnham. (Pitman's Technical Primers Series.) Pp. xxii+194. (London: Sir Isaac Pitman and Sons, Ltd., 1923.) 5*s.* net.

THIS small volume is a welcome addition to the literature dealing with special steels, as it contains a large amount of useful information compressed into a small compass. The necessity for economy in the use of iron ore is clearly indicated both by Sir Robert A. Hadfield and the author, who show that, by the use of special steels, the amount of iron necessary for most purposes is greatly reduced.

Considerable information is given relating to the constitution and manufacture of special steels and to their later heat or other treatment. Much useful work has been done during the past twenty years in connexion with the heat treatment of ordinary carbon steel, but this treatment, in the case of large masses, is always unsatisfactory on account of the impossibility of bringing about uniform structural changes. If, however, carbon steel is alloyed with other elements a considerably greater range of mechanical and other properties is available. These considerations are dealt with in this small book. Accounts are given of various classes of special steels, while under "chromium steel" details are given relating to rustless steel, such as its composition, mechanical and heat treatment, mechanical properties, resistance to corrosion, and its applications. A chapter each is devoted to silicon, manganese, and tungsten steels, while some details are given respecting the manufacture, properties, and uses of other types of special steel. The final chapter (xii.) points out the general trend of progress, and there are four appendices which deal respectively with: (1) carbon steels; (2) a classified list of papers by Sir Robert A. Hadfield; (3) a list of symposia of the Faraday Society; and (4) the relation between hardness number and shock qualities, tensile strength and compression strength of various types of steel.

The book provides the student and the practical man with a handy survey of the subject, and should find a place in all technical libraries. W. H. M.

(1) *Animal Nutrition: Foods and Feeding.* By E. T. Halnan. Pp. 52. 2*s.* net. (2) *Farm Costing and Accounts.* By C. S. Orwin. Pp. 31. 1*s.* 6*d.* net. (3) *Insect Pests and Fungous Diseases of Farm Crops.* By A. Roebuck. Pp. 55. 2*s.* net. (4) *Poultry Keeping on the Farm.* By Edward Brown. Pp. 54. (London: Benn Bros., Ltd., 1923.) 2*s.* net.

THE four little books under notice belong to the "Successful Farming Series," the purpose of which is "to raise the standard of British Farming in all its branches."

Even in this small compass Mr. E. T. Halnan (1) has developed the subject of animal nutrition from the fundamental scientific facts to the practical deductions drawn therefrom. The exposition is lucid, and the book should not only interest farmers who have no scientific knowledge, but it should also be of real use to them in their daily work.

(2) In "Farm Costing and Accounts," by Prof. C. S. Orwin, simple methods are given for keeping financial accounts suited to the needs of almost any farmer—and incidentally sufficient for purposes of reclaiming excess income tax—and an outline of the methods of keeping the more intricate costing accounts.

(3) "Insect Pests and Fungous Diseases of Farm Crops," by Mr. A. Roebuck, contains descriptions of the common insect pests and the appearances of plants attacked by them or by various fungi. The writer suggests prophylactic measures such as balanced manures, and the avoidance of harbouring places for pests such as are found on untidy and ill-kept farms and buildings.

(4) In "Poultry Keeping on the Farm," Mr. Edward Brown emphasises the possibility of increasing very greatly the number of poultry kept in this country. In his opinion this increase can take place most profitably on farms, where the birds could find much of their food; but he maintains that there are also big openings for specialised poultry keeping, more especially in the vicinity of large towns, and for selective breeding.

The Elementary Principles of Lighting and Photometry. By J. W. T. Walsh. Pp. xvi+220. (London: Methuen and Co., Ltd., 1923.) 10*s.* 6*d.* net.

MR. WALSH'S book may be regarded as a useful supplement to pre-War works on illumination. The text may be conveniently divided into four main sections. We have first an account of the effect of light on the eye,

followed by an explanation of terms and elementary principles. Next there are chapters dealing with various aspects of photometry, leading to a discussion on calculations of illumination. Finally we have, in the second half of the book, a general discussion of practical lighting problems. Consideration of the human eye forms a natural starting-point, and in general a logical sequence of subjects is adopted. One may question, however, whether the separation of heterochromatic photometry and the flicker-photometer in the penultimate chapter is desirable. Surely this might more fitly have been included in the earlier section of the book dealing with photometry in general? Mr. Walsh's experience at the National Physical Laboratory has stood him in good stead in dealing with this phase of the subject. The hints on laboratory practice are sound, and there is a useful description of the chief forms of illumination-photometers. It is interesting to note that, with proper precautions, an accuracy of 2-3 per cent. is considered possible with this class of instrument. The chapter on industrial lighting contains a useful survey of the work of the Home Office Departmental Committee on Lighting in Factories and Workshops, and the contents of various American codes. One is glad to note the inclusion of a chapter on daylight illumination, which is now being studied in a more scientific manner than in the past.

The final chapters on colour and light-projection include a variety of special applications of light such as motor-car headlights, searchlights, flood-lighting, and artificial daylight. (In the calculation of flood-lighting on p. 189 a slip appears to have been made.) The book is concluded by a series of definitions of the chief photometric quantities, a bibliography, and an adequate index.

L'Arc électrique. Par Maurice Leblanc fils. (Recueil des Conférences-Rapports de Documentation sur la Physique. Vol. 3, 1re Série, Conférences 7, 8. Édité par la Société *Journal de Physique.*) Pp. 131. (Paris: Les Presses Universitaires de France, 1922.) 10 francs.

THE first chapter of the work under notice contains the more important formulæ obtained by modern physicists in connexion with the electric arc. A drawback to the use of these formulæ is that it is difficult to find out where theory ends and empiricism begins. If we accept the formulæ we have to abandon the theory of dimensions as applied to equations. In the second chapter Mrs. Ayrton's work is well described. It is stated that Blondel was the first to prove that there was no appreciable counter electromotive force in the arc. If E denotes the potential difference across the arc and I the current through it, then dE/dI is called the resistance of the arc, and it is pointed out that it is a negative quantity. A good description is given of magnetic and mercury vapour lamps. The phenomena shown by the so-called "non-arcing" metals, such as phosphor-bronze, aluminium-bronze, aluminium and zinc, are attributed to a metallic oxide covering the electrodes with an insulating layer or to the vapour being difficult to ionise. It is pointed out that although the current and voltage vanish instantaneously in alternating current arcs, yet their power factor is not unity. This is stated to be due to the fact that they do not both follow the sine law. As a matter of fact, provided that the ordinate of the current wave is always proportional to the ordinate of the voltage wave, and they vanish instantaneously, the power factor would be unity whatever the shape of the voltage wave. The third chapter gives the technical applications of the electric arc to searchlights, furnaces, electric welding, for producing high-frequency waves, and in electric "safety valves" for protection against lightning. A. R.

Machine-Shop Mathematics. By G. Wentworth, D. E. Smith, and H. D. Harper. (Wentworth-Smith Mathematical Series.) Pp. v+162. (London: Ginn and Co., 1922.) 5*s.* 6*d.* net.

THE presentation, in most cases without proof, of a hundred and twenty formulæ in as many pages can scarcely lay claim to the title of mathematics, but this book forms nevertheless a clearly worded and practical introduction to machine-shop calculations. Its scope is confessedly limited to the needs of those who hope to become expert machinists with little or no mathematical grounding, and throughout the book more attention is paid to the explanation of technological details than to the development of method. The use of measuring instruments and calculations affecting cutting speeds, taper turning, screw cutting, indexing and gear cutting are clearly described, generally with the aid of excellent diagrams. The number of formulæ is large, and a judicious reduction in this respect would bring emphasis on to the more important without prejudice to the range of the book. Illustrative problems are worked out in the text, and examples throughout are numerous and well chosen. Their value to the self-dependent student would, however, be greatly enhanced if answers were given. Calculations are in most cases made to cover British as well as American practice, but reference tables at the end give American standards only. H. W. S.

An Introduction to the Psychology of Religion. By R. H. Thouless. Pp. vi+286. (Cambridge: At the University Press, 1923.) 7*s.* 6*d.* net.

THERE is an undoubted movement of thought towards a restatement of religion and religious problems along the lines of recent psychological achievement. This has already taken the place, to a large extent, of the apologetic defence of religion on the plane of the sciences of Nature. Mr. Thouless writes for those who wish to make a study of the problems of religion from a psychological point of view without any prior knowledge of psychological terminology. The most interesting parts of his book are those in which he relates religion to certain of the instinctive tendencies of man, while defending it from the charge of being no more than a subjective experience of gregariousness or sex; and his chapter on the phenomena of mysticism, for which he goes in the main to the mystics of the Roman Catholic Church. He treats this subject with great insight and exactness, and interprets it sympathetically in the light of recent psychoanalytical theory. The book, while avowedly "popular," will be of interest to students both of religion and of psychology.

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.*]

Gravitation and Light-pressure in Nebulæ.

DOES not Prof. Lindemann's theory of spiral nebulæ (discussed by Sir Oliver Lodge in NATURE of May 26, p. 702) fail through disregarding the absorption or reflection of radiation which must necessarily accompany any mechanical action of light-pressure? Prof. Lindemann's typical nebula has a mass of about 0·1 gram per sq. cm. of area, which is probably something like the true value; but to get this value, Prof. Lindemann's assumed particles of diameters 10^{-4} or 10^{-5} cm. must lie behind one another some thousands deep. The particles in the outermost layer are, no doubt, acted on by light-pressure in the way supposed, but not so those in the inner layers; these are shielded from light-pressure but not from gravitation—and here the whole theory seems to fail. Incidentally, a nebula formed of solid particles lying thousands deep would surely be too opaque for novæ formed in its interior to be seen as novæ.

The whole question seems to be governed by a calculation much simpler than any given by Prof. Lindemann. If a star or group of stars emit radiant energy E per unit time, the flow of momentum through any cross-section of a cone of solid angle ω will be $E\omega/4\pi C$ per unit time. Thus the maximum mass m which light-pressure can possibly support (or repel) in this cone at a distance r from the light is given by

$$\frac{\gamma m M}{r^2} = \frac{E\omega}{4\pi C},$$

where γ is the gravitation constant, and M the mass of the star or stars. Thus the maximum mass per unit area, $m/\omega r^2$, is

$$\frac{1}{4\pi\gamma C}\frac{E}{M}.$$

This is of course independent of r, because gravitation and light pressure both fall off as $1/r^2$; it does not depend on the number of stars at work, since E and M are each proportional to that number. For the aggregate of matter in the universe we may perhaps put E/M equal to unity, this being about half its value for our sun. The maximum mass per unit area which light-pressure can support or repel is now $1/4\pi\gamma C$, or about one gram per 25,000 sq. cm., whereas the spiral nebulæ, on Prof. Lindemann's own estimate, have one gram per 10 sq. cm. No doubt it may be argued that the nebulæ in the past were more tenuous than now, but the nebulæ reduced to a surface-density of one gram per 25,000 sq. cm. would cover the heavens many times over at any reasonable distance.

I have long wondered whether a true example of suspension in equilibrium between gravitation and light-pressure may not possibly be found in the shells which constitute the outer surfaces of the planetary nebulæ. That there is suspension in equilibrium seems scarcely open to question; the hypothesis that gravitation and light-pressure are the equilibrating agencies satisfies all the numerical tests I have been able to apply. But it is necessary for stability that the matter should be gaseous, as is in fact spectroscopically found to be the case. A hollow shell of solid particles can be suspended in equilibrium, but this equilibrium cannot be stable for radial displacements. Press the shell closer in to the star and its particles shield one another more from light-pressure, so that gravitation becomes relatively more potent than light-pressure and the shell falls in. But a hollow shell of gas may be stable if its temperature is such that its degrees of dissociation and ionisation are sufficiently sensitive to changes of temperature. Press such a shell closer in to the star and its constituents break up more; assuming that this increases its opacity, light-pressure becomes relatively more potent and the shell is driven back. Draw the shell out to a radius greater than the equilibrium radius and the converse occurs: the equilibrium is stable.

J. H. JEANS.

May 28.

IN the issue of NATURE for May 26, p. 702, there is an interesting letter by Sir Oliver Lodge about a suggestion I had put forward on the nature of the spiral nebulæ. Sir Oliver Lodge suggests that the recombination of electrons ejected photoelectrically might well be more important as a source of light than simple reflection. This does not seem to me probable. In spite of many efforts to improve photoelectric cells, the best type only gives an efficiency of about 2 per cent. Even if the spirals were equally efficient, therefore, only this fraction of the incident energy could be emitted in the form of light on recombination of the electrons. It is probable that any material of which spirals may be composed has a reflection coefficient of at least 20 per cent. and very likely 50 per cent., so that ordinary reflection must be at least ten times and is probably some hundreds of times as effective as the process imagined by Sir Oliver Lodge.

F. A. LINDEMANN.

Clarendon Laboratory,
University Museum, Oxford,
June 4, 1923.

Selection and Segregation.

I THINK by "recent discussions in the columns of NATURE" Prof. Arthur Willey (NATURE, May 5, p. 602) alludes to discussions started by me. I gather that he believes that evolution is founded on mutations the inheritance of which is Mendelian, and, therefore, that natural selection preserves but does not create racial change. Experiment furnishes him with justification, but not with proof. On the same evidence, and a great deal more, divergent opinions have been founded. Crucial tests are required—tests which, from the nature of the case, experiment cannot furnish, but which may be found in abundance among facts that are within common knowledge and are not disputed. So far as I am able to judge, they do not support Mendelian theory, and to them I invite Prof. Willey's attention. If I be mistaken, it should be easy to indicate my errors. If I be right (I am not alluding to Prof. Willey), is it worth while to ignore evidence which is common property and on which attention is more or less riveted, or to hint that I am ignorant of the latest work of the truest biologists—and then to scuttle from my challenge? In spite of Mendelians, the Mendelian facts are so illuminating that they are sure, when linked with the rest of our knowledge, to influence immensely our conceptions of, and control of, life. They can be so linked only by means of crucial instances. May I, therefore, iterate a few of the latter? I have some morals to draw or imply. Can a flaw of fact or reasoning be found in the following?

1. Our powers of observing are proportionate to our familiarity with the objects of study. In all Nature, we are, for purposes of observing fluctuations and natural selection, sufficiently intimate with only one species—our own (see NATURE, January 13, p. 50). Either we must derive our evidence from the lives and deaths of men, or else our thinking is mere guessing. Examining the evidence, we find (*a*) that stringent natural selection is in full swing all the world over; (*b*) that fluctuations, not mutations, are chosen; and (*c*) that the result is always adaptive evolution. If that be the case with men, whom naturalists describe as having "escaped from selection," is it not, to say the least, likely to be the case with other types?

2. Human races never differentiate while there is interbreeding, but invariably diverge when separated by time and space. So far as clear evidence goes, this is true of all natural types. Have we not here proof that offspring blend parental differences, and therefore that natural racial change is based on fluctuations?

3. It has been said very truly, "The fact that the gametes of the cross transmit each member of the pair pure, is as strong an indication as can be desired of the discontinuity between them." The converse must be true also; if the members of the cross blend, we have proof that the unlikeness between them was built up of fluctuations. Now, all human races, and so far as I know all natural races, blend when crossed, except in characters linked with sex.

4. There is massive evidence, not disputed by Mendelians, that male is undeveloped female, and *vice versa*. Here we have alternate patency and latency, alternate *reproduction*, *not* alternate *inheritance*. Male and female characters, belonging to different sets, do not blend; but, presumably, *the patent characters of the one sex blend with the latent characters of the other*. Sometimes, as in aphides, the patency and latency extends unaltered over many generations. But if, as is alleged, the *inheritance* of sex is Mendelian and segregation occurs, how is the prolonged latency of the male traits conceivable? Theoretically males, as well as females, should appear in the first parthenogenetic generation, after which, since the males cannot reproduce, and the females have become pure dominants, males should never again appear.

5. If a mutant crosses with the normal, we have, admittedly, in the impure dominant, exactly such patency and latency as is found in sexual characters. Mendelians insist that afterwards there is segregation, and, therefore, that in following generations pure dominants and recessives occur. How, then, does it happen that "pure" dominants sometimes produce recessives, and recessives dominants? How does it happen that *purely* bred domesticated types (*e.g.* pigeons, poultry, and many plants) often "throw back"—reproduce the ancestral type which according to theory was eliminated perhaps hundreds, perhaps even thousands, of generations previously? Is this not clear evidence that Nature treats mutations like sexual traits, making their reproduction, not their inheritance, alternate?

6. Crossing often reveals long-lost ancestral traits among artificial varieties, but never among men or other natural types. Is this not clear proof that while man often chooses mutations, Nature selects among fluctuations? But man does not always choose mutations. Sometimes, though he cannot easily perceive fluctuations except among his own kind, he selects them. Thus speed in racehorses is due to a high average of excellence in a thousand co-ordinated structures. A thousand mutations occurring at once are out of the question. As might be expected, (*a*) racehorses tend, in lack of stringent selection, to retrogress with a speed which is proportionate to the antecedent progression, and (*b*) the offspring of a cross between race and ordinary horses blend the parental differences, as in hunters and hacks.

7. Apparently, then, the crossing of mutants with the normal results in alternate reproduction. Yet careful artificial breeding produces all the effects of alternate inheritance; for in this way undesired traits may be rendered almost permanently latent, as witness the narrow stripes revealed by the offspring of horses crossed with the broad-striped Burchell zebra, whence it appears that man never domesticated the horse as such, but began with an animal striped like the Somali zebra, the coloration of which he rendered latent by selecting mutations. Human mutations—idiocy, hare-lip, tumours, and so on—are common; but useful human mutations are unknown. Many of them, idiocy, for example, become yearly more common, and medical men, believing that they usually indicate the reappearance of latent ancestral traits, hope by preventing procreation to reduce their frequency. If, however, Mendelian theory be correct, they are new variations, and the position of humanity is hopeless. In that case the human species is "ever-mutating"; and, since human mutations are ever-injurious, there is no scope for selection. And yet the odd thing is that there is always selection, and the result is always improved adaptation.

8. I suppose my word "predisposition" (potentiality, diathesis) corresponds somewhat with the Mendelian word "gene." But I merely follow physiologists and pathologists who, assuming germinal predisposition, seek in each case to discover the nurture that causes development. If I have speculated, it is only to suppose, as others have done, that perhaps all the cells of the body are alike in nature, and differ only through nurture. "Gene," on the other hand, implies a knowledge more profound, or an assumption more daring. Itself a discrete unit, it is the representative of a unit character (one with Mendelian inheritance). Like the "physiological units," "gemmules," and "determinants" of our predecessors, it is a brick in the architecture of the germplasm. It is difficult to understand, however; for the multicellular individual, a cell-community, is compounded of characters; and a character may be a sub-community (*e.g.* rose-comb, extra digit, blacksmith's muscle), or a quality of the whole community (for example, size, shape, colour), or a quality of a character (for example, colour of a flower). As we have just seen, crossed natural varieties blend their characters: have they, then, no unit characters, and, therefore, no genes? I understand that characters, not their modifications, are represented by genes. Thus there is a gene (or genes) for normal but not for diseased skin, for skin-colour but not for sunburn, for normal but not for blacksmith's muscles. Unfortunately I know of no character that is not a modification of its antecedent self. Thus the muscles of the athlete were modified by nurture from those of the ordinary man, which were modified from those of the youth, and so on right back to the germ-cell. Which, then, is the character, and which its modifications? *Obviously* all characters are "fluctuations due to conditions of environment, to nutrition, correlation of organs, and the like. There is no indisputable evidence that they can be worked up and fixed as a specific character." But try to conceive a character which is not a product of some sort of nurture! It appears, then, that genes represent nothing conceivable, and that evolution is impossible. But the attempt to understand genes makes my head

ache. Intellectually unfit to grapple with these subtilties, I must return to the simple, if crude and ignorant, physiological conception that all characters are products of germinal predisposition and somatic nurture; and to the notion that, while there is always blending and sometimes alternate reproduction, there is never alternate inheritance.

G. ARCHDALL REID.

20 Lennox Road, South, Southsea, Hants,
May 17.

Martini's Equations for the Epidemiology of Immunising Diseases.

THE differential equations constructed by Dr. Martini and quoted by Dr. Lotka in NATURE of May 12, p. 633, namely,

$$\frac{du}{dt} = au(1-i) - qu, \quad . \quad . \quad . \quad (1)$$

$$\frac{di}{dt} = au(1-i) - mu, \quad . \quad . \quad . \quad (2)$$

aroused my interest by the statement that they cannot be integrated in finite terms. I have noticed that in one particular case the integrals of the equations can be expressed in a moderately simple form, and that in this case Dr. Martini's second position of equilibrium, namely,

$$u = \frac{m(a-q)}{aq}, \quad i = \frac{a-q}{a},$$

is unattainable within a finite time unless it is permanent.

The particular case in question which has come to my notice is that in which $q=m$, that is to say, the fraction of the affected population which ceases to be so per unit time is equal to the fraction of the immune population which loses immunity or dies per unit time.

In this case it is evident by subtraction that

$$\frac{du}{dt} - \frac{di}{dt} = -q(u-i),$$

so that $u-i = Aqe^{-qt}$, where A is the constant of integration. On substituting for i in (1) it is evident that

$$\frac{du}{dt} = (a - q + aAqe^{-qt})u - au^2,$$

an equation reducible to the linear form (and so soluble by quadratures) by the substitution $v = 1/u$.

The solution, which it will be sufficient to quote, is

$$\frac{1}{u} = \sum_{n=0}^{\infty} \frac{(-)^n a^{n+1} A^n e^{-nqt}}{(a-q)(a-2q) \ldots (a-nq-q)} + B\, exp\{(q-a)t + aAe^{-qt}\},$$

where B is the second constant of integration.

It is easy to see that the second position of equilibrium is given in this case by

$$u = i = \frac{a-q}{a},$$

and if u and i have this value for a finite value of t, it is readily seen successively that A = 0 and B = 0, so that u and i have this value for all time. On the other hand, whatever be the values of A and B, the value $(a-q)/a$ is the limit to which both u and i tend as the time tends to infinity, provided that a exceeds q; if a does not exceed q, they tend to zero, unless B = 0.

I imagine from Dr. Lotka's silence concerning these results that they have not been previously obtained, and, for all I know, the case $q=m$ may be of no practical importance. But the analysis which I have given seems to me to throw some light on what the behaviour of the solution might be expected to be in the general case.

G. N. WATSON.

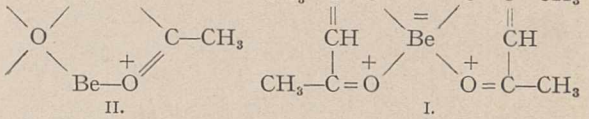
The University, Birmingham,
May 12.

The Structure of Basic Beryllium Acetate.

THE remarkable compound $Be_4O(C_2H_3O_2)_6$, the crystal structure of which Sir William Bragg describes in his letter in NATURE of April 21, p. 532, can be given a chemical formula in complete accordance with its properties. Tanatar and Kurowski have described (Journ. Russ. Phys.-Chem. Ges. 39, 936, 1630; 40, 787; *Chem. Centr.* 1908, I. 102, 1523; II. 1409) a series of compounds (including the formate, acetate, propionate, and benzoate) of the general formula Be_4OA_6. These compounds have none of the characteristics of salts. They are volatile, they have low melting-points (some are liquid), they are soluble in organic solvents such as benzene, and they do not conduct electricity.

They resemble the non-ionised members of the "chelate" series of compounds, to which Prof. Morgan has directed attention. These are derived from substances containing such groupings as HO - C.....C = O, which combine with an atom of a metal by replacement of the hydroxyl hydrogen, and at the same time also (as he has shown) through the carbonyl oxygen. The simplest example is the volatile beryllium acetylacetonate (formula I.). The carbonyl oxygens becoming trivalent must each lose an electron. These two electrons go to the beryllium, which already has two valency electrons, and thus give it the four required to constitute the four non-polar links in the resulting compound. Chelate compounds of this type, in which the group is attached through both oxygens to the same metallic atom, are not formed by the carboxyl group, obviously because this would lead to the formation of a 4-ring, which is unstable. But there is no reason why the carboxyl should not react in this way if the attachment is to two different metallic atoms, with the formation of a ring of 5 or 6 atoms.

This must happen with basic beryllium acetate. We have at the centre, as Sir William Bragg suggests, the oxygen atom attached to 4 beryllium atoms. The octet of the oxygen is made up of 4 electrons from the four beryllium atoms, and four from the oxygen. But the oxygen atom originally had six valency electrons, and so it must lose two. The attachment of the acetate group to two beryllium atoms is shown in formula II. It forms a 6-ring :—



But in forming the ring each acetate group must lose an electron from its carbonyl oxygen, so that the six give up six electrons, in addition to the two given up by the central oxygen. We therefore have eight electrons, two of which go to each beryllium atom, increasing its valency electrons from 2 to 4. Thus each beryllium atom can form four non-polar links, these being (1) to the central oxygen, and (2, 3, 4) through three acetate groups to each of the other three beryllium atoms. One of these six chelate groups thus corresponds to each edge of the tetrahedron.

Mr. T. V. Barker has pointed out to me that if the double link in the carboxyl group remains permanently attached to one particular oxygen atom, the most symmetrical configuration of the molecule is one that exhibits a threefold axis of symmetry, and consequently is enantiomorphous; but if the double link oscillates between the two oxygens, then the symmetry is that of a regular tetrahedron.

Tanatar and Kurowski have described (*l.c.*) a compound $Zr_4O_5(OCO{\cdot}C_6H_5)_6$, which is soluble in benzene. Now zirconium can form 6 non-polar links, and in the group Zr:O two of these form the double link to the oxygen, which also absorbs two of the 4 zirconium valency electrons. Thus the group ZrO resembles a beryllium atom in having two free valency electrons, and also the power of forming four non-polar links. The zirconium compound can therefore be formulated as $(ZrO)_4O(OCO{\cdot}C_6H_5)_6$, with a structure exactly analogous to that of the beryllium compound. It would be interesting to know whether this zirconium benzoate has, as one would expect, a crystal structure similar to that of the basic beryllium acetate.

N. V. SIDGWICK.

Dyson Perrins Laboratory, Oxford, May 15.

Biology of Man.

IN the review by J. S. H. of Mr. Wells's "Men Like Gods" (NATURE, May 5, p. 591) we are told that even domestic-minded leopards and tigers are not lightly to be dismissed after recent experiments on the *inheritance* of tameness and wildness in rats. Almost in the next paragraph we are further informed that the rôle of eugenics is to be reduced to a minimum, and its functions are to be replaced by education. Wildness in the lower animals is to be removed by selective breeding, wildness and brutality in man is to be cured by education, by environment, and that mysterious process a "change of heart." It is very strange how dominant is the wholly unwarranted belief that man is an animal for whom other laws hold than for his humbler mammalian kindred.

KARL PEARSON.

Galton Laboratory of National Eugenics,
University of London.

IN referring to the reduction of eugenics to a minimum I was quoting Mr. Wells, not putting forward my own views. Later on, in criticising Mr. Wells, I expressly referred to the possibility of the "control of heredity" in man as well as in lower organisms.

In the second part of his letter Prof. Pearson is ambiguous. He refers to "the wholly unwarranted belief that man is an animal for whom other laws hold than for his humbler mammalian kindred." In one sense of the word *other* this is of course wholly unwarranted—if, that is, we take it to mean "wholly different." If, however, we mean that, besides the laws applicable to lower organisms, there are "other" *additional* laws at work in the sphere of human evolution, then I venture to say that we are enunciating a truism. To take the simplest and most important example. No other organism can transmit tradition for more than one generation: man can. Or to take another example cognate to the "change of heart" (which need be no less important for being "mysterious"), you do not find cows or sheep or other of man's mammalian kindred stopping the business of their existence to look at the sunset or at a work of art; whereas man (or rather many men) do so.

One of the chief human characters of man is his greater modifiability (in the strict biological sense). This implies that alteration of environment, especially of social environment, must co-operate with eugenics if any human progress is to be achieved. J. S. H.

Official List of Fourteen Generic Names of Fishes.

THE Secretary of the International Commission on Zoological Nomenclature has the honour to notify zoologists, especially ichthyologists, that Prof. David Starr Jordan and the U.S. Fish Commission concur in recommending the adoption of the general principle that names now current are not to be discarded unless the data show this to be a clear-cut necessity. Under this general principle they propose that the following fourteen generic names of fishes, in regard to which a difference of opinion exists, shall be provisionally legitimised with the types indicated:

Aëtobatus Blainv., 1816 (type, *Raja narinari* Euphrasen); *Conger* Cuv., 1817 (*Muraena conger* L.); *Coregonus* Linn., 1758 (*Salmo lavaretus* L.); *Eleotris* Bloch and Schneider, 1801 (*gyrinus* Cuv. and Val.); *Epinephelus* Bloch, 1792 (*marginalis* Bloch); *Gymnothorax* Bloch, 1795 (*recticularis* Bloch); *Lampetra* Gray, 1851 (*Petromyzon fluviatilis* L.); *Malapterurus* Lacépède, 1803 (*Silurus electricus* L.); *Mustelus* Linck, 1790 (*Squalus mustelus* L. [=*Mustelus laevis*]); *Polynemus* Linn., 1758 (*paradisaeus* L.); *Sciaena* Linn., 1758 (*umbra* L. =*Cheilodipterus aquila* Lacép. as restr. by Cuvier, 1815); *Serranus* Cuv. (*Perca cabrilla* L.); *Stolephorus* Lacép., 1803 (*commersonianus* Lacép.); *Teuthis* Linn., 1766 (*javus* L.).

The Secretary of the Commission will delay the vote on this case until one year from date, in order to give to the profession ample opportunity to express concurrence or dissension as respects any or all of these names.

C. W. STILES,
Secretary to Commission.

25th and E. Streets, N.W.,
Washington, D.C., May 10.

Tertiary Brachiopods from Japan.

WITH reference to the notice of Ichirô Hayasaka's memoir on "Tertiary Brachiopods from Japan" in NATURE of May 12, p. 647, may I add my testimony as to the extreme importance of this work, and, at the same time, direct attention to one or two discrepancies? To do full justice to this memoir is beyond the scope of this letter, and one can only deal with the matter in the briefest possible way.

Mr. Hayasaka is to be congratulated upon having provided us with such an excellent list of Japanese Tertiary Brachiopoda, many of which seem to be correctly placed as to genus and species. There are some forms, however, which one is surprised to find included in the list, for example, *Hemithyris psittacea*, *Terebratulina caput-serpentis*, *T. septentrionalis*, *Magellania* (*Neothyris*) *lenticularis*, and *Magadina cumingi*.

With regard to *H. psittacea*, considering its wide circumpolar distribution, it might reasonably be expected to occur as an Upper Tertiary fossil in Japan; but the figures given by Hayasaka do not suggest this species to me. They show a much larger shell, without the characteristic beak.

Terebratulina caput-serpentis (now *retusa*) is North Atlantic in its distribution, and a variety (v. *emarginata*) inhabits the Mediterranean. It ranges from the Miocene in Europe.

Terebratulina septentrionalis is also a North Atlantic species, occurring on both the American and North European shores. The geological history of this

species is not well known; but it is cited from the Pliocene. I am dealing with its supposed occurrence at the Cape in a forthcoming paper.

The presence of the essentially Austral forms, *Magellania lenticularis* and *Magadina cumingi*, in the Tertiary rocks of Japan, opens up a very wide question as to the former geographical distribution of these genera. With regard to the first species, I might point out that the figures accompanying the memoir do not suggest the New Zealand form; figure 17 especially being very unlike.

As to *Magadina cumingi*, the figures certainly present a general resemblance to the species occurring off the coasts of S.E. Australia and to certain New Zealand Miocene forms. But identity in outward appearance is not a safe criterion. It is found by experience that it is necessary to investigate the interiors before a species can be definitely referred to its proper genus. Forms having the same shape externally may possess quite different loop-stages. This feature is nowhere better displayed than in the forms possessing Bouchardiform beak characters, like the species in question.

In conclusion I should like to point out that Dall's generic name for *T. grayi* Reeve, namely, *Pereudesia*, 1920, is antedated by my *Coptothyris*, 1918 (replacing my *Thomsonia*, 1916, preoccupied). This fact has been pointed out in other papers. By the recognition of this form as a distinct genus there are now three finished types of northern genera in the Dallininæ.

J. WILFRID JACKSON.

Manchester Museum,
May 21.

The Ionising Potentials of Nitrogen and Hydrogen.

IN a paper published last autumn (Proc. Roy. Soc. A, 102, pp. 283-293, 1922) I suggested a new mode of attack on some ionisation problems and described its application in experiments on mercury vapour. The object of the method is to give a direct means of studying the types of ion produced in a gas or vapour by the impact of electrons of known speed. The experimental principle involved is the combination of an ordinary ionising potential arrangement with a simple positive-ray analysis apparatus. The extension of the method to gases and some of the results obtained may be of interest.

For the production of ions the common arrangement of a tungsten filament, a grid and a plate is used. Electrons from the filament are accelerated to the grid by a field V_1 and then retarded by an opposing field V_2 which also serves to draw positive ions toward the plate. A narrow slit in this lets through a beam of positive ions which are then further accelerated by a large electric field, V_3. These ions are then bent in a semicircle by a magnetic field and detected electrically. Different values of V_3 bring ions of different m/e on to the detecting slit. By using two Langmuir pumps a sufficiently high vacuum is maintained in the positive ray box to prevent scattering, and very sharp peaks are obtained corresponding to different types of ion.

In nitrogen it was found that for values of V_1 slightly above the ionising potential of 16·9 volts, only molecular ions of $m/e = 28$ were present. As V_1 was increased small numbers of N^{++} ions began to appear at $24{\cdot}1 \pm 1{\cdot}0$ volts, while N^+ ions were not present in appreciable numbers until V_1 passed $27{\cdot}7 \pm 1{\cdot}0$. These three critical potentials are interpreted as corresponding to the transitions $N_2 \longrightarrow N_2^+ + e^-$, $N_2 \longrightarrow N^{++} + N + 2e^-$ and $N_2 \longrightarrow 2N^+ + 2e^-$. If this interpretation is correct, the first ionising potential of atomic nitrogen is about 11 volts and the second about 18 volts, assuming the heat of dissociation of nitrogen to be of the order of 140,000 calories, equivalent to six volts.

At a value of V_1 corresponding to the K-limit for nitrogen (375 volts) the proportion of atomic ions increased very sharply.

Preliminary results on hydrogen indicate that the ionisation of molecular hydrogen in the neighbourhood of 16·5 volts is not usually accompanied by dissociation as has been generally supposed. Whether there may be a small number of atomic ions produced at this point is not yet certain. Experiments are being continued. H. D. SMYTH.

Cavendish Laboratory,
May 25.

Chromosome Numbers in Aegilops.

I HAVE recently been investigating the cytology of species of Aegilops, and find the chromosome numbers as follows:—

	Haploid Number.
Aegilops cylindrica	= 7
A. ovata	= 14
A. ventricosa	= 14

On morphological and other grounds I expressed the view in my monograph on "The Wheat Plant" that one or both of the former species appear to be involved in the ancestry of the *vulgare* group of wheats.

Later I hope to discuss the significance of these chromosome numbers in relation to this hypothesis.

JOHN PERCIVAL.

University College, Reading,
May 26.

Effect of Insulin upon Blood Sugar Concentration.

THE injection of insulin into rabbits causes the blood sugar concentration to be lowered, as determined by micro methods. When a certain concentration is reached, 0·05 per cent. by Bang's method, the animal goes into convulsions. If the animal is then killed and the sugar extracted from a large quantity of blood, it is found that it is without copper-reducing value as determined by the Wood-Ost method. This method is not liable to estimate substances in blood other than reducing sugars.

There is, however, a considerable quantity of carbohydrate present, as indicated by the α-naphthol test. The substance is dextro-rotatory. We have not succeeded by acid hydrolysis in obtaining copper-reducing substances from it, though these can apparently be formed under certain conditions as a result of enzyme action *in vitro*.

Dudley and Marrian (Proc. Physiol. Soc., May 19, 1923) have shown that the glycogen content of the liver and muscles of animals is greatly diminished after insulin. We have obtained from the liver and muscles of rabbits after insulin a substance similar to that present in blood under this condition. Owing to its resistance to acid hydrolysis it would not be estimated by ordinary methods. The chemical nature of this sugar is being studied.

We noticed in the case of some solid preparations that the α-naphthol reaction gradually disappeared on drying. Mr. H. F. Holden suggested that this might be due to polymerisation, and that on hydrolysis with acid the α-naphthol reaction would reappear. We find that this happens. It seems possible that the carbohydrate content of the animal body may be not appreciably diminished after large doses of insulin. The above facts would suggest that the sugar stored in the body as glycogen is converted

into this peculiar form. Can this be the "Zwischenkohlenhydrate" which Laquer suggests is formed as an essential step in carbohydrate metabolism?

L. B. WINTER.
W. SMITH.
Biochemical Laboratory, Cambridge,
June 4.

The Value of the Planck Constant *h*.

IN NATURE for March 3, p. 287, I directed attention to the desirability of obtaining new data on the value of e/m, from deflexion experiments or from the Zeeman effect.

Dr. Harold D. Babcock, of the Mt. Wilson Observatory, has just finished a series of measurements on the value of e/m, from the Zeeman effect, and obtains as the weighted mean of 49 separate determinations, a value of $1{\cdot}761 \times 10^7$, as compared with my recomputed value of $1{\cdot}758 \pm 0{\cdot}009$ from spectroscopic data. A thorough study of possible errors leads Dr. Babcock to the conclusion that the error in the above value can scarcely exceed $\pm 0{\cdot}002$. On this basis Dr. Babcock's new value of e/m is the most accurate now known.

Particular interest attaches to the value of the Planck constant h, using this new value of e/m. Of the seven methods listed by the author in his determination of the most probable value of h (*Phys. Rev.*, 14, 361, 1919), the only method involving the value of e/m is that from Bohr's theory of the Rydberg constant N_0. Using for the sake of technical accuracy the value of $N_\infty (= 109{,}737)$ and the assumed value of $e/m = 1{\cdot}761 \pm 0{\cdot}002$, we obtain $h = 6{\cdot}556 \pm 0{\cdot}011$ instead of $6{\cdot}542 \pm 0{\cdot}011$, using $1{\cdot}773 \pm 0{\cdot}002$ for the value of e/m. This latter value of e/m and its error were obtained from the results given in Kaye and Laby's Tables. It is now evident that the close agreement in the mean value of e/m, from Zeeman effect and from deflexion experiments, given in those tables, is merely an accident, and that the author's previous assumption of error in e/m was unjustifiably small.

The new value of h is not only in very close agreement with my previous most probable value (6·5543), but coincides exactly with Duane's latest value, from the continuous X-ray spectrum. Using these two new values of h (methods 3 and 4 of the article cited), we obtain as a corrected most probable value $h = 6{\cdot}557 \times 10^{-27}$ erg. sec. I believe that the error in this quantity can be scarcely more than a few units in the last place, unless Millikan's value of e is unexpectedly in error.

RAYMOND T. BIRGE.
University of California,
May 18.

A Method of Broadcasting Pictures.

I HAD occasion to suggest to the British Broadcasting Co. a few weeks ago that an attempt should be made to "broadcast" a picture, and proposed a simple method of doing so. The company thereupon invited me to try the experiment on Empire Day (May 24). A photograph of H.M. King George V. was chosen as a suitable subject, and it was broadcast at 5.45 P.M. in 20 minutes, and instructions were given for reproducing the picture, either in typescript or in graduated dots on squared paper.

Most of the pictures show an unmistakable likeness. The best versions were sent in by Gladys Haylock, Queen's Park, London, and Reginald Matthews, King's Lynn. The former, who is 11 years old, states that the reproduction was made in three-quarters of an hour. The B.B.C. has decided, as a reward, to broadcast the portraits of these children in turn.

The method is, briefly, the following: The picture is divided into a number of small squares, and the average brightness of each square is indicated by one of six letters. The estimation is made by any photometric method, but a little practice soon teaches one to estimate it by mere inspection. The six letters are chosen so that the spaces taken up by them in typewriting have different average shadings forming a scale of darkness which corresponds to the average shading of the squares represented by the letters. Another consideration in this choice is the ease of telephonic transmission. The letters X, I, J, G, M differ sufficiently in pronunciation to be unmistakable, and the last four have increasing darknesses when typed; X represents a note of exclamation. The lightest space is indicated by a full stop, dictated as "stop." A blank is indicated by the vowel sound O.

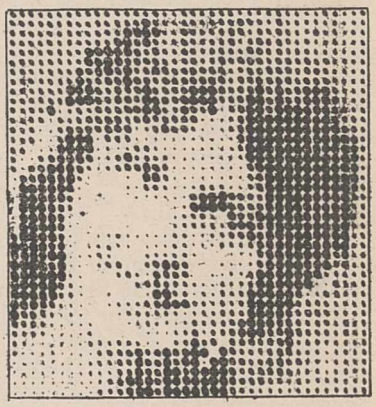


FIG. 1.

Fig. 1 shows a picture consisting of 1520 dots. It is a reproduction of a half-tone picture only 8 mm. wide which I "coded" with the aid of a special microscope kindly lent to me by Prof. R. R. Gates. The number of dots used is somewhat large.

For the Empire Day experiment it was necessary to have a smaller number of dots, so as not to exhaust the patience of the recipients. The result of limiting a picture to 600 dots is seen in Fig. 2.

Each line contains 20 dots. The letters representing these are dictated in fives, thus:

(1) ....g jjjjj g....
(2) ....gmg jxgjj gg...

and so on.

The quickest method of reproduction is to use a special typewriter having six letter keys, each connected with a lever printing a dot of the corresponding size. A simple photographic method with two discontinuous movements might also be used, in which case we might obtain a negative for subsequent multiplication.

Coloured reproductions have also been suggested, but no doubt the chief advantage of the method will be found in its extreme simplicity.

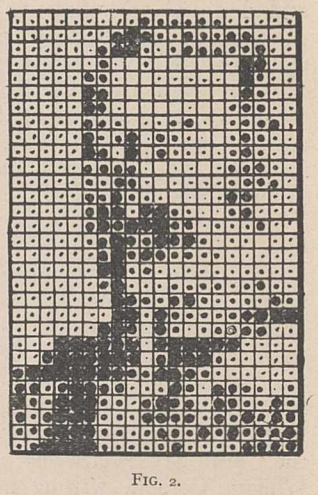


FIG. 2.

E. E. FOURNIER D'ALBE.
21 Gower Street, W.C.

Hay Fever.

HAY fever is a catarrhal affection mainly of the upper respiratory passages, which occurs only in certain individuals and is due to the poisonous action of the pollen of certain plants which they have inhaled. Our knowledge of the disease may be divided into three periods, viz. clinical, experimental, and therapeutic. The clinical period was inaugurated by John Bostock, the physiologist, in 1819. He gave an admirable account of the symptoms as they occurred in himself every summer over a period of thirty-eight years. Other accounts, complete and incomplete, gradually accumulated, and these were analysed with great discrimination and acumen by Phoebus of Giessen, who published his work "Der typische Frühsommer-Katarrh" in 1862. Nothing has been added to the pure clinical history of the disease since this time. The second period is typified by the masterly scientific research of Dr. Charles H. Blackley, of Manchester, who was also a sufferer from the disease. In his work "Experimental Researches on the Causes and Nature of Catarrhus aetivus," 1873, he established, by ingenious methods, the fact that hay fever is caused by the inhalation of pollen. To this period belong also the works of W. P. Dunbar, of Hamburg. He also was a hay-fever sufferer. Going beyond Blackley, he proved that it is only the protein of the pollen that is the toxic agent. The third period, in which fall attempts to prevent or cure the disease by specific means, is associated particularly with the names of Noon and Freeman in England and Dunbar in Germany.

It was in 1819 that the disease was made known by Bostock, who described the symptoms from which he suffered every June and July almost all his life. These symptoms were, a sensation of heat in the eyes with itching and smarting. After about a week, violent sneezing occurred, with a feeling of tightness in the chest, difficulty of breathing, languor, and loss of appetite. Towards the end of July, all this discomfort spontaneously disappeared. It is remarkable that medical history contains only one or two trivial and doubtful references to such a condition before the appearance of Bostock's paper in 1819. In 1828 he made a second communication and included statements of twenty-eight cases like his own. All developed the disease at the same time of the year—the summer, and nothing special could be ascertained as to its cause from the age, sex, constitution, or mode of life of the sufferers, who were mostly males.

In this second paper Bostock referred, however, to the idea, apparently prevalent even at that time, that the morbid state was engendered by effluvia from new-mown hay, but he was not of this opinion from observations on himself, both at Ramsgate, where there was no hay, and at Kew, where there was much. He considered that the main factors which led to an outbreak were dazzling sunlight and excessive summer heat. Even in 1828, however, MacCulloch refers to the "term hay-fever lately become fashionable"; and William Gordon, writing in 1829 on the "nature, cause, and treatment of hay asthma," said that there could be no doubt that it was due to the aroma emitted from the flowers of grass, particularly from those of *Anthoxanthum odoratum* or sweet-scented vernal grass. He based this view on the grounds that (1) the plant is one of the most strong scented of the grasses; (2) because as soon as it begins to flower, and *not until then*, the asthma begins; (3) because as the flowers arrive at perfection the disease increases; and lastly, because after the flowers have died away previous sufferers can pass through the most luxurious meadows with impunity.

After the accounts of Bostock and Gordon, cases began to be published, and all the authors were of opinion that the disease occurred in certain persons who were presumed to have a predisposition to it, and it was early recognised, especially by Elliotson (1833), that inheritance plays a part in the idiosyncrasy, a belief that all later observation has confirmed. Of 59 histories analysed by Phoebus, 23 occurred alone in their respective families, whereas 36 were associated with one or more other families. The whole of the latter occurred in 13 families, being distributed as follows: in 8 families 2 affected (brothers and (or) sisters); in 5 cases father and child. In 2 families 3 members were affected; in 1 family 4 members, and 2 families 5 members. In one of the latter, a man, his daughter, and three sons suffered, while a fourth son was made asthmatic by the smell of guinea-pigs. The disease was known to be commonest among the better classes, and many of those who have written on the subject were themselves attacked. Among these may be mentioned Bostock, Blackley, Gream, Kirkman, Fleury, Helmholtz (the physicist), Dunbar (the bacteriologist), and Verworn (the physiologist). Among 150 cases collected by Phoebus 100 were male and 50 female.

Although it was early suggested that the origin of the symptoms was referable to vernal grass in flower, there were authors whose experience did not permit of such an exact diagnosis. Some thought that grasses were all equally detrimental, others that only aromatic grasses were the agents, and particularly *Anthoxanthum odoratum*. Others again blamed rye-grass, hay as such, roses, trees in bloom, dust, sunlight, heat, and even bacteria. The last was the view of Helmholtz. Even where grasses were incriminated it was believed that the actual cause was some aromatic effluvium wafted from the plant. Some believed that the chief agent was coumarin. Kirkman (1852) seems to have been the first who tested upon himself the effect of pollen. At Christmas he noticed in his hot-house a single plant of *Anthoxanthum odoratum* in blossom and laden with pollen. He plucked it, rubbed the pollen with his hand and sniffed it up. Almost immediately sneezing and all the symptoms of an attack of hay fever followed.

It was, however, Charles Blackley who, in a series of experiments well conceived and admirably carried out over a long series of years, definitely established the pollen etiology of the disease. Having obtained negative results with benzoic acid, coumarin, odoriferous substances, ozone, dust, light, and heat, he applied himself to the subject of pollen, not of grasses only but from plants belonging to no less than thirty-five other natural orders. The experiments were made at all times of the year, the pollen being applied to himself or other patients by way of the nostrils, tongue or

conjunctiva, or by inhalation or actual inoculation in the skin—the most approved modern method of diagnosis. Pollen from a number of grasses produced typical hay fever. Blackley particularly blamed the pollen of italian rye-grass (*Lolium italicum*), meadow fox-tail grass (*Alopecurus pratensis*), rye (*Secale cereale*), wheat (Triticum), oats (*Avena sativa*), and the common hazel-nut (*Corylus avellana*). He also studied the size and shape of different pollen grains, and concluded that the disturbance in predisposed persons was due partly to the mechanical and partly to the physiological action. In experiments on himself, dazzling light and heat were ineffective.

To study the distribution of pollen in the atmosphere Blackley then undertook a long series of experiments with ingenious apparatus which he devised, and he traced by microscopic methods of enumeration the pollen grains in the air in a variety of weather conditions. From May to the end of July he traced from day to day the pollen incidence in the air, and showed how it was subject to great fluctuations depending on temperature and moisture. About 95 per cent. of the pollen found was identified as belonging to the Graminaceae. In dwelling-rooms little or no pollen was found. By means of moistened glass slips attached to the tails of kites flown as high as 1500 feet, Blackley made numerous observations both on the sea-shore and inland, and demonstrated the remarkable fact that in the upper strata of the air there was nineteen times as much pollen as was found near the surface of the earth, and he showed how pollen can be carried to great distances by wind currents in the upper reaches of the air.

Blackley was so far ahead of his time, that despite the excellence of his work the causation of hay fever was still regarded as a *terra incognita*. A common idea prevailed that it was a nervous disease in certain persons with a labile or hysterical nervous organisation. The reinvestigation, on the scientific lines laid down by Blackley, led, in the hands of Dunbar (1903), to a complete confirmation of his results; but Dunbar went further by proving that the deleterious agent in pollen is only its protein. Collecting pollen in large quantities, he showed that extracts are highly toxic in hay-fever subjects.

One of Dunbar's collaborators—Liefmann (1904)—found that, at the time of the worst hay-fever attacks in the centre of the city of Hamburg, no less than 250 grass pollen grains settled in 24 hours on a surface measuring 1 square centimetre (*i.e.* about 2,500,000 per square metre). Year by year it was noted that on the first appearance of pollen in the air patients began to suffer from hay fever. In the beginning of June grass pollen is in excess of all others, and from the third week of July begins to disappear. Kammann estimated that 40 per cent. of the pollen mass was protein, and a solution of a strength of 1 : 30,000—1 : 1,000,000 dropped into the eye could determine an immediate attack of hay fever. Dunbar tested the activity of a large number of pollens other than those from grasses, but mostly with negative results. Besides the pollens of grasses and sedges the following pollens were, however, found to be active: honeysuckle (*Lonicera caprifolium*), lily of the valley (*Convallaria majalis*), Solomon's seal (*Polygonatum multiflorum*), evening primrose (*Œnothera biennis*), rape (*Brassica napus*), spinach (*Spinacea oleracea*), as well as a number of Compositæ and privet (*Ligustrum vulgare*). These experiments were all made in Europe. In the United States of America there is a common form of "hay fever" caused not by grass pollen but by pollen of golden rod (Solidago), and particularly ragweed (*Ambrosia elatior*). From its occurrence in September this variety is widely known as "autumnal" or "fall" fever. According to the records of the American Hay Fever Prevention Association, something like 1 per cent. of the whole population (about 1,000,000 cases) are liable to June or autumn fever.

Hay-fever research is being very actively carried out in the States, and already a very large number of pollens are known to be toxic. Several general principles are emerging from this work; for example, the negligible importance of insect-borne pollens as contrasted with the importance of those that are air-borne, and the great variations which occur from the diversity of the local flora. Important hay-fever and botanical surveys are now being compiled from many of the American States. The diagnosis of the capacity of pollen to produce hay fever is made by cutaneous inoculation, by a scratch on the forearm, of a dilution of the pollen protein, which may be extracted in several different ways. A wheal, 5 or more mm. in diameter, surrounded by a red halo and appearing within half an hour, is regarded as a positive reaction.

It is now known that far more plants can produce hay fever than was formerly supposed. Indeed the term "hay fever" is quite inappropriate. "Toxic pollen idiopathy" has been suggested in its place. Later studies have also directed attention to what are called "group reactions." Thus patients with June fever react to grass pollens, while those with autumnal fever react mainly to the pollen of compositæ, such as golden rod, golden glow, sunflower, and ragweed. The group reaction indicates that the pollens of allied families of plants have a common protein chemical constitution. Although many different pollens can produce symptoms, it does not follow that all such pollens are of practical importance in the disease. The principle that only anemophilous pollen is the natural toxic agent is very important, and thus the entomophilous pollens of golden rod, golden glow, sunflower, and daisy, although they can produce hay fever, do not do so in practice except in unusual circumstances. That such circumstances do occasionally operate is made clear by the recent researches of Pott at Bloemfontein. In this city he has clearly shown that a severe form of pollinosis occurs from October to January, and it is caused by the pollen of the pepper tree (*Schinus molle*). Normally this pollen is sticky and is insect-borne, but in the hot, dry weather prevailing in Bloemfontein it becomes dried and is dispersed by wind. In fact, it was the principal and occasionally almost the sole pollen deposited on glass plates exposed to the air, and it was also demonstrated in the nasal mucous secretions of susceptible subjects. Of great importance also is the determination of the actual dates of flowering of hay-fever plants in each particular district. More than 200 plants are known to be capable of setting up symptoms of "hay fever."

With regard to the nature of the predisposition which

renders certain persons susceptible to pollen, nothing is known with certainty. It has been suggested that the affected persons may possess a specific proteolytic ferment which, acting on pollen protein, liberates a poison which is the active agent. The predisposition has been regarded as allied to anaphylaxis—the state of hypersensitivity, which can be induced especially in guinea-pigs by a sub-lethal dose of a protein of some kind.

Hay-fever predisposition, however, differs fundamentally from true anaphylaxis. The anaphylactic state can be transmitted passively to a normal animal by means of the serum of an animal rendered actively anaphylactic. This is not so with hay fever. Dunbar injected the blood serum of hay-fever persons into guinea-pigs, and twenty-four hours later injected the animals intravenously with rye-pollen protein. No positive results were obtained. Further, normal persons never develop hay fever after the subcutaneous injection of pollen protein. Dunbar injected a normal person with quantities of pollen protein far in excess of what he could have received normally, but this individual was able to take long walks through meadows in full flower, with impunity. A normal person has not the capacity of reacting to pollen protein, nor can he be made to develop this power experimentally. It may be said, therefore, that whatever is the nature of pollen idiosyncrasy, it is not to be ranged alongside the true anaphylactic state. It is allied to those idiosyncrasies which occur in certain persons who develop asthma or catarrhal symptoms from exposure to the secretions or excretions of horses, dogs, cats, goats, rabbits, guinea-pigs, or to such substances as silk, or food-stuffs like white of egg, or certain drugs.

From the great mass of persons who have the pollen idiosyncrasy, and the "annual torment," as Blackley called it, which they undergo, it is not surprising that many different treatments have been recommended. If the hay-fever patient could keep away from pollen, naturally he would not suffer from the disease. Thousands of persons find relief annually at the seaside or on islands or barren districts. The German Hay Fever Association used to recommend Heligoland. In the United States, Fire Island on the Atlantic side of Long Island has long enjoyed a reputation as a suitable refuge for hay-fever sufferers. Blackley in England spoke highly of Lundy Island and some of the islands in the Hebrides. For the great majority of patients such luxuries are manifestly impossible.

From the vast number of methods of treatment praised at one time or another, only two are worthy of consideration. Dunbar recommended the serum called Pollantin, prepared by inoculating horses with repeated doses of pollen protein. This is used either in the liquid or dry state for local application to the nose before the onset of symptoms. The main objection to this treatment, which may be most successful in certain cases, is the temporary character of the relief afforded. The other method, erroneously called desensitisation, is the active immunisation of the patient himself by pollen protein introduced by Noon and Freeman. For its success accurate diagnosis of the specific pollen idiosyncrasy is necessary in the first place, the production of strong protein solutions in the second place, and pre-seasonal inoculation in the third place. As the immunity is not durable the treatment must be annual. By this method Freeman (1914) recorded 30 per cent. of complete successes and no improvement in 11 per cent. Between 1916 and 1920 Cooke and Vander Veer injected 1774 patients with complete success in 25 per cent. and no success in 10 per cent. The recent results of Bernton (1923) are of the same order. It is probable that the state of insusceptibility lasts only for a few weeks, when the patient again manifests his idiosyncrasy unaltered. W. B.

The Tercentenary of Blaise Pascal.

By Prof. H. WILDON CARR.

NO one can read the story of Pascal's life without amazement at the greatness of his genius and sadness at the mode in which it found expression. To Voltaire in the eighteenth century he is a "fou sublime, né un siècle trop tôt." To Chateaubriand in the early nineteenth century he is "cet effrayant génie, qui, à cet âge où les autres hommes commencent à peine de naître, ayant achevé de parcourir le cercle des sciences humaines, s'aperçut de leur néant et tourna ses pensées vers la religion." He lived at the beginning of the brilliant leadership of France in the intellectual development of Europe. In his short life he did notable work in mathematics and physics, and above all (to continue the quotation from Chateaubriand), "toujours infirme et souffrant, fixa la langue que parlèrent Bossuet et Racine, donna le modèle de la plus parfaite plaisanterie, comme du raisonnement le plus fort."

To appreciate the greatness of Pascal and to discern the leading motive in his wonderful activity, it is necessary to enter sympathetically into the spirit of the age in which he lived, and particularly to understand the nature of the religious influence which peculiarly affected him from infancy to maturity.

The outward circumstances of his life may be recorded quite briefly. He was born at Clermont in the Auvergne on June 19, 1623. His father, Étienne Pascal, was King's Councillor and Magistrate, president of the *Cour des Aides*. Blaise had two sisters, Gilberte, three years older, and Jacqueline, two years younger than himself. Their mother died when Blaise was three years old. In 1631 the father retired and settled with his family in Paris for the sake of their education. In 1638 he had managed unfortunately to incur the displeasure of Cardinal Richelieu, and, having good reason to fear a *lettre de cachet*, had to go into hiding. He returned home, however, risking arrest, when he heard that his dearly loved daughter Jacqueline was suffering from small-pox, and he remained constantly with her until her recovery. The following year there was brought about a reconciliation with the Cardinal, and shortly after he received the appointment "Intendant pour les tailles de la généralité" at Rouen, to which city the family then went to live. In 1648 the

"Intendants" were suppressed by Mazarin, and the Pascals returned to Paris. The following year they went back to their native Clermont, where Gilberte, who had married her cousin, Florin Périer, was already settled. In 1651 the father died. Blaise, devoted to his sister Jacqueline, had hoped that after the father's death she would continue to make her home with him, but she had already formed her resolution to enter the religious life, and would not be dissuaded from taking immediately the austere vow at the convent of Port Royal.

The four following years are described by Blaise as his "mondaine" period. He sought distraction in travel and society, but in 1655, after a mental crisis which is described as his second conversion, he decided to retire and devote himself entirely to religion. From 1658 till his death in 1662, although not bedridden or incapacitated from attending to his ordinary wants, he was so weak and in such continual pain that he could do no consecutive work. Jacqueline died in 1661. Blaise in his last illness was nursed by Gilberte. He died in her house. When the end was approaching the doctors attending him were assuring him that there was no danger, and refused to call in the priest. Pascal was in anguish lest he should die without the sacrament, but Gilberte acted on her own initiative just in time. She lived to be sixty-seven, and had five children. She wrote the life of her brother, and also a life of her sister Jacqueline.

Blaise Pascal was educated by his father, and had no other tutor. He never entered the university. All his acquaintance with the intellectual movements of his age, with its science, its philosophy, its religion, was derived directly from his father and conversation with his father's friends. On the other hand, at his father's house he met the most distinguished mathematicians and theologians of the time. Étienne Pascal did not merely supervise his son's education; he undertook it alone and unaided in order to follow out a predetermined method, which reminds us, alike in its conception and in its consequences, of the analogous case of the father of John Stuart Mill. One part of the scheme was to concentrate the boy's mind during his earliest years on perfecting his knowledge of his own language. His lessons were limited to the grammar and syntax of his native French, and the teaching even of Latin was deferred until this was acquired, in the expectation that the new task would then be comparatively easy. The other part of the scheme was to defer mathematics, indeed to forbid the study of it, until the acquirement of languages was perfect. The reason of this is curious. The father was not only himself learned in the mathematical sciences, but also had given his daughter Gilberte thorough instruction in them, yet he feared for his son that they would prove of such absorbing interest that he would be distracted from the study of languages. When the lad was twelve, however, the father discovered that he had acquired, apparently surreptitiously, an acquaintance with geometry which amounted to precocity. He was found one day demonstrating for himself with *barres et ronds* the thirty-second proposition of Euclid's first book. We are told that after this he was allowed to read Euclid, but only in his recreation hours.

Not less powerful than the parental influence was that of his sisters. For their education also the father had original ideas. He did not himself undertake it, but they were educated by a man as men. Their tutor was a Monsieur de Mondory, in favour with the Cardinal and the Court. Jacqueline was an extraordinarily precocious child. She was a very pretty girl before the small-pox destroyed her beauty. She wrote verses from the time of her early childhood, and when fourteen composed a comedy in five acts. She was deeply religious. One of her poems is a hymn of gratitude to God for her recovery, and she describes the scars left by the disease as the impressions of God's seal. She no doubt regarded this illness as a sign of her call to the religious life. Soon after her entry to Port Royal she was appointed sub-prioress, and she consulted her superior as to whether she should cultivate her talent for poetry. The reply of Mère Agnes, Arnauld's sister, is pathetic. "C'est un talent dont Dieu ne vous demandera point compte: il faut l'ensevelir." She signed the formulary imposed on Port Royal condemning the Jansenist doctrine under extreme pressure, though she struggled against it and wished to resist. "Je sais bien," she wrote to Dr. Arnauld, "que ce n'est pas à des filles à défendre la vérité, quoique l'on peut dire par une triste rencontre, que, puisque les évêques ont des courages de filles, les filles doivent avoir des courages d'évêques." Arnauld insisted, however, and the grief hastened her death.

To understand the religious fervour of the Pascal family we must also enter sympathetically into the spirit of the age. The seventeenth century shows in all its philosophy, and even we may say in its science, the influence of a deep personal interest in the problem of the relation of the individual mind to God. The reforming zeal of the sixteenth century had spent its force and been succeeded by the universal conviction of the reflecting believer that Christianity is much more than an institution based upon a verifiable historical revelation, that it is, in fact, a revelation in the philosophical meaning, an interpretation of human and divine nature. We only understand Pascal when we see that his religion is not ordinary piety or superstition, but profound philosophy.

Let us now look at the man himself. He is a younger contemporary of Galileo and Descartes. He survived both, but died before Malebranche or Spinoza had begun to write. This is peculiarly significant in appreciating his attitude towards the Cartesian philosophy, for Malebranche developed that doctrine along Augustinian lines, which may have been actually suggested by Pascal's writings. The illustration of *le ciron* to explain the relativity of magnitudes, expounded by Malebranche in the "Recherche de la Vérité," seems taken directly from a well-known passage in Pascal's "Pensées."

Pascal agreed with Descartes in his doctrine of the soul, or thinking substance, with its corollary that the animals are automata, but he was revolted by the "Principia" and its claim to be able to explain the world by "figure and movement." "Quand cela serait vrai," he says, "nous n'estimons pas que toute la philosophie vaille une heure de peine." Notwithstanding his keen enjoyment of mathematical problems and his intense interest in physical experiments, the

whole value of philosophy for him lay in the light it shed on moral problems, and on the power it gave man to interpret the Christian revelation. His point of view, while it accepts the principles of Descartes's philosophy, applies them in a way which makes his doctrine its very antithesis.

Descartes was shown the Treatise on Conic Sections which Pascal composed when sixteen, and refused to believe in its originality. He thought it the work of Desargues, from whom indeed Pascal had learnt much, but Desargues himself acknowledged the originality of Pascal's treatise in its essential points. In 1647 Descartes paid two visits to Pascal, who had come to Paris with his sister Jacqueline for medical advice. Jacqueline has given an account of their meeting in a letter to her sister Gilberte Périer. They discussed the question of the void. Torricelli, the pupil of Galileo, had demonstrated the phenomenon of atmospheric pressure by the famous invention of the barometer, inverting a column of mercury in a glass tube closed at one end, with the other end immersed in an open mercury bath, and then measuring the height of the column.

This was of course the crucial experiment, but there still remained considerable doubt as to its interpretation. To many, including Torricelli himself, it was merely a case in point of the old principle that nature abhors a vacuum. Descartes had rejected this principle on *a priori* grounds. Pascal explained to Descartes his theory of an ocean of air, at the bottom of which we were situated, and assumed that like all fluids it would maintain an equilibrium, and reasoned that above every point of the earth's surface was a column pressing down on us, the weight of which would vary with the altitude. He had already made experiments to prove this on a tower in Rouen, and he now proposed to carry out an experiment on a large scale on the Puy de Dôme in Auvergne. Descartes discussed it with great interest and confidently foretold its success. The experiment was carried out by the aid of Pascal's brother-in-law, M. Périer, with the result that the time-honoured, firmly established principle of the abhorrence of a vacuum passed into limbo.

Pascal's life divides naturally into three periods. To the first belong the mathematical works and the physical experiments, to the second the literary achievement of the "Lettres Provinciales," and to the third the philosophical and mystical "Pensées." In all of them his great genius is manifest, and he might easily have been one of those master minds which determine the direction of human thought. In science and philosophy he showed an intellectual power and incentive which places him on a level with Descartes and Galileo, yet he stands alone, grand but solitary, in the great intellectual movement of humanity. It was more than a religious act, it was typical of his whole intellectual position, when he joined the solitaires of Port Royal. We may count his unworldliness as loss or as gain, but he sacrificed for it alike scientific and philosophic leadership. The tragedy is that the Christian Church did not value what he gave to her when he renounced the world.

The works by which Pascal has immortalised himself are "Les Lettres Provinciales" and "Les Pensées." His mathematical works, like his arithmetical machine which took three years to perfect and is preserved at the Conservatoire des Arts et Métiers in Paris, are valuable for the evidence they afford of the nature of his genius rather than for their originality of discovery, but the two great literary works have been read in innumerable successive editions. Yet strangely enough both are valued and cherished for what to Pascal himself was purely adventitious and no part of the original design. The "Provinciales" are classical on account of their attack on the Jesuits and for the exposure of Jesuit casuistry. The world has little interest to-day in the Jansenist doctrine, which it was the main purpose of the letters to expound and to defend. Were it not for Pascal, the very names of Jansenius and Molina would scarcely be known outside narrow theological circles. The doctrine of sufficient grace has little more than antiquarian interest for students, but for Pascal it was the rationalising of Christian doctrine, the philosophy of a religion of redemption as distinct from the institution of sacraments and formularies founded on it.

The "Lettres Provinciales" had an immediate success, but it is unlikely that they would have accomplished their design, or have afforded even a temporary cessation of the Jesuit hostility against the theologians of Port Royal, but for an event of an altogether different nature, and one which had a powerful influence on Pascal himself. This is what is known as the miracle of the sacred thorn. Pascal's niece, Marguérite Périer, was a pensionnaire at Port Royal, and the little girl suffered from an abscess of the lachrymal gland, which discharged into the eye and into the nose, causing her inconvenience and suffering. Medical treatment had proved wholly ineffective, but after having touched the spot one day with the relic of the sacred thorn, exposed for adoration on the altar, she was completely cured. The doctors certified that "la guérison surpassait les forces ordinaires de la nature," and the miracle was solemnly attested by the vicars-general of the Archbishopric of Paris.

"Les Pensées" was not designed by Pascal for publication in any form whatever. When he died a disordered mass of papers containing his written notes was found. They were unconnected, casual, jottings on odd bits of paper, many being incompleted sentences. It was known that Pascal had had in mind to write an "Apology" of Christianity, a defence against atheistical arguments. The editors took this as the clue to the arrangement of the fragments, and Arnauld, Nicole, and other leaders of Port Royal, after the "peace of the church," which restored them to their monastery in 1669, published the first edition of the "Pensées." Few books have had such a success. Edition has followed edition through the succeeding centuries. The original fragmentary notes still exist, and scholars may now study them in the "Reproduction en phototypie du manuscrit des Pensées de Blaise Pascal," published by Monsieur Léon Brunschvicg.

Such was the marvellous genius, the tercentenary of whose birth is being celebrated this year in his native city, Clermont, and at the scene of his activities, Port Royal des Champs, near Paris.

Obituary.

PROF. JOHN COX.

THE death of Prof. John Cox at Hayes Court, Hayes, on May 13, removes an interesting personality from our midst. Prof. Cox devoted an active life to the cause of education and had a varied educational career, holding, at different times, the post of University extension lecturer, headship of a Cambridge college, and a professorship in physics in a Canadian University.

Born in 1851, Cox was a brilliant scholar of the City of London School under Dr. Abbott, where he was a contemporary and competitor for scholastic honours with his friend H. H. Asquith. He went as a scholar to Trinity College, Cambridge, and studied mathematics, being eighth wrangler in 1874. Equally versed in classics, he took a good place in the Classical Tripos of the same year. He gained a fellowship at Trinity College on a dissertation in which he applied Hamilton's methods to some problems in geometrical optics. He was for ten years warden of Cavendish College, Cambridge—a new College offering residential facilities to a younger class of undergraduates at a reduced cost. Ultimately the College was closed down, though some years after Cox had severed his connexion with it.

In 1890 Cox was appointed professor of physics in McGill University, Montreal. Previous to that time the physics had been taught with small facilities by Dr. Johnson, professor of mathematics. This appointment gave Cox a great opportunity, for it was at the time that McGill University was rapidly growing, through the munificent gifts of the late Sir William Macdonald. Ample funds were offered to build a new physics laboratory, and, before making plans, Cox was sent on a mission to study the physical laboratories in Europe and the United States. He threw himself with great energy into the new project, and the result was a well-designed laboratory which at the time of its opening was one of the finest and best equipped in the world. Under the impetus given by the appointment of Callendar and afterwards of Rutherford, the laboratory became a centre of research in physical science, and Cox followed with pride and enthusiasm the pioneer researches of Rutherford and Soddy on radioactivity.

While keenly interested in all developments of physics, Cox had not the practical training requisite for research in experimental physics, but devoted himself to the teaching and administrative side. A fluent and polished speaker, he was an admirable lecturer, and as a speaker for popular audiences on scientific and general topics he had few superiors. It was characteristic of his temperament that he was somewhat dilatory in ordinary business matters and often required the spur of necessity to deal with correspondence. A man of wide interests and wide social sympathies he exercised a strong influence for good both in Montreal and the University. In 1909 he retired from McGill with a Carnegie pension to live in England, and was awarded the honorary degree of LL.D. by McGill University. He immediately took up the work of lecturing for the Oxford Extension Delegacy and particularly for the Gilchrist Trust. This was a type of work which he thoroughly enjoyed and carried out with great enthusiasm and success. During the War, he offered his services to the Ministry of Munitions and assisted in the work of the munition tribunals.

After the death of his wife, Cox lived at Hayes Court with a daughter. He retained his enthusiasm for science to the end and, before his illness became acute, followed with keen interest the work of Einstein and Bohr. Of his publications, the best known is his book on mechanics published by the Cambridge University Press. This useful work was written on novel lines, being largely influenced by the writings of Marx, of whom he was an admirer. Another small book, "Beyond the Atom," gives a vivid account of the bearing of the earlier radioactive researches, with which he had come in contact in Montreal, on the structure of matter. A man of fine character, of attractive personality and varied gifts, his unexpected end will be mourned by a wide circle of friends. He leaves two daughters and a son, who is a mining engineer in Canada.

MR. R. W. HOOLEY.

MR. REGINALD WILLIAM HOOLEY, whose death on May 5 at the age of fifty-seven we regret to record, devoted many years to the study of the geology of the Isle of Wight, and to the systematic exploration of the Wealden rocks of the south coast. He made an important collection of the remains of reptiles and fishes from the cliffs between Brook and Atherfield, and established a small museum at his residence at Winchester. He also acquired an excellent knowledge of the Wealden reptiles, which he extricated from the hard rock with great skill, and he wrote several important papers on his specimens. He described new Chelonia in the *Geological Magazine* in 1897 and 1900.

In 1904 Mr. Hooley was elected a fellow of the Geological Society, and he contributed papers on unique specimens of the crocodile Goniopholis and the pterodactyl Ornithodesmus to the Society's Quarterly Journal in 1907 and 1913. During recent years he discovered and prepared a skeleton of Iguanodon, in some respects finer than the well-known specimens at Brussels and showing parts of the skin. Of this remarkable fossil he wrote an exhaustive memoir, illustrated by his own drawings, which he had intended to read to the Geological Society at a recent meeting.

Mr. Hooley was an indefatigable worker, with only scanty leisure to devote to science, and his premature death is regretted by the large circle of geologists and palæontologists who enjoyed his friendship and co-operation. His specimens of Goniopholis and Ornithodesmus are already in the Geological Department of the British Museum (Natural History), and the rest of his collection is destined to be added to them.

A. S. W.

WE regret that the date of the death of Mr. F. W. Harmer was given incorrectly in NATURE of June 9 as April 24: it should have been April 11.

Current Topics and Events.

SOME time ago Dr. George Sarton, of the Carnegie Institution, Washington, and editor of *Isis*, directed the attention of scientific men to the enormous amount of ignorance and superstition which still surrounds them (*Isis*, vol. iii. pp. 449-50). This mental condition is not confined to the poor and uneducated, but is to be found among many people who have had the advantage of a collegiate education. Yet how common is that ignorance has recently been shown by the attacks made in the United States upon the Darwinian theory by Mr. W. J. Bryan, a campaign which has found an echo in Great Britain. On May 25 the writer of a letter headed "War on Darwinism" in the *Daily Mail* gravely assured us that *the origin of man has not been discovered by science*, and that the author of the "Origin of Species" was wrong because "Ruskin laughed the thing to scorn in 'The Eagle's Nest,'" and "Disraeli did likewise in 'Tancred.'" That remarkable epistle emanated from a certain "Modern High School, Lee, London." *Damnant quod non intelligunt!* The logic equals the knowledge: Darwin *wrong* because Froude (a manufacturer of English history), Ruskin (a word-painter), and Disraeli (an imaginative writer) laughed and did other things! One would have thought that the days when Darwinism was "reviled by bigots and ridiculed by all the world" were for ever past, were we not forcibly reminded to the contrary by such fanatical attacks from time to time. However man's origin may have been brought about, no trained mind questions the fact of that origin, which is no mere phantasm but rests upon irrefragable evidence. Whether it would be a good thing to teach the doctrines of evolution in our "modern high schools" may be a questionable matter; but it would indeed be a good thing if teachers in "modern high schools" were to teach their pupils to emulate the noble example set them by such scientific men as Charles Darwin and Thomas Henry Huxley, who devoted their lives to the search for scientific truth.

ON June 6, at the Langham Hotel, the Anglo-Batavian Society entertained Prof. H. A. Lorentz at a banquet which was attended by a number of British men of science. The Anglo-Batavian Society was formed a few years ago in order to promote good-fellowship between the English and Dutch races, on a similar basis to that of the Pilgrims' Club, which seeks to promote good-fellowship between Great Britain and the United States. A couple of years ago the Society was instrumental in establishing an interchange of University lecturers between Holland and England. At first this was limited to the medical faculty, but last year it was decided to extend the lectures to other faculties, and to include physicists and others. In that way Profs. J. F. Thorpe, Brereton Baker, and Sir Humphry Rolleston visited Holland in the months of February, April, and May last, while Prof. W. de Sitter, of Leyden (astronomy), H. R. Kruyt, of Utrecht (chemistry), E. D. Wiersma, of Groningen (medicine), and Prof. H. A. Lorentz, of Leyden (astronomy and physics), visited Great Britain. During the months of May and June Prof. Lorentz visited consecutively the Universities of London, Manchester, Edinburgh, Leeds, and Liverpool, where he lectured on the rotation of the earth and its influence on optical phenomena and the theory of the Zeeman effect. In addition to these lectures, Prof. Lorentz addressed the Royal Institution on June 1 on the subject of radiation of light, and gave by invitation a series of three lectures at University College, London, on June 4, 5, and 7, on relativity. The last three lectures formed a connected course, the aim being to present in a simple form the fundamental principles and some of the applications of the theory of relativity. The other lectures were mainly devoted to questions belonging to the quantum theory and to a discussion of the relation between it and former views. In his discourse at the Royal Institution Prof. Lorentz showed how the ideas of the corpuscular and the undulatory theory of light were closely interwoven in Newton's mind and may be interwoven once more in the physics of the future. The banquet given to him by the Anglo-Batavian Society was presided over by Sir Walter Townley, chairman of the council of the Society. In replying to the toast of his health Prof. Lorentz expressed his great appreciation of the welcome which he had received everywhere in England.

A REPRESENTATIVE and well-attended meeting was held on Friday, June 1, at the Royal Society of Medicine, at which it was decided to establish a memorial to the late Prof. A. D. Waller and Mrs. Waller. In view of their lifelong devotion to, and enthusiasm for, scientific investigation, it was felt that the most fitting memorial would be the formation of a fund to be used for the promotion of scientific research. Further, in recognition of their close association with the London (Royal Free Hospital) School of Medicine for Women, where Prof. Waller succeeded Sir Edward Sharpey Schafer as lecturer in physiology, a post which he held from May 1883 to November 1886, and Mrs. Waller was first a student and afterwards a member of council, a position which she held to the last year of her life, it was decided that the research fund should be entrusted to, and administered by, the council of that School. A committee was formed to carry out this scheme, and the following, among others, have consented to serve: Sir E. Sharpey Schafer (chairman), the Maharaj of Jhalawar, Sir Charles Sherrington, Sir Humphry Rolleston, Sir Sydney Russell-Wells, Sir Walter Fletcher, Sir David Ferrier, Sir David Prain, Sir Frederick Mott, Sir Leonard Rogers, Miss Aldrich-Blake, Mrs. Scharlieb, Miss Tuke, Mr. Bousfield, Prof. Adam, Prof. Halliburton, Prof. Gowland Hopkins, Prof. Starling, and Mr. Alfred Palmer. Already 1100*l.* has been promised, and further subscriptions may be sent to the honorary secretaries, Prof. Winifred Cullis and Prof. J. S. Macdonald, or to the hon. treasurer, Prof. J. Mellanby, St. Thomas's Hospital Medical School, London, S.E.1.

A STATEMENT as to the position of the Scientific Expeditionary Research Association was made at a luncheon at the Trocadero Restaurant on June 7. The objects of this Association were referred to in an article published in NATURE of January 13, 1923. It has now been arranged that the first expedition shall start in September next, the three-masted schooner *St. George*, of approximately 1000 tons register, having been secured for the purpose. The ship, which is designed on the lines of a yacht, is fitted with auxiliary steam-power, and will be under the command of Commander D. Blair. It is intended that seven or eight fully qualified men of science, representing biology in its different branches, ethnology, oceanography, and geology, shall accompany the expedition, and that full opportunities shall be given them for serious scientific work. The expedition will last for about ten months, and the route followed will be Panama, Galapagos, Easter Island, Pitcairn, Gambier Islands, Rapa, Australs, Cook Islands, Tahiti, Rangiroa, Marquesas, Cocos, Panama, Azores. There will be accommodation for not more than thirty paying guests, and the cruise should offer a unique opportunity for any one with scientific interests to visit the Pacific Islands under favourable conditions for research work, which would supplement the organised research of the expedition. The arrangements for the latter are being made by a committee of scientific men who are specialists in the different subjects which will be investigated. The offices of the Association are at 50 Pall Mall, London, S.W.1.

JUNE opened this year with very unfavourable weather conditions. May was dull and cold generally, but statistics of past years show worse weather in May than that experienced this year. The unfavourable atmospheric conditions in May occasioned a drift of cold air over the British Isles from the Arctic regions. A change, however, has occurred since the commencement of June, and the drift of air is chiefly from the Atlantic, with more normal conditions, although the days are mostly decidedly cool. Greenwich records afford a ready comparison with the past for a period of at least 80 years. June 1-6 this year was continuously cold, the day temperatures being below 60°, with the exception of June 3, when a break of warmer weather was experienced over the south-west and south of England, and at Greenwich the maximum in the shade registered 71°, while the sun was shining for 8·4 hours. The lowest mean maximum temperature in June recorded at Greenwich since 1841 is 62·4° in 1909, which is 7·6° below the normal, there being only 3 days during this month with the temperature 70° or above; 1860 and 1916 are the only other years with so small a number of warm days in June. In 1909 the first half of the month was generally cold. In 1903 June was also cold, and the two weeks from June 7-20 were probably colder than any other similar period in June on record; the maximum or day temperature on June 19 was 48·5°, which is the lowest day temperature in June during the last 80 years, and 5° below the coldest day in the early part of June this year.

THE annual conversazione of the Institution of Civil Engineers will be held on Thursday, July 12, at 8 P.M.

SINCE 1917 the Royal Society's Gold Medals have been struck in brass, although the recipients have been informed that in due course the brass copies will be replaced by gold. The receipt of an invitation from a prominent firm of jewellers to view the King's Gold Vase and the Gold Cup made for the Ascot meeting, 1923, gives reason for the hope that at no distant date the Mint may find itself in a position to release the small quantity of gold required to strike these medals in their proper medium.

THE tercentenary of the Oxford University Botanic Garden will be celebrated on Saturday, June 23, in the Garden at 3.30-5.50 P.M. The speakers will include the chancellor of the University, Sir David Prain, the president of Magdalen College, and Sir F. W. Keeble, Sherardian professor of botany in the University.

IT is announced in *Science* that Dr. George K. Burgess has been appointed director of the Bureau of Standards in succession to Dr. S. W. Stratton, who resigned to become president of the Massachusetts Institute of Technology. Dr. Burgess has been connected with the Bureau of Standards for twenty years, becoming chief of the division of metallurgy in 1913.

IN another part of this issue we print an article on the life and work of Blaise Pascal by Prof. H. Wildon Carr. Celebrations commemorating the tercentenary of Pascal's birth are to be held in France on July 8-9. The principal meeting will be in Paris, where the French President will be present at a gathering to be addressed by the Minister for Public Instruction and members of the French Academy. A meeting will also be held at the summit of the Puy de Dôme, the site of Pascal's classical experiment showing the fall of the barometer with increasing height above sea-level.

THE trustees of the British Museum have accepted a portrait of Alfred Russel Wallace, which is being presented to them by a memorial committee of which Sir James Marchant is secretary. The artist is Mr. J. W. Beaufort. The painting will be unveiled in the Central Hall of the Natural History Museum, South Kensington, at 12 noon on Saturday, June 23. Places will be reserved as far as possible for those specially interested in Wallace's work, on the receipt of applications addressed to the Director.

THE arrangements for the International Air Congress, which is to be held in the rooms of the Institution of Civil Engineers, on June 25-30, are now nearly complete. A large number of papers has been received; these have been arranged in four groups, or sections, and the discussions on the four will go on simultaneously. The Congress, of which H.R.H. the Duke of York is president, will be opened at 10 A.M. on June 25 by H.R.H. the Prince of Wales. An inaugural address will be

given by the Duke of Atholl, Under Secretary of State for Air; while at the final meeting the closing address will be delivered by the Secretary of State for Air, Sir Samuel Hoare. Among the important papers of general interest may be mentioned those on air mails by General Williamson, on the development of commercial aviation by Mr. Handley Page, on aviation insurance by Mr. Sturge, and on various airship questions by Major Scott and Ing. Nobili. Problems in navigation and in the medical aspects of aviation are not neglected, while the standardisation and the scientific aspects of aviation are represented by papers by Sir Richard T. Glazebrook, Mr. Le Maistre, Wing-Commander Hynes, Dr. Stanton, Mr. Southwell, Mr. McKinnon Wood, and other members of the staff of the Royal Aircraft Establishment.

THE eleventh International Physiological Congress, which will be held at Edinburgh on July 23-27, under the presidency of Sir Edward Sharpey Schafer, is apparently the first scientific meeting of its kind in Scotland, and promises to be very successful. Already more than 250 physiologists from various parts of the world have signified their intention of attending the meeting, and a large number of countries will be represented. The largest contingent from abroad is coming from the United States and Canada, and will number about forty. A second notice has just been circulated, from which we see that, on presentation of an official voucher, return tickets to Edinburgh will be issued at a single fare and a third by any railway booking office in Britain. The provisional programme of the Congress includes a reception by the Lord Provost of Edinburgh and an address by Prof. J. J. R. Macleod, of Toronto, on insulin. Those who intend to take part in the Congress should, unless they have already done so, communicate without delay with one of the secretaries, Prof. G. Barger or Prof. J. C. Meakins, University of Edinburgh.

THE seventh International Congress of Psychology will be held at Oxford on July 26–August 2, and will differ from preceding congresses in that it will be restricted to 200 members, membership being confined to trained psychologists, and a few others approved by the committee. It is hoped to provide international symposia on subjects of present interest, the contributions being circulated in advance, and each day will be devoted to a different aspect of psychology (general, educational, industrial, medical, social, etc.). The mornings will be occupied in the discussion of more general problems (such as the perception of time, the perception of form, the nature of general ability, the concepts of mental and nervous energy, the principles of vocational testing, the psychological value of certain psychoanalytic views), and the afternoons in the presentation of a limited number of papers offered by individual members. Exhibits of apparatus and less technical lectures will be also arranged. The recognised languages of the Congress will be English, French, German, and Italian. Further particulars can be obtained from the assistant secretary, Mr. W. J. H. Sprott, Clare College, Cambridge.

THE ninety-first annual meeting of the British Medical Association is to be held at Portsmouth on July 24-27, and the president-elect, Mr. C. P. Childe, senior surgeon of the Royal Portsmouth Hospital, will deliver his address on the first day of the meeting. The following presidents of sections have been elected:—Medicine: Sir Thomas Horder; Surgery: Sir Henry Gray; Obstetrics and Gynæcology: Dr. V. Bonney; Pathology and Bacteriology: Dr. H. Maclean; Neurology and Psychological Medicine: Dr. Henry Devine; Ophthalmology: Sir John Parsons; Public Health: Dr. A. Mearns Fraser; Diseases of Children: Dr. E. Cautley; Laryngology and Otology: Mr. E. B. Waggett; Radiology and Electrology: Mr. S. Gilbert Scott; Naval and Military Hygiene: Surgeon Rear-Admiral Sir Percy Bassett-Smith; Tuberculosis: Sir Henry Gauvain; Medical Sociology: Mr. H. B. Brackenbury; Orthopædics: Mr. T. H. Openshaw; Venereal Diseases: Sir Archdall Reid; Anæsthetics: Mr. W. J. Essery. A provisional programme has been issued which includes provision for discussions on diabetes (Section of Medicine), in which Dr. F. G. Banting, of the University of Toronto, will take part, on the part played by fungi in disease (Section of Pathology and Bacteriology), to be opened by Dr. A. Castellani, of the London School of Tropical Medicine, and the artificial light treatment of lupus and other forms of tuberculosis (Section of Tuberculosis), to be opened by Dr. Reyn, of the Finsen Light Institute at Copenhagen. The annual exhibition of surgical appliances, foods, drugs, and books will be opened on July 24 and remain open until July 27. The honorary local general secretaries for the meeting are:—Mr. C. A. Scott Ridout, St. Elmo, Clarendon Road, Southsea, and Mr. E. J. Davis Taylor, 20 Clarence Parade, Southsea.

AFTER several unsuccessful attempts under the Russian regime, an institute of geodesy was eventually founded in Finland in 1918. The first report, which has now been published, covers the work accomplished until the end of 1919. The need for accurate triangulation in Finland is great. The existing maps leave much room for improvement. Two chains of triangulation cross the country, one from north to south, surveyed about 1840 in the measurement of an arc of meridian, and the other along the Gulf of Finland from the isthmus of Carelia to the Åland Islands. The latter is very defective and the first is of little use as the triangulation stations were seldom marked on the ground. The first eighteen months of the institute's existence were spent largely in organisation. No funds being available for a new building, a house in Helsingfors was adapted for the purpose. Dr. I. Bonsdorff was appointed director and given a staff of five or six assistants. A small supply of instruments and a library of about 1000 volumes were acquired. It was decided to begin work on a line of primary triangulation from the isthmus of Carelia to the Åland Islands joining to the triangulations of Sweden, Esthonia, and Central Europe. A preliminary reconnaissance for this triangulation was undertaken.

UNDER the title *Open Air* the proprietors of *Country Life* have commenced the issue of a new monthly magazine for lovers of Nature and outdoor life. All kinds of outdoor activities are to be catered for, and in the first number there appear articles on walking and motoring, camping and yachting, fishing, tennis, birds and flowers, photography and weather forecasting, and the charming scenery of the British countryside. The policy of the magazine is to put within the reach of every one some knowledge of Nature, to increase interest and participation in all outdoor life and pastimes, and to point the way of obtaining the most lasting and satisfying pleasures from the beauties and wonders of Nature. The first number makes a successful attempt to attain this ideal. The articles are simply and attractively written and the illustrations are numerous, charming in effect, and well reproduced. Special mention should be made of the article on Thomas Hardy's county; of the account of the kingfisher at home, by Miss E. L. Turner, illustrated by her own inimitable photographs; and of the description of some of the wild flowers of the countryside by Mr. Bedford. If the standard of the first number is maintained the magazine should appeal to a wide circle of readers.

WE have received a copy of the fourth annual report of the Governors of the Imperial Mineral Resources Bureau dealing with the year ended December 31, 1922. The Bureau maintains an intelligence service in matters relating to the mining and metallurgical industries, partly by correspondence with representatives in different parts of the British Empire and by co-operation with various government departments, and partly by a system of indexing published information bearing on mineral resources in all parts of the world. The information thus accumulated is of much value in answering inquiries and compiling reports on mineral resources. This work of answering inquiries and putting producers and consumers in touch with one another is of growing importance in connexion with the Bureau's work. Since the publication of the last report, the compilation of the "Mineral Conspectus of the British Empire and Foreign Countries" for the period 1913–1919 has been almost completed. Special attention is directed to the eight volumes on iron ore dealing with the present and prospective iron-ore supplies of the world, prepared by the request and with the assistance of the National Federation of Iron and Steel Manufacturers. Two legal publications were issued during the year, dealing with Transvaal and British Columbia. A statistical series for the period 1919–1921 is in the press, and the parts dealing with the more important minerals and metals are being published in advance. A review of the mineral industry of the Empire during 1922 is promised at an early date. During the year under review the Bureau continued its efforts towards the unification of mineral statistics, an enterprise in which it is much to be hoped that success will attained.

PART i. vol. 18 of the Journal of the Royal Horticultural Society, dated January 1923, contains much interesting material for students of horticulture. The Rev. A. T. Boscawen has a note upon New Zealand trees and shrubs grown successfully in Cornish gardens; it is illustrated by seven excellently reproduced photographs. Mr. F. C. Stern has an interesting note upon cultivation in a garden made in an old chalk-pit; while few plants succeed in pure chalk rubble, there is a very long list of plants successfully grown in a mixture of chalk and soil. Mr. J. Coutts has a paper upon the cultivation of lilies. As a contribution from the Wisley Laboratory, appears a twenty-page report by Mr. W. J. Dowson upon the wilt disease of Michaelmas daisies; as the result of inoculation experiments the disease is traced to *Cephalosporium Asteris* Dow., provisionally determined as a new species, though ultimately culture of the fungus may necessitate its redetermination as a micro-conidial stage of a Fusarium. An important practical conclusion in this paper is the practicability of raising healthy plants by vegetative propagation from diseased stocks, by striking cuttings from the tips of the rooted suckers. Mr. A. H. Hoare briefly describes the Rhododendron bug, *Stephanitis* (*Leptobrysa*) *rhododendri* Horvath, now scheduled under the Sale of Diseased Plants Order of 1922 and the cause of severe damage to rhododendrons in many districts. From the annual report of the council, the Royal Horticultural Society would appear to be in a very prosperous and flourishing condition, the membership of the Society having increased by 1214 during the year 1921.

A NOTE in NATURE of May 19, p. 681, referred to the habit of a sparrow in persistently tapping a window pane. Sir David Wilson-Barker writes to say that a chaffinch for about two months last year did almost the same thing, with this difference, that it never settled on the window ledge. Sir David suggests that the bird was playing with its own reflection.

DR. T. H. C. STEVENSON will read a paper on "The Social Distribution of Causes of Death in England and Wales," at a meeting of the Society of Biometricians and Mathematical Statisticians on June 25, at 8 P.M., in the theatre of the Galton Laboratory, University College, London. Visitors will be welcomed.

WE have received a copy of No. 142 of the Circular of the Bureau of Standards, entitled "Tables of Thermodynamic Properties of Ammonia." The pamphlet contains some valuable tables, together with an excellent Mollier chart of the properties of ammonia, and should be very useful to those interested in refrigeration.

MESSRS. G. BELL AND SONS, LTD., announce the early publication of "The Structure of the Atom," by Prof. E. N. da C. Andrade, and a revised and enlarged edition of "X-rays and Crystal Structure," by Sir William Bragg and Prof. W. L. Bragg, in which the original intention of the authors has been maintained, namely, to describe sufficiently the elements of the physics, the crystallography, the chemistry, and the mathematics required for the understanding of the subject.

THE volume of the *Bulletin International* of the Academy of Sciences of Prague for 1917 appeared in 1919 under new auspices, but with the handsome style and typographic excellence of former issues unimpaired. The Academy continues to publish, in French or German, much geological, anatomical, and physiological work, which will no doubt be recorded in the various *Zentralblätter*; but it is a pleasure to consult these papers in their original form, and to find that their production has so admirably survived the test of political distractions.

THE series of lectures recently given at University College, London, by Sir John Russell and members of the staff of the Rothamsted Experimental Station are to be published by Messrs. Longmans and Co., in the "Rothamsted Monographs of Agricultural Science," under the title of "The Micro-organic Population of the Soil." Another book to be issued by the same publishers is "Lead: Its occurrence in Nature, the modes of its extraction, its properties and uses, with some accounts of its principal compounds," by Dr. J. A. Smythe, in "Monographs on Industrial Chemistry."

THE Geologische Vereinigung continues the issue of its valuable journal, the *Geologische Rundschau*, under the care of Profs. Steinmann, Wilckens, and Cloos, and the subscription price (10 gold marks for foreigners) compares favourably with that of most of our own scientific periodicals. Volume 13, beginning in May 1922, contains original articles, such as that by Steinmann on the uprising of the Andes, as well as the usual critical summaries that embody much independent opinion on the part of their authors. Scientific libraries will do well, by placing the *Rundschau* on their shelves, to keep in touch with a wide range of progressive work, promulgated by progressive thinkers.

PRELIMINARY arrangements for the regular publication of the *Journal of Scientific Instruments* have now been made by the Institute of Physics in co-operation with the National Physical Laboratory. The special attention of those workers who have new designs for instruments is invited to the fact that the *Journal* is to serve as a medium of publication of detailed descriptions and critical surveys of the behaviour of such instruments. Original papers or laboratory and workshop notes dealing with the practical or theoretical aspects of scientific instruments should be sent to the Editor, Dr. John S. Anderson, The National Physical Laboratory, Teddington, Middlesex.

Our Astronomical Column.

PROJECTION OF ALDEBARAN ON THE MOON.—The present series of occultations of Aldebaran has once more directed attention to its apparent projection on the moon's disc when it disappears at the bright limb. The subject is discussed by Mr. R. L. Waterfield in the British Astronomical Association's Journal for March. He describes some interesting experiments that he made, using a card with a minute pinhole and a lamp behind it as an artificial star. It was found that the brighter the illumination of the artificial moon that was made to cover this star, the further was the latter projected on the disc before disappearance.

Since diffraction makes every bright point appear as a disc in the telescope, this will of itself extend the bright limb of the moon beyond its true position, and also extend the disc of Aldebaran inwards; a considerable fraction, but not the whole, of the observed projection is shown to be thus explained. The width of the diffraction ring that can actually be seen depends on the brightness of the object. Thus faint stars do not show the projection.

To explain the full amount of projection observed, it was found necessary to invoke irradiation, which is probably physiological and differs for different observers; this is quite in accord with experience in the case of Aldebaran.

FAMILIES OF ASTEROIDS.—Mr. K. Hirayama's researches on the connexion between the orbits of many of the asteroids have already been mentioned in this column. He returns to the subject in the *Japanese Journal of Astronomy and Geophysics*, vol. i. No. 3. He studies the secular perturbations by Jupiter and the other planets, and finds quantities which he terms "invariable elements," which are a sort of mean of the actual varying elements. The important elements are mean inclination and mean eccentricity. He makes diagrams in which these quantities are taken as ordinate and abscissa, the third important element, the mean motion, being indicated by varying the colour of the dot. He thus finds several families of planets that show such close agreement in these three points that he has no doubt that they had a common origin; he indicates 5 families, each being called after the earliest discovered member of it; the names are Themis, Eos, Coronis, Maria, and Flora, and the numbers of asteroids belonging to them are 25, 23, 15, 13, and 57.

There seems to be little doubt that Mr. Hirayama has hit on a remarkable relation between the orbits of many asteroids, and that there are strong reasons for postulating a common origin for each family. We thus revert in a sense to the old notion of an exploded planet, but a series of disruptions now appears more probable than a single one.

STONYHURST COLLEGE OBSERVATORY, REPORT FOR 1922.—Sunspots are regularly drawn and measured at the College Observatory on every fine day. The spot activity showed a decided decline in 1922, there being 93 days when the sun was seen to be spotless, as against 29 in 1921. On the other hand, the mean daily magnetic range, both in declination and horizontal force, showed a slight increase. Spectroscopic work was also done, both on the sun and on stars, a special study being made of γ Cassiopeiæ. Papers have been contributed to the *Observatory*, to Monthly Notices of the R.A.S. and elsewhere, on the connexion of magnetic disturbances with sunspots, on the prominences, and on the proper motions of stars in the Perseus clusters. Seismological records were also kept. The disturbance in the Chilian earthquake of November 11, 1922, was so great that the boom adhered to the stop, causing a loss of part of the record. The report also contains full details of the meteorological observations. Father Cortie notes that it is intended to utilise the large stock of stellar spectra at the Observatory for the deduction of spectroscopic parallaxes.

Research Items.

MONOLITHS OF THE NAGA TRIBE OF ASSAM.—In the Journal of the Royal Anthropological Institute (vol. liii., 1922) Mr. J. H. Hutton discusses the monoliths erected by the Naga tribes of Assam. He assumes that the monolith erected when the founder gains the highest social rank is the translation into stone of the original phallic posts, which seem to be connected with the monolithic remains at Dinapur. Many Angamis erect a pair instead of a single stone, of which the erect stone represents the male and the prostrate stone the female—the object being a magical means of procuring fertility for the members of the tribe, their cattle, and crops. On the other hand, these monoliths are memorials of the dead. Of two possible explanations, the more likely one is assumed to be that the monolith is merely a translation into stone of the wooden statue erected in honour of the dead by villagers who do not erect memorial stones. The alternative is that the erect stones originally commemorated a feast, and thus became the memorial of the giver. It has always been a problem how monoliths, like those of Stonehenge, were erected. Mr. Hutton was present at the erection of one of these stones, dragged by human labour, and his careful description of the methods employed throws much light on the general question of monolith erection.

THE ROOTING OF CUTTINGS.—Prof. J. Small has a note in the *Gardeners' Chronicle* for May 5 upon his experiments at Belfast, in collaboration with Miss M. J. Lynn, upon the effect of watering with dilute acetic acid upon root production by cut shoots. The experiments appear to be preliminary in nature, and no data are supplied as to the actual hydrion concentration around the base of the cutting, but the results reported certainly seem to show greater root production after treatment with very dilute vinegar. In experiments with cuttings of *Aucuba Japonica* evidence was obtained indicating that carbon dioxide might have a stimulating effect upon root production. These results may prove of great practical importance if confirmed upon further trial, but so far the experiments with species, difficult to strike in ordinary practice, are not sufficiently advanced to justify the drawing of conclusions

SLEEP MOVEMENTS AND VEGETATIVE REPRODUCTION IN PLANTS.—The *Journal of Indian Botany*, vol. iii., No. 5, contains a paper by W. T. Saxton upon "Nyctinasty," in which it is suggested that instead of the plants adopting a special "sleep" position at night, the leaves then actually resume a normal position, relaxing from a position of "physiological strain" which has been assumed under the influence of daylight. R. H. Dastur has a note upon vegetative reproduction by root runners, in which it is assumed that the current teaching is that buds are only formed upon roots when the plants are old or when the original stems are removed or cut down. The writer is evidently unaware of Beijerinck's classical paper of 1887, in which the natural production of buds on the roots of healthy plants was fully described and the literature of the subject, extensive even at that date, very fully cited.

CHEMISTRY OF SOME JAPANESE PLANT PRODUCTS.—In *Acta Phytochimica*, vol. i, No. 2, Yasuhiko Asahina gives a résumé of his researches, previously published in Japanese, upon the active principles in the dried fruit of *Evodia rutæcarpa*, which in recent times has been almost exclusively used as tincture in Japan instead of tincture of iodine. In addition to evodin, previously isolated by Keimatsu, Asahina recognises two alkaloids, evodiamin and rutæcarpin, giving different colour reactions with cold concentrated sulphuric acid, and a terpene that is possibly ocimen. Yuji Shibata and Kenshô Kimutsuki make the important suggestion, backed by considerable experimental evidence, that the spectrograph provides a valuable means of identifying and distinguishing the various flavones rapidly and surely, while Keita Shibata, Shôjiro Iwata, and Makoto Nakamura describe baicalin, a compound of a new flavone with glucuronic acid obtained from the roots of *Scutellaria baicalensis*.

INVESTIGATIONS UPON FRUIT TREES.—The *Journal of Pomology and Horticultural Science*, vol. 3, No. 2, April 1923, contains a preliminary report by L. N. Staniland upon the results to date of his quest for apple stocks resistant or immune to woolly aphis. The paper, although preliminary, describes a large number of experiments and observations upon artificial inoculations, from which it appears that the Northern Spy stock is immune under English conditions. As it is not a stock suitable for all purposes in this country, research is now extended to its seedlings, which are also to be tested for immunity. Some of the Paradise stocks at East Malling are very much more resistant than others, while two "Wilding Crabs" have been found which appear to be immune. The search for immune individual stocks is being continued with the view of breeding work in which immunity may be combined with other desirable characteristics. There is also a valuable report by M. B. Crane upon the "Self Sterility and Cross Incompatibility" of cherries, apples, and plums, which describes the continuation of the work upon this problem previously reported upon by I. Sutton in the *Journal of Genetics*, vol. vii. (reprinted in the *Journal of Pomology*, vol. i). The paper provides an enormous mass of valuable data, supplemented by some striking photographs, of the results of various crosses, and of self-pollination experiments. The results seem to place beyond doubt the fact that many varieties of fruit trees are completely self-sterile, while in the sweet cherry and the plum, cross incompatibility occurs, *i.e.* some varieties crossed with pollen of certain other varieties wholly fail to form fruit. The importance of these conclusions, supported with full data as to varieties and their behaviour, to the grower stocking an orchard, scarcely needs comment. Points of great scientific interest continually arise in the course of such long-continued and carefully controlled experiments; for example, the observation now reported that apple varieties originally quite self-sterile have indubitably become slightly self-fertile with advancing age.

NEW ISOPOD FROM CENTRAL AUSTRALIA.—Prof. C. Chilton describes (Trans. R. Soc. S. Australia, xlvi., 1922) a new species of Phreatoicus, a freshwater crustacean, which occurred in thousands in the hot water near an artesian bore at Hergott, a little south of Lake Eyre. The specimens had well-developed eyes and were of a dark-slaty colour; hence they evidently had not come up the bore from underground waters. Specimens were later found in various springs and natural waters over an area of about thirty miles, so that the species is widely distributed. Although the species is placed for the present in the genus Phreatoicus, it differs from the other members of the genus in the greater expansion of the basal joints of the last three pairs of peræopods and in the apparent absence of the coxal joints of all the peræopods. The first species of Phreatoicus

was described in 1883 from the underground waters of the Canterbury Plains, New Zealand, and other species of the genus and of allied genera were subsequently described from the surface and underground waters of Australia. In 1914, Barnard recorded a species of Phreatoicus from the mountain streams of Cape Colony. The characters and distribution show that the family is an ancient one, and this was proved also by the discovery of a fossil species, from the Triassic beds of New South Wales, not very different from some of the existing species.

NEW SQUALODONTS FROM THE MIOCENE OF MARYLAND.—R. Kellogg describes and figures the remains of two Squalodonts recently discovered in the Calvert Cliffs (Miocene), Maryland (Proc. U.S. Nat. Mus., vol. lxii., Art. 16). Of the two, one is definitely referred to a new species, *Squalodon calvertensis*, the other is at present indeterminate. The introduction to the paper gives a good summary of the history of the Squalodonts generally, and is followed, under the misleading and erroneous title of "Nomenclature," by a descriptive list of the various species and a "key."

THE CONSTITUTION OF CLAYS.—In Bulletin 708 of the U.S. Geological Survey (1922), H. Ries and other authors describe "The High-grade Clays of the Eastern United States." Of all rocks, clays probably offer the greatest difficulties to petrographers. W. Maynard Hutchings (*Geol. Mag.*, 1890, p. 266) prepared thin films from clays for microscopic examination, retaining the particles in their relative positions. Except where lamination has to be studied, no great advantage arises from this method, and H. C. Sorby (Quart. Journ. Geol. Soc., Proc., 1880) did good work on separated grains, which could be pressed down or rolled over under the cover-glass. Allan B. Dick's "smudge" method ("Kaolin, China-clay, etc.," Mus. of Pract. Geology, p. 261, 1914) keeps the constituents matted together for comparison of their optical characters, and something similar seems to be effected by the squeezing-out process adopted in the American researches (Bull. 708, p. 293) by R. C. Somers. His photographs give the impression of coherent sections; but probably only a massing of the mineral particles can be inferred. Chlorite is omitted from the list of minerals observed, and Hutchings failed to recognise it even where altered biotite formed an important constituent of his clays. He found it, however, abundantly in slates derived from the decay of basic igneous rocks, such as his "ash-slates," and H. B. Milner, in his recently published "Introduction to Sedimentary Petrography," regards its appearance in loose sediments as due to the breaking down of slates and schists. It would seem that the green hydrated products from ferromagnesian silicates, wisely called by various authors "chloritic matter," should find a considerable place as constituents of many clays and sandstones, though probably in a highly comminuted form. R. F. Somers recognises halloysite and diaspore in the American clays, in addition to the prevalent flakes of kaolin. The white material known as "indianite" from south-central Indiana is discussed by W. N. Logan (Bull. 708, p. 147), who finds it to consist mainly of the hydrous aluminium silicates, halloysite, and allophane. In the field it is associated and interlocked with a sandstone of Pennsylvanian age, blocks of which graduate into the clay, and H. Ries (p. 161) comes to the very interesting conclusion that the indianite has arisen from replacement of quartz pebbles, through the action of aluminium sulphate spreading from the underlying pyritous shales.

STOKES'S LAW OF FALL OF A SPHERE.—In the issue of the Proceedings of the United States Academy of Sciences for March 15 Prof. Millikan, now of the California Institute of Technology, gives a summary of a theoretical and experimental investigation of the law of fall of a sphere in a viscous fluid which will be published later in full in the *Physical Review*. On theoretical grounds he shows that the viscous resistance to the motion of a sphere of radius a with velocity v in a fluid of viscosity n and mean free path l must be $6\pi anv/(1+A'l/a)$ where A' is a constant which must decrease as the density of the fluid decreases. In order to express this decrease he writes $A'=A+Be^{-ca/l}$ where c is a constant. He finds that his experiments with drops of different materials falling in gases of various constitutions and densities are all reproduced by the complete formula with values of $A+B$ which differ by not more than 3 per cent. from each other.

CURVE FITTING.—In many physical problems, experimental data give the numerical values of a function at regular or irregular intervals of a variable on which the function depends. Often it happens that these experimental values indicate that the function starts at zero, rises to a maximum and then falls again to zero. Frequency distributions, river gauge readings, and certain physical and biological data define functions of this type. In such cases it is often necessary to obtain a theoretical function which gives a reasonable fit to the data and can at the same time be integrated. The constants occurring in the theoretical equation should also be capable of calculation without such laborious computation as to make the work impracticable. In a pamphlet, "A Method of Curve Fitting," issued by the Physical Department of the Egyptian Ministry of Public Works (Cairo, Government Publications Office, 1922, P.T. 5), Mr. S. Krichewsky explains an equation which has been found to include a wide range of observations, including frequency distributions. The equation is

$$z=f(x)=dy/dx=ky^m(a-y)^n,$$

wherein $f(l_1)=f(l_2)=0$, $a=\int_{l_1}^{l_2}f(x)dx$, $y=\int_{l_1}^{x}f(x)dx$, so that z is the ordinate at x, and y the area from l_1 to x. Mr. Krichewsky's method certainly possesses limitations due to the small number of free constants contained in his equation. Much of the pamphlet is concerned with the calculation of the constants to fit the equation to sets of observed data.

HARDENING STAINLESS STEEL.—Messrs. Automatic and Electric Furnaces, Ltd., of Farringdon Road, London, manufacture a special electric furnace for hardening "stainless" cutlery. The demand for stainless cutlery has been affected adversely by the fact that in many cases a permanent edge cannot be obtained by its use. To get over this difficulty the steel is treated as follows: it is first heated in the furnace to a temperature of 970° C. (as shown by the pyrometer) and then cooled in air. It is next reheated to the same temperature and quenched in water. Finally, it is tempered to 220° C. in an electrically heated muffle. A very fine microstructure is thus obtained. Besides its rust-resisting qualities, stainless steel has a thermal conducting coefficient less than one-third that of pure iron. It is an excellent material for making permanent magnets for use in positions where freedom from corrosion is an advantage, as when quenched at 970° C. it has a large coercive force and great remanence. It is also useful for making mirrors of all kinds.

The Liverpool Meeting of the British Association.

THE preliminary programme and invitation circular for the meeting of the British Association to be held at Liverpool on September 12-19, under the presidency of Sir Ernest Rutherford, have just been issued. The Association has met at Liverpool on four previous occasions, the years and the presidents being 1837, Earl of Burlington, afterwards Duke of Devonshire; 1854, Earl of Harrowby; 1870, Prof. Huxley; 1896, Lord Lister. The meeting in 1896 was the fourth largest in the history of the Association, the attendance being 3181, and it is hoped that this number will be exceeded at the forthcoming meeting. Arrangements have been made with the Railway Companies in Great Britain under which members attending the meeting may obtain return tickets to Liverpool on payment of single fare and a third.

The provisional programme of addresses, discussions, etc., is given below, the sections being as follows:—A, Mathematics and Physics; B, Chemistry; C, Geology; D, Zoology; E, Geography; F, Economic Science and Statistics; G, Engineering; H, Anthropology; I, Physiology; J, Psychology; K, Botany; L, Educational Science; M, Agriculture.

Wednesday, September 12, 8.30 P.M.—Inaugural general meeting: presidential address by Sir Ernest Rutherford, on the electrical structure of matter.

Thursday, September 13.—Addresses by presidents of sections:—D, Prof. J. H. Ashworth, on modern zoology, its boundaries and some of its bearings on human welfare. E, Dr. Vaughan Cornish, on the position and opportunity of the British Empire. K, Mr. A. G. Tansley, on the present position of botany. I, Prof. G. H. F. Nuttall, on symbiosis in animals and plants. M, Dr. C. Crowther, on science and the agricultural crisis. Discussions (Sections A, B, G) on cohesion and molecular forces; (Sections F, J) on psychological assumptions underlying economic theory; and (Sections G, J) on vocational tests for engineering trades.

Friday, September 14.—Addresses by presidents of sections: C, Dr. Gertrude Elles, dealing with some aspects of evolutional palæontology. G, Sir H. Fowler, on transport and its indebtedness to science. L, Prof. T. P. Nunn, on the education of Demos. B, Prof. F. G. Donnan, on the physical chemistry of interfaces. J, Dr. C. Burt, on the mental differences between individuals (with special reference to individual psychology in education and industry). Discussions (Sections E, H) on the methods of anthropology in relation to the social sciences; (Sections F, M) on the outlook for British agriculture; and (Sections B, I) on the physical chemistry of membranes in relation to physiological science. Lecture (Section D) by Mr. Julian S. Huxley on the physiology of development in the frog; and by Prof. G. Elliot Smith on the study of man.

Monday, September 17.—Addresses by presidents of sections:—A, Prof. J. C. McLennan, on the origin of spectra; H, Prof. P. E. Newberry, on Egypt as a field for anthropological research; F, Sir W. H. Beveridge, on unemployment and population. Discussions (Sections J, L) on the delinquent child; (Sections E, L) on geography as a basis for a general science course. Lecture (Section K) by Dr. W. L. Balls, on cotton.

Tuesday, September 18.—Discussions (Sections G, L) on the teaching of dynamics; (Sections K, M) on virus diseases of plants; and (Sections E, H) on the origin of domestic animals.

Delegates of the Corresponding Societies will meet on Thursday, September 13, and on Tuesday, September 18, to discuss matters of common interest to the Societies and the Association. The officers of the Conference of the Corresponding Societies are:—*President*: Prof. H. H. Turner. *Vice-President*: Prof. P. G. H. Boswell. *Local Secretary*: Miss E. Warhurst.

An exhibition of scientific apparatus is being organised and will be held in the Central Technical School. Leading scientific instrument and scientific apparatus makers will be represented, and it is believed that this will be the most complete exhibition of its kind that has ever been held. It will include the latest inventions in instruments and apparatus, as well as charts and diagrams, and, in order to make it thoroughly representative, every section has been asked to submit ideas and suggestions.

International Union for Pure and Applied Chemistry.

CONFERENCE AT CAMBRIDGE, JUNE 17-20.

THE International Union for Pure and Applied Chemistry will meet in Cambridge, at the invitation of the Vice-Chancellor of the University, on June 17–June 20, when about 150 delegates, representing more than thirty different countries, will be present.

The majority of the delegates are expected to arrive on Saturday, June 16. On Sunday, June 17, there will be visits to colleges and other places of interest in the afternoon. In the evening there will be a reception of the delegates by Sir William Pope, president of the Union, and the British Federal Council, in the Arts School.

On Monday, June 18, in addition to the meetings of committees, a report by Prof. J. W. McBain, on "The Nature of Soap Solutions," will be presented and discussed. Two receptions will be held on this day, one by the master of Gonville and Caius College and Mrs. Anderson, and the other by the master of Sidney Sussex College and Mrs. Weekes.

On Tuesday, June 19, there will be the usual committee meetings, and in addition two reports will be presented and discussed. The first will be by Dr. E. K. Rideal on "Recent Developments in Contact Catalysis," and the second by Prof. J. F. Thorpe on "New Aspects of Tautomerism." During the afternoon there will be a garden party in the gardens of Sidney Sussex College, and in the evening the annual banquet of the Union will be held in the Hall of Trinity College.

On Wednesday, June 20, after the committee meetings, Prof. F. Gowland Hopkins will present his report on "Chemical Mechanisms involved in the Oxidations which occur in Living Tissues."

At 4 P.M. the degree of Doctor of Science, *honoris causa*, will be conferred on the following delegates: Prof. W. D. Bancroft, Cornell University; Prof. E. J. Cohen, University of Utrecht; M. A. Haller, president of the Paris Academy of Sciences; Prof. C. Moureu, Collège de France; Prof. R. Nasini, University of Pisa; Prof. Amé Pictet, University of Geneva; and Prof. F. Swarts, University of Ghent. The ceremony at the Senate House will be followed by a reception by the Vice-Chancellor and Mrs. Pearce in the Fitzwilliam Museum.

Technical Chemistry at the University of Edinburgh.

THE experience gained by Sir James Walker in the manufacture of high explosives during the War strengthened his convictions as to the vital need for strong schools of chemistry in British universities, and led to the view that it might be possible to cater rather more directly for chemistry students aiming distinctly for industrial careers than was possible in Edinburgh at that time. As a result the University instituted a department in technical chemistry to meet the needs of those students who desire definitely to prepare for the practice of chemistry in industry, and now proposes, under a recently instituted ordinance, to grant degrees of B.Sc. in technical chemistry leading to the Ph.D. and D.Sc. degrees.

In order to accommodate its ever-expanding scientific departments, the University recently acquired a site of 115 acres of agricultural land at Liberton, on the southern outskirts of the city. The chemistry department was the first to be given accommodation on the new site, and in 1919 work was begun on a new chemistry building, the first of the King's Buildings of the University, which is now nearing completion. In 1921 a portion of this new chemistry building was set aside for the technical chemistry department, and laboratories were designed to meet its special needs.

To get a clear idea of the technical chemistry department it is advisable briefly to survey the general building of which it forms a part. The chemistry building consists of a two-storey frontage looking towards the city, backed by ranges of single-storey rooms with some cellar accommodation. The two-storey portion contains physical chemistry laboratories, staff rooms, library, and administrative offices. Situated centrally behind this portion is a series of laboratories, having the factory shed type of saw-tooth roof with north window lights, stores, and a number of lecture rooms with necessary service and museum rooms. The lecture rooms are lighted by lanterns supported centrally over the ceilings, and an interesting and convenient feature of this lighting system is the provision of movable ceilings to the lanterns so that by the touch of a button at the lecture bench the ceiling can be lowered to cut off all light from the room for lantern projection purposes. Ventilation is effected by the passage of a gentle current of warmed fresh air across the rooms from front to back. The laboratories are very brightly lighted from above and there is no trouble anywhere with dark corners. Even in winter there is little demand for artificial light during the normal working day. A ventilating fan in one wall of each laboratory near the roof is designed to keep the atmosphere fresh, though the provision of an open fume duct at each student's working place and at each evaporating and drying outfit ensures a reasonably clean atmosphere under heavy working conditions.

Flanking the centrally situated laboratories and lecture rooms are corridors running the whole length of the building and giving access to series of smaller rooms, which run along the east and west fronts of the building. These rooms are research laboratories, balance rooms, etc.

The technical chemistry department is situated at the south-east corner of the building, and apart from its laboratories has the advantages of lecture room, dark room, stores, balance room, etc., accommodation provided in the general scheme. There are three larger and two smaller laboratories, with an adjoining workshop. The larger rooms have north roof lights, and normal ventilation is secured by having some of the windows capable of being opened. Additional ventilation is available when necessary in a uralite fume duct, provided with openings closed by sliding doors, running along the back wall of the laboratories, and discharging to the atmosphere through a large-capacity Keith fan. A bye-pass connexion in the fan house enables this fume duct to be put in connexion with a Campbell fume ejector when required.

The floors are of concrete, and slope to centrally situated grid-covered drains. Further drainage accommodation is provided at intervals round the walls of the rooms.

A system of pipes traverses the walls of the laboratories at a mean height of 4 ft. 6 in., and tap and plug connexions are provided at frequent intervals so that each potential working space has at hand the following services — electric power and light, cold and hot water, steam, gas, compressed air, and vacuum.

Apart from cupboard and shelving accommodation provided as wall fixtures, there is no fixed furniture, but movable tables of various heights are available for use as occasions require.

Plant power units will be driven by their own motors in order to retain maximum flexibility, both as regards equipment and its grouping.

One laboratory is provided with a chimney into which are collected four sheet-iron dampered draught pipes serving as furnace flues. Another room has a range of three superimposed platforms for use where a succession of reactions may require gravity feeds.

Of the smaller rooms one is fitted up on the lines of the larger ones, while the other is designed more as an orthodox chemical research room. Here, however, instead of providing fixed bench accommodation, light movable tables are supplied so that they may be arranged to suit the work in hand.

The technical chemistry courses aim at providing:—

1. A sound instruction in the principles of chemistry.
2. A study of the methods of translating chemical processes from the laboratory to the works, with special attention to the combustion of fuels.
3. Practice in such analyses as those of water, oils, and fuels.
4. Laboratory practice in fundamental operations such as filtration, evaporation, crystallisation, drying, electrolysis, furnace work, nitration, sulphonation, fusion, distillation, etc., with small-scale works plant.
5. A sufficient acquaintance with the elements of engineering practice for the following purposes:
   - (*a*) To enable men to co-operate intelligently and satisfactorily with an engineering staff concerned with the provision and working of large-scale plant.
   - (*b*) To make men more competent in handling large-scale operations, the success of which is largely dependent on the best use of mechanical and electrical appliances.
   - (*c*) To give facility in the interpretation of plans and drawings and sufficient skill in drawing to be able to make working drawings of simple plant parts and structures.
6. An insight into the methods of factory organisation.
7. An acquaintance with methods of factory accounting with the view of a proper understanding of costing processes.
8. When desired—and by special arrangement—detailed study of a particular chemical industry or group of industries.

The Electric Charge of Colloids.[1]

By Prof. H. R. KRUYT, University of Utrecht.

SINCE Hardy's publication in 1900, the electric charge of the particles has been the central problem of colloid chemistry. I propose to develop this point of view for both suspensoids and emulsoids, and indeed in the same manner for both types.

In 1907, Freundlich propounded his theory, according to which the origin of the electric double layer was to be sought in a preferential adsorption of one of the ions of the liquid. This theory was applicable to colloid particles with regard to the external phase, and to capillary electric phenomena with regard to the moving liquid. It gave a satisfactory explanation of many facts concerning the coagulation of suspensoids and of the investigations of Perrin and Elissafoff on electro-omosis, of Kruyt on streaming potentials, and of Powis on cataphoresis. Several problems of colloid chemistry could be elucidated by these investigations, *e.g.* the irregular series of flocculation, peptisation, etc. Nevertheless this theory, according to which the double layer is built up only by ions coming from the external liquid, so that the material of the solid wall does not take any part in the process, could not explain all the facts. Especially the investigations on the alkaline sol of SnO_2, carried out by pupils of Zsigmondy, make it obvious that in this case the inner side of the double layer is built up by stannate and not by hydroxyl ions.

The special conditions of the atoms at the periphery of a crystalline particle can account for the formation of a double layer, as Fajans has pointed out. For example, when a negative sol of AgBr is made from solutions of $AgNO_3$ and KBr, with a slight excess of the latter, the Ag-atoms in the crystal lattice are each surrounded by six Br-atoms, whereas an Ag-atom at the crystal boundary is connected to five only; thus it will attract a Br-ion from the surrounding liquid towards the vacant place. This ion, however, is accompanied by a K-ion, which will place itself near the attracted Br-ion. Thus the double layer is formed by the special selective attraction of the solid phase. This train of thought, when slightly modified, holds too for a disperse amorphous phase. According to Langmuir and Harkins, the molecules at a phase interface are oriented with their electrically polar parts towards the water; therefore the conditions are similar to those at the surface of a crystal lattice.

Has the electric charge in the case of lyophilic colloids, like the proteins, the same capillary electric character as in that of the suspensoids? If not (and most physiologists consider it so), colloid chemistry is on the wrong track. The behaviour of proteins is often explained as if they gave real solutions, electrolytically dissociated as amphoteric electrolytes, following Ostwald's law of dilution. Kruyt and De Jong have made investigations on the sol of agar, the behaviour of which cannot possibly be interpreted in that way, the agar being a carbohydrate though giving a typical lyophilic colloid. They pointed out that there is a considerable decrease of viscosity when small amounts of electrolytes are added, the effect being a function only of the valency of the cation, just as is the case with suspensoids and capillary electric phenomena. This effect is the electro-viscous effect, already predicted years ago by Hardy, and thoroughly discussed in the late von Smoluchowski's last paper.

As the electric charge of the agar particles has, without any doubt, just the same character as that of, say, a gold sol, why should a gelatine sol have a charge of quite another origin? Investigations in collaboration with different pupils (unpublished until now for the most part) have convinced me that with gelatin, glycogen, casein, starch, gum arabic, and even with rubber in benzene, the capillary electric phenomena play the principal rôle and can account for the behaviour, which is often interpreted as if we were not dealing with colloids, but with electrolytes in real solution. The influence, especially, of neutral salts can now be understood much better.

The only difference between suspensoids and emulsoids lies in the fact that the latter are hydrated to a large extent, viscosity showing this fact clearly. Water bound by hydration acts as a stabilising factor, just as the electric charge does. The latter can be removed by electrolytes, as mentioned before, and the hydration by adding alcohol or acetone. When hydration only is removed, there remains a suspensoid with all the typical properties of such. Salting out a protein is a combination of the removal of charge (according to the valency) and of hydration (according to the lyotropic strength). Special experiments with agar have made this obvious.

Dr. Bungenberg de Jong has pointed out that the action of tanning agents, like tannin, is a mere dehydration, causing just the same effects as alcohol, though by a very different mechanism.

As a general conclusion, I wish to emphasise the view that the electric charge of all colloids has the same origin, namely, a capillary electric one. The electric charge of suspensoids is their only stabilising factor, the emulsoids having a second in their hydration. With both, the way in which the double layer is built up is not always independent of the material from which the particle is made: with a gold sol, as well as with an agar sol, the double layer behaves in perfect accord with the adsorption theory of Freundlich. With the sol of stannic oxide, as well as with a protein sol, the ions of the molecules situated in the periphery of the particles play an important rôle in the constitution of the double layer.

The advantage of the train of thought developed here lies in the principle of unity according to which colloid-chemistry can be treated.

[1] Synopsis of a lecture delivered at the Universities of London, Edinburgh, and Aberdeen in May 1923.

Plant Ecology.

IN "Die Vegetationsverhältnisse der Grimselgegend im Gebiet der zukunftigen Stauseen" (Bern, Wyss Erben, fr. 8), Dr. Eduard Frey records the character of the vegetation of an area which will soon be submerged in connexion with a water-power scheme in the upper Aare. The area is of special interest in affording a unique opportunity for studying the colonisation of naked siliceous rock and broken soil exposed by the prolonged retreat of the glaciers. Dr. Frey describes in detail the physical characters of the district and the statics of the different plant associations, and also traces the succession of plant life from the original colonisation of unoccupied rock and debris by lichens and mosses to the ultimate condition in which vascular plants are mainly concerned. He remarks on the crowding

in a very narrow space at the edge of the glacier of different plants and plant societies. Compared with the Bernina, the flora of the Grimsel is poor in number of species, a fact due primarily to the uniform character of the mineral which forms the basis of the soil. The general features of the district and its vegetation are illustrated by nine very good photographic plates.

Dr. Mario Jäggli's study of the vegetation of the Maggia delta ("Il delta della Maggia e la sua vegetazione," Rascher, Zürich, fr. 7) on Lake Maggiore, between Locarno and Ascona, deals with a fluctuating low-lying area, just above water-level, or periodically or permanently submerged. The writer describes the general character of the delta and its recent transformations, as well as the climatic conditions in relation to the vegetation. He gives an account of the plant associations at the different levels and also a complete systematic list of the species and their distribution in the area. The work is illustrated by a coloured phyto-geographical map and a section in profile.

A widely differing area forms the subject of a communication by Rolf Nordhagen ("Vegetationsstudien auf der Insel Utsire im westlichen Norwegen"; Bergens Museums Aarbok, 1920–21, Hefte 1), who gives an account of the vegetation, with the constituent plant-associations and a list of the species, of a small isolated island, about 614 square kilometres in area, off the west coast of Norway. The flora of the island bears a strong resemblance to that of the Faroe Islands, though, unlike the Faroes, it has no high lands, the highest point being only 80 metres above sea-level. The value of the work is enhanced by a large number of photographically produced text-blocks.

University and Educational Intelligence.

CAMBRIDGE.—Mr. H. M. Fox, Gonville and Caius College, has been appointed demonstrator of comparative anatomy. The following members of the staff of the Solar Physics Observatory have been reappointed for five years: Messrs. C. T. R. Wilson, Sidney Sussex College, F. E. Baxandall, C. P. Butler, and W. Moss.

The Committee for Geodesy and Geodynamics reports that funds have now been secured for the erection of a small building for practical work near the Observatory. It is expected to be ready early in July. A grant of 200*l.* has been made by the Royal Society from the Caird Fund towards the purchase of pendulum apparatus for research purposes. A pair of transit instruments, an astronomical clock, and a twelve-inch theodolite have been presented to the School of Geodesy by the Surveyor General of the Trigonometrical Survey of India, with the approval of the Government of India; and other valuable loans and presents have been received.

Prof. Nils Bohr has been proposed as an honorary member of the Cambridge Philosophical Society on the occasion of his receiving an honorary degree from the University.

LONDON.—The following doctorates have been awarded:—*Ph.D. in Science*: Mr. L. G. F. Dolley (University College) for a thesis entitled "The Compressibilities of Binary Gas Mixtures"; and Vidya Sagar Puri (King's College) for a thesis entitled "Studies in Alternating Current Electrolysis."

The chairman (the Rt. Hon. the Viscount Chelmsford) and members of University College committee, the Provost and members of the academic staff, will hold a reception at the College on Saturday, July 7. The new anatomy building and the extensions of the physiology and engineering departments will be open to inspection.

MANCHESTER.—The award of the degree of D.Sc. has been recommended to Mr. J. C. Duff for a thesis on "Complex Metallic Ammines," and to Mr. W. F. Rawlinson for papers dealing with X-ray spectra and with the properties of supersonic waves in water.

Mr. W. H. Dearden has been elected Hadfield research scholar in metallography. This is the first award of the scholarship, which was instituted last year by Sir Robert Hadfield on the occasion of the inauguration of the Metallographic Institute at Stockholm. The scholarship is tenable at the Institute, and the scholar works under the direction of Prof. Benedicks. Mr. Dearden was a student of the Department of Metallurgy, 1919–22, and being head of his year in the Final Examination was awarded a graduate scholarship. During the past session he has carried out research on the causes of the failure of manganese bronze as a result of the attack of solders.

OXFORD.—The annual report of the Savilian professor of astronomy, Prof. H. H. Turner, was presented to Convocation on June 5. Reference is made in the report to the seismological work done at the observatory, especially on the determination of the depth at which earthquakes take place, and on the various periodicities which have been found in the recurrence of earthquakes, notably one of about four years which seems to be connected with a change in the earth's interior. In this department Prof. Turner has received much assistance from Mr. J. S. Hughes, of New College, whose services have been made possible by the financial help of Dr. J. E. Crombie, of Aberdeen. Voluntary work on the Vatican Zones of the Astrographic Catalogue has been given by Messrs. F. Sargent, A. Burnet, and C. Martin. Dr. Fotheringham has lectured on ancient chronology, and has published papers on the "Visibility of the lunar crescent" and on a correction of the secular acceleration of the moon's mean motion as determined from occultations and conjunctions in the Almagest. Mr. F. A. Bellamy has continued his general supervision of the observatory as first assistant, and has published a paper on faint stars with large proper motions on plates of the Oxford Astrographic Catalogue. Miss E. F. Bellamy has continued her revision of the Vatican Zones of the Catalogue.

At the ensuing Encænia it will be proposed to confer the degree of D.Sc. on Sir Ernest Rutherford and on Prof. Louis Lapicque, professor of physiology in the University of Paris.

THE University of Geneva has conferred the degree of doctor *honoris causa* on Prof. A. C. Seward, professor of botany in the University of Cambridge, and on Mr. Douglas W. Freshfield.

APPLICATIONS are invited by the Imperial College of Science and Technology for the Henry George Plimmer fellowship in pathology. Candidates must be qualified to undertake research in morbid anatomy, histological anatomy, chemical pathology, protozoology, bacteriology, and allied subjects in either zoology or medicine or botany. Further particulars can be obtained from the Rector of the College, South Kensington, S.W.7. The latest date for the receipt of applications is June 25.

THE Imperial Education Conference, which will open on June 25 at the Board of Education and

remain in session until July 6, is the second conference of its kind, the first having been held in 1911. The Chief of the Imperial General Staff convened an Imperial education conference in 1919, but this was limited to the discussion of problems which had presented themselves to the Imperial Education Committee, War Office, as a result of the experience gained in the working of the educational schemes within the British Army and the Forces of the Dominions. Most of the discussions at the coming conference will take place in private, but there will be public (evening) sessions on June 26, June 27, and July 3 devoted to infant education, the boy-scout and girl-guide movements, and "The Island and the Empire" (paper by Sir Charles Lucas) respectively. Educational films will be exhibited at the Central Hall, Westminster, on July 5, and an exhibition of the work of elementary schools and training colleges in England will be opened by the president of the Board of Education on June 25. No public official announcement has been made by the Board of the subjects to be dealt with in the course of the private discussions.

THE International Federation of University Women sends us a pamphlet (Occasional Paper, No. 2) containing, *inter alia*, an article by Prof. Kristine Bonnevie, of the University of Christiania, on the work of the League of Nations Committee on Intellectual Co-operation, of which she is a member. Prof. Bonnevie is of opinion that the most fruitful field for intellectual co-operation will be found in bibliography, and she notes that a special committee is investigating systems of cataloguing and other questions with the view of facilitating co-operation between libraries of different countries. Another special committee is studying exchanges of professors and students, equivalence of studies, degrees, and diplomas, and the establishment of international scholarship funds and international holiday courses. Information is also being collected about the condition of intellectual life and the conditions of life for intellectual workers (typically university professors and artists) in various countries. Particulars are given of the Federation's campaign for raising funds for the acquisition of Crosby Hall as part of an international university women's residential club-house.

THE April number of "The University Bulletin" issued by the Association of University Teachers contains some interesting statistics of salaries of teachers in the English provincial universities, 15 of the London colleges, the Welsh colleges, and 4 other university colleges. From these statistics the following mean salaries of full-time teachers have been calculated: of 478 professors, 933*l.*; 970 assistant professors, readers, and lecturers, 450*l.*; 548 assistant lecturers and demonstrators, 299*l.* Another table, designed to indicate the extent of the hardship suffered by university teachers who have spent some years in school teaching through those years not counting towards pension, brings out the fact that in 12 universities and university colleges 175 teachers have had 1446 years of school service, while in some as many as one-third of the teachers have taught in schools. Steps are being taken to cultivate relations with teachers in universities in the Dominions Overseas and in the United States. It is stated that university teachers' associations already exist for South Africa, Australia, Melbourne, Queensland, West Australia, and Tasmania, and that others are projected for Manitoba, Saskatchewan, Adelaide, Sydney, and Hong-Kong. The American Association, formed in 1915, embraces 180 institutions in the United States and Canada.

Societies and Academies.

LONDON.

Royal Society, June 7.—Sir Charles **Sherrington** and E. G. T. **Liddell**: Stimulus rhythm in reflex tetanic contraction.—K. N. **Moss**: Some effects of high air temperatures and muscular exertion upon colliers. The mean daily energy value of the food consumed by the colliers investigated was 4712 calories. Men working in hot mines consume more food, and a larger proportion of salted food, than men in cool mines; oxygen consumption per minute in various kinds of work at the face by an efficient collier varies from about 1300 c.c. to 2000 c.c. In persons not acclimatised to heat, the maximum amount of sweat lost per hour is about 1·4 lbs., whereas in a collier accustomed to work in a hot place the maximum loss was 5½ lbs. The sweat contains about 0·2 per cent. of chloride, and the loss of chloride during a shift is very considerable. A group of symptoms known to the men as miners' cramp, or stokers' cramp, is referred to water-poisoning brought about by the combination of great loss of chloride by sweating, excessive drinking of water, and temporary paralysis of renal excretion.—F. A. E. **Crew**: The significance of an anchondroplasia-like condition met with in cattle. Dexter cattle are remarkable for their bodily conformation. They produce four classes of calves in such proportions as to suggest that the Dexter itself is a di-hybrid in respect of its characters—coat colour and bodily conformation. A proportion of these calves are still-born and characteristically deformed, presenting certain constant features simulating closely those which constitute the condition of anchondroplasia in the human. The proportions in which these monstrous calves occur suggest that the "bull-dog" calf results from the action of complementary lethal factors which are amplifying factors producing an exaggerated form of the Dexter characterisation. The pituitary, thyroid, and adrenals are abnormal. The lethal factor in this case is probably such as affects the functioning of the pituitary. It may be possible to eradicate the "bull-dog" calf by breeding methods.

Physical Society, May 25.—Dr. Alexander Russell in the chair.—C. H. **Lees** and J. E. **Calthrop**: The effect of torsion on the thermal and electrical conductivities of metals. A method is described of measuring the effect of twisting on the thermal conductivity of a wire. In each of the steel, aluminium, copper, and lead wires tested the twist decreases the conductivity along the wire by a small amount which is approximately proportional to the square of the twist per unit length. The change of electrical conductivity is in general less than the change of thermal conductivity, but is also approximately proportional to the square of the twist per unit length. A. **Rosen**: The use of the Wien bridge for the measurement of the losses in dielectrics at high voltages, with special reference to electric cables. One difficulty in the application of large potential differences to a bridge is the effect on the arm which has to withstand the high voltage. In the arrangements due to Monasch and Schering, this arm is the known condenser; in the bridge used by the author the voltage is applied to the ratio coils. The errors introduced by earth impedance are eliminated by using the Wagner auxiliary bridge. Measurements can be made on cables, and the use of the double bridge in determining the "wire-to-wire" and "wire-to-sheath" losses in a multi-core cable is described. Corrections due to imperfections of the bridge arms and a simple quantitative theory of the double bridge

are given.—C. R. **Darling**: An experiment on the production of an intermittent pressure by boiling water. If a glass tube, open at both ends, and of about 5 mm. bore, be stood in a beaker of boiling water, steam bubbles form at the point of contact, causing the water to rise in the tube. The column of water sinks after a time, and then rises again, the rising and falling occurring at irregular intervals. If, however, the tube be narrowed to about 1 mm. near the top of the water, and widened out considerably just above the water surface, the action becomes regular. The water is apparently superheated at the points of contact of the tube and beaker, so that the steam produced can sustain a higher pressure of water. When the water reaches the widened part it is cooled and increases in density until the extra steam pressure at the bottom of the tube is overcome, when it discharges completely. The capillary bore slows down the rate of flow in both directions. A separating funnel with open tap and short stem is well suited to the experiment. The arrangement constitutes a simple heat engine, with source and sink, automatically passing through a regular cycle of operations.—N. W. **McLachlan**: A novel instrument for recording wireless signals. The device consists essentially of a drum of Swedish iron with an annular recess in which are situated coils of fine wire, the ends of the coils being connected to corresponding slip rings. The periphery of the drum is faced with cast-iron rings. A small steel shoe rides on the rings, and side play is prevented by a brass guide-piece with a projection which fits into the annular recess. At each end of the guide-piece a hook is formed, and one of the hooks is connected by a light rod to a duralumin lever pivoted to turn in a horizontal plane. A silver syphon passes through the lever and rests lightly on a moving paper tape. The drum is revolved by a small electric motor, and when a current flows in one of the coils the shoe is attracted to the drum and a large pull is required to prevent relative motion of the two. This pull actuates the syphon-lever mechanism, which can be used to show the dots and dashes of the Morse code. The instrument is extremely sensitive, and will work at a speed of 150 words a minute with a current of 25 micro-amperes.

EDINBURGH.

Royal Society of Edinburgh, May 21.—Prof. F. O. Bower, president, in the chair.—A. P. **Laurie**: An interesting property of the water molecule. On a modification of Langmuir's theory of chemical combination, namely, that the two nearest magnetons of two approaching atoms, forming the Langmuir pair, move outwards laterally in opposite directions, thus binding the two atoms together as one common molecule, a water molecule has four external magnetons, in addition to the four which are attaching the two hydrogen nuclei. This molecule can, therefore, form groups combining one with another to give hollow shells or rings which have the property, peculiar to water alone, of having no external magnetons. In the same way, the hydrates formed by combining water with a molecule or ion have no external magnetons, the result being the formation in solution of molecular groups, which may be regarded as chemically neutral to each other. They can account for the properties of water solutions of salts, resulting in their obeying the gas laws in dilute solutions, and also for the part played by water as the only possible medium for organic life.—H. Stanley **Allen**: A static model of the hydrogen molecule. A theory of the constitution of molecules is developed on the basis of the "quantum force" introduced by Langmuir with the view of securing a static model of the hydrogen atom. It is here assumed that the "quantum force," which, like the repulsive force employed by Sir J. J. Thomson in the same problem, varies inversely as the cube of the distance, is a repulsion or an attraction according to the sign of the electrical charges between which the force acts. On this assumption a hydrogen molecule is possible, having many of the properties of the molecule imagined by Bohr but with the electrons at rest relatively to the hydrogen nuclei. Various configurations of equilibrium are theoretically possible, but not all of these are stable. The calculated ionisation potentials are in moderately good agreement with the experimental results. Though the numerical values may need modification, it is now possible to postulate a hydrogen molecule in which the electrons are at rest instead of in orbital motion. The principles may be applied to more complex atomic and molecular systems.—Henry **Briggs** and John **Mallinson**: Further tests upon metal Dewar flasks intended to hold liquid air. The pressure in the vacuous envelope was obtained by direct measurement, and a series of results are given for British- and German-made flasks of different kinds. Radiation is by far the chief source of heat transfer in a flask holding liquid air, and further improvement is to be sought only by better attention to the polished surfaces. Losses by conduction down the neck and (unless the vacuum has much deteriorated) by conduction across the vacuous space are generally relatively small in amount. The charcoal used makes it unnecessary to evacuate by pumping to a pressure of less than 0·1 or 0·2 mm. of mercury.

SHEFFIELD.

Society of Glass Technology (at University College, London), May 16.—Prof. W. E. S. Turner, president, in the chair.—F. **Twyman** and F. **Simeon**: On the refractive index changes in optical glass occasioned by chilling and tempering. Chilling dense barium crown and borosilicate crown glasses may lower the refractive index by as much as 0·004 and 0·0013 respectively. This lowering of refractive index can be removed by heating to a temperature and for a length of time which have been ascertained in certain cases. A want of homogeneity can be produced by moulding, owing to surface chilling, which requires for its removal a longer maintenance at the high temperature than would suffice to remove elastic stress from a homogeneous sample.—V. **Stott**: Notes on burettes. Accurate readings can be obtained much more quickly by using a long emptying time and a short drainage than by using a short emptying time and a correspondingly longer drainage time. The errors occurring through using a burette calibrated for a certain delivery time, with a jet which gave a different delivery time are, in some cases, too large to be negligible.—A. **Ferguson**: A new method of glass-melting. The process consists of employing a cone or column of whirling gases at 1800° C., into the vortex of which batch ground to a 60-mesh standard is dribbled at the rate of two pounds per second; the carbon dioxide of the limespar and soda ash is first driven off in a preheater, so that the work of the furnace is only to raise the temperature from 850° C. to 1350° C. instead of from 20° C. All reactions necessary to form glass molecules take place in a gas at least two million times less viscous than tank metal.—S. **English**: Natural sillimanite as a glass refractory. This material possesses properties of considerable value to glass-makers. Test pieces were made up by mixing 100 parts of sieved sillimanite with 10 parts of finely ground ball clay; such a mixture

can be made into slabs and pressed into crucibles, if care is taken in working it.

DUBLIN.

Royal Irish Academy, May 28.—Prof. Sydney Young, president, in the chair.—J. J. **Drumm**: The constitution of catechin, Part I. Benzopyranol salts are prepared from catechin of a type closely allied to the anthocyanidins. Von Kostanecki's coumarane formula for catechin is no longer tenable; A. G. Perkin's chromane formula with slight modifications is again put forward.

Royal Dublin Society, May 29.—Prof. J. A. Scott in the chair.—Rev. H. C. **Browne**: A simple from of photographic depth chart. The chart consists of four concurrent lines, and may conveniently be drawn on squared paper. A straight edge laid anywhere across these lines intersects them in points which give respectively the stop diameter, the nearest distance in focus, the distance to be sharply focussed on, and the furthest distance in focus. The readings are all direct, reciprocals being avoided. Three sample charts were described, one suited for general work, a second especially adapted for the photography of small objects at short distances and on an enlarged scale up to 12 or more diameters, and a third intended for carrying in a photographic note-book, which, though only $3\frac{1}{2}$ in. $\times 2\frac{1}{2}$ in. in size, gives clear readings for distances up to 60 feet, and stop diameters up to 1·5 inches.—T. G. **Mason**: Ligneous zonation and die-back in the lime (*Citrus medica*, var. *acida*) in the West Indies. Tangential bands of parenchyma are distributed in the wood in both normal lime tree and in specimens affected with "die-back"; they originate during periods of relatively great aridity. The wood from trees affected with die-back exhibits considerable irregularity in the distribution of the parenchyma bands, and the sections suggest that the cambium had been exposed to sudden checks in its activity. Rapid and repeated desiccation of the meristems may be an important factor in causing die-back of the lime.—L. B. **Smyth**: On a problematic structure in the Oldhamia Rocks of Bray Head. These rocks consist of scattered tabular bodies 0·3 mm. in thickness, with rectilinear outlines and of variable size (average, 1-3 mm. diameter) and shape, lying on a bedding plane of chlorite-sericite shale. Their composition differs from that of the shale only by the greater proportion of chlorite. A considerable number of the bodies are lozenge-shaped. They may be crushed pseudomorphs of crystals.

PARIS.

Academy of Sciences, May 22.—M. Albin Haller in the chair. The president announced the death of M. de Freycinet, Free Academician.—A. **Vayssière**: The characters suitable for classifying the gasteropods of the family of the Cypræideæ. These have hitherto been mainly classified according to the character of the shell and this is shown to be insufficient.—M. **Pélissier**: An account of the formation of a new volcanic island south of Poulo-Cécir de Mer. Plans of the island and crater, together with a chart showing soundings round the new island are given.—Paul **Lévy**: A functional operation generalising the derivation of non-integral order.—P. **Zervos**: Some transformations of partial differential equations.—A. **Guillet**: The rapid and precise measurement of the frequency of rotation of the shaft of a motor by the stroboscopic method. A description of the construction and use of an improved form of stretched wire stroboscope.—M. **Dumanois**: The utilisation (in a motor) of a mixture of lamp oil and alcohol containing a high percentage of the latter. A mixture of alcohol (70 per cent.) and kerosene (30 per cent.) was successfully used to replace petrol in a motor car: the car was run on this mixture (after suitably modifying the carburettor) from Paris to Toulouse, 450 miles, without trouble.—Jean **Durand**: Contribution to the study of methods of testing foundry iron.—Albert **Bazin**: The hovering flight of birds: flights without motor in undulating winds.—M. **Auric**: Demonstration of Stefan's law.—A. **Leduc**: The loop of J. Thomson and the new equation of state of gases.—E. **Brylinski**: The propagation of maintained electromagnetic waves along an iron wire. Remarks on a recent communication of M. G. Laville on the same subject.—J. **Rossignol**: Researches on the cathode phosphorescence of the ruby. An examination of the influence of the velocity of the stimulating cathodic electrons on the law of decrease of phosphorescence of the ruby with time. Synthetic rubies were employed, with percentages of chromic oxide varying between 0·1 per cent. and 10 per cent. Curves for one ruby are given, showing the relation between the intensity of phosphoresence, voltage of the poles of the cathode tube, and fall of intensity with the time.—Mlle. Irène **Curie**: An arrangement for measuring strong ionisations due to the α-rays. The principle of the method consists in utilising for the ionisation current only a fraction of the α-rays. This portion is allowed to escape through sectors in a brass cover and the ratio of reduction, which can be varied, may be as high as $\frac{1}{1000}$.—M. **Volmar**: The action of light on the tartar emetics. Tartrates of the type $CO_2H \cdot CH(OH) \cdot CHO(RO) \cdot CO_2K$, in which R may be antimony, arsenic or bismuth, are decomposed by ultra violet light, gas being evolved (carbon dioxide, carbon monoxide and hydrogen and hydrocarbons in the case of antimony), and metal deposited. Double tartrates of copper and of iron are also changed by exposure to light of short wave length.—Albert **Noyes**, jun.: The photochemical decomposition of solid bodies.—A. **Bigot**: Kaolins, clays, etc. Colloidal plasticity. Experiments on baking clay briquettes prepared in different ways, compression of dry powder, compression of slightly moistened powder, reduction to plastic state with water. The colloids play an important part in the results of firing ceramic materials.—F. **Zambonini**: Thorium molybdate, $Th(Mo\ O_4)_2$. An account of the mode of preparation, crystal form and molecular volume of thorium molybdate.—Pierre **Jolibois** and Pierre **Lefebvre**: Baking of plaster of Paris and its preservation in moist air. Plaster of Paris which has been dehydrated at temperatures between 150° and 300° C. rapidly absorbs water vapour from saturated air: if the dehydration temperature has been above 400° C. the rate of absorption of water vapour is very slow.—F. **Diénert** and F. **Wandenbulcke**: The estimation of silica in water. The method suggested is based on the colour developed by the addition of ammonium molybdate and dilute sulphuric acid, utilising a standard solution of picric acid as a colour standard.—Max and Michel **Polonovski**: Etheserolene.—Ch. **Mauguin**: The arrangement of the atoms in crystals of cinnabar. The results of an X-ray study of cinnabar crystals.—Mlle. Gertrude **Weber**: The limit between the Danian and the Maestrichtian in the Crimea.—L. **Vegard**: The constitution of the upper layers of the atmosphere. In a previous communication on the spectrum of the aurora borealis it has been shown that nitrogen is the dominating element at the upper limit of the atmosphere. It is probable that the nitrogen is solidified in the form of small crystals, and that this nitrogen dust is charged electrically by the photoelectric effect of the solar radiation.—Henri **Coupin**: Remarks on

the locomotion of the Oscillatoria.—H. **Colin** and H. **Belval**: The supposed reserve dextrins of Monocotyledons. A revision of the work of Leclerc du Sablon (1898–1899). The bulb of *Hyacinthus orientalis* contains no dextrin: the reserve carbohydrates consist of starch and a soluble levulosan only.—R. de **Litardière**: Remarks on the fixation of Merkel's liquid and on certain so-called nuclear structures provoked by fixing reagents with osmic acid base. An adverse criticism of the results of Overton on the somatic kinesis in *Podophyllum peltatum*, with special reference to the action of various fixing fluids.—Raphael **Dubois**: The toxicity of copper with respect to moulds. Remarking on a recent communication by M. and Mme. Villedieu on the non-toxic action of copper on moulds, the author directs attention to the fact that he arrived at a similar conclusion in 1890. An explanation of the undoubted beneficial effects of copper suspensions in fighting mould in the vine and other plants has still to be found, and it is suggested that since it has been shown that salts of copper may act both as oxydase and peroxydase, this may be the cause of the observed beneficial action.—Jivoin **Georgévitch**: New researches on the Goloubatz fly. From the heads of this fly a poisonous substance can be extracted by either water, alcohol, chloroform, or ether, and injections of this material proved rapidly fatal to guinea-pigs, rabbits, and white mice. Losses of cattle through the ravages of this fly have been unusually heavy this year in Serbia, Roumania, and Bulgaria.—Alfred **Maubert**, Léon **Jaloustre**, and Pierre **Lemay**: The influence of thorium-X on the catalase of the liver. Thorium-X acts on catalase from the liver, stimulating in small doses and paralysing in large doses. The action is due to the α-radiation.—René **Jeannel**: The origin of the entomological fauna of the Carpathians and of the Bihor mountains.—Pierre **Lesne**: A new appearance of *Leucotermes lucifugus*. A Strelitzia in the hot-house of the Natural History Museum at Paris has been found to have been seriously attacked by this ant.—Alphonse **Labbè**: The genesis of the nemato cysts of the nudibranchs.

CALCUTTA.

Asiatic Society of Bengal, May 2.—B. **Prashad**: Observations on the luminosity of some animals in the Gangetic Delta. Notes on the various methods of the production of light by different animals are given.—N. **Annandale**: Plant and animal designs in the mural decorations of an Uriya village. The designs discussed are painted on the walls of houses on an island in the Chilka Lake. They are mostly of a very simple nature, consisting of outlines in white chalk on a red background. The plants or parts of plants most commonly represented are the maize, the cocoanut, the sola plant, and the kadumba flower; the animals—ducks, peacocks, and fish. The last are always represented in pairs, forming a well-known Indian symbol. Other symbols such as the footprints of Krishna are combined with the plant designs.—Johan van **Manen**: on the 44th verse of the Dhammapada. Comparison of the Pali, Prakrit, Chinese, and Tibetan versions, with conclusions concerning "metaphysical punning" as an essential element of some of the earliest Buddhist utterances, ascribed to the Buddha himself.

Official Publications Received.

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1923, June 2. Pp. 20. (Greenwich.)

Eleventh Report of the Microbiological Laboratory (Government Bureau of Microbiology) for the Year 1920. (Extract from the Report of the Director-General of Public Health, New South Wales, for the Year ended 31st December 1920, Section 4.) Pp. 131-195. (Sydney: J. A. Spence.)

Twelfth Report of the Microbiological Laboratory (Government Bureau of Microbiology) for the Year 1921. (Extract from the Report of the Director-General of Public Health, New South Wales, for the Year ended 31st December 1921, Section 4.) Pp. 81-94. (Sydney: J. A. Spence.)

Sudan Government: Wellcome Tropical Research Laboratories, Khartoum. Report of the Government Chemist for the Year 1922. Chemical Section—Publication No. 26. Pp. 30. (Khartoum.)

Department of the Interior: United States Geological Survey. Bulletin 686: Structure and Oil and Gas Resources of the Osage Reservation, Oklahoma. By David White and others. Pp. xvi+427+60 plates. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 480: Surface Water Supply of the United States, 1918. Part 10: The Great Basin. Pp. vi+271. 20 cents. Water-Supply Paper 483: Surface Water Supply of the United States, 1918. Part 12: North Pacific Drainage Basins. B: Snake River Basin. Pp. v+171. 15 cents. Water-Supply Paper 508: Surface Water Supply of the United States, 1919–1920. Part 8: Western Gulf of Mexico Basins. Pp. iv+136. 15 cents. (Washington: Government Printing Office.)

Annales de l'Observatoire Royal de Belgique. Troisième série, tome 1, fascicule 2. Pp. 269-415. (Bruxelles: M. Hayez.)

Diary of Societies.

SATURDAY, JUNE 16.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Projectiles and their Properties (VI.).

MONDAY, JUNE 18.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof. G. Dawes Hicks: The Nature of Images.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Capt C. J. Morris: The Gorge of the Arun.

TUESDAY, JUNE 19.

ROYAL SOCIETY OF MEDICINE (Special General Meeting), at 5.

ROYAL STATISTICAL SOCIETY, at 5.15.—Prof. A. L. Bowley: Death Rates, Density and Population.—Dr. J. C. Dunlop: Misstatement of Age in the Returns of the Census of Scotland.

MINERALOGICAL SOCIETY (at Geological Society), at 5.30.—Dr. L. J. Spencer, with chemical analyses by E. D. Mountain: New Lead-Copper Minerals from the Mendip Hills (Somerset).—Dr. W. F. P. McLintock: A Petalite-bearing Rock from Devonshire.—A. Brammall and H. F. Harwood: Dartmoor Granite; Monazite and other Accessory Minerals; Tourmalinisation.—S. Tsuboi: Optical Dispersion of Three Intermediate Plagioclases.—S. Tsuboi: A Method of determining Plagioclases in Fine Grains.—C. S. Garnett: The Toadstone Clays of Derbyshire.—Dr. G. T. Prior: The Meteoric Stone which fell at Ashdon, Essex, on March 9, 1923.—Dr. G. T. Prior: The Sinai Meteorite.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Prof. P. G. H. Boswell and J. Reid Moir: Flint Implements at Foxhall Road, Ipswich.

WEDNESDAY, JUNE 20.

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark and I. D. Margary: Report on the Phenological Observations in the British Isles from December 1921 to November 1922.—Dr. T. G. Longstaff: Meteorological Notes from the Mount Everest Expedition of 1922.—R. Arnison: Exhibit of a new form of Open-scale Barograph by Short and Mason, Ltd.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—K. S. Sandford: The River-Gravels of the Oxford District.—L. Dollo and P. Teilhard de Chardin: The Deposits of Paleocene Mammalia in Belgium.

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—J. Lort-Williams: Birth Control as it interests me. (Lecture.)

THURSDAY, JUNE 21.

ROYAL SOCIETY, at 4.30.—Dr. F. F. Blackman: Plant Respiration as a Catalytic Process (Croonian Lecture).

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.—Sir Archdall Reid: New Method of treating Skin Diseases.

LINNEAN SOCIETY OF LONDON, at 5.—E. Heron-Allen and A. Earland: The Foraminifera of Lord Howe Island.—T. A. Dymes: The Seeds of the Marsh Orchids.—Prof. A. Dendy and L. M. Frederick: A Collection of Sponges from the Abrolhos Islands.—Prof. M. Zalessky: Some New Species of Permian Osmundaceæ.—Dr. Ethel N. M. Thomas: Observations on the Seedling Anatomy of the Genus *Ricinus*.—Dr. C. H. O'Donoghue: Opisthobranchiata from the Abrolhos Islands.—C. N. Withycombe: The Function of the Bladders in *Utricularia vulgaris* L.

CHEMICAL SOCIETY, at 8.—O. R. Howell: The Constitution of the Higher Oxide of Nickel.—F. Allsop and J. Kenner: The Relationship of the Tautomeric Hydrogen Theory to the Theory of Induced Alternate Polarities.—S. Sugden: Electron Valency Theories and Stereochemistry.—Prof. W. A. Bone, D. M. Newitt, and D. T. A. Townend: The Relative Influences of Water Vapour and Hydrogen upon the Combustion of Carbon Monoxide-Air Mixtures at High Temperatures.—I. W. Wark: Metallic Hydroxy-Acid Complexes. Part I. Cuprilactates.—I. W. Wark: Metallic Hydroxy-Acid Complexes. Part II. Cuprimalates, their Formation, Properties, and Composition.—S. Minovici: Cholesterol and its Rôle in the Organism.

FRIDAY, JUNE 22.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Prof. F. Horton: The Excitation and Ionisation Potentials of Gases and Vapours. (Lecture.)