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Science and Society.

AMONG the subjects discussed at the recent meeting of the British Association, few have attracted so much interest or comment as the relation of science to unemployment and to labour. The question was fairly raised in Prof. T. E. Gregory's presidential address on "Rationalisation and Technological Unemployment", and his assertion that rationalisation, one of the most popular remedies for unemployment, may in itself be one of the causes producing the evil, was not seriously challenged in the discussion which followed. If, therefore, we have to admit that the elaboration of scientific methods of production and management is increasing, even if temporarily, the volume of unemployment, it is at least intelligible that labour should be dubious about acknowledging or accepting that leadership of science which we have frequently discussed in these columns.

There is, indeed, in the present situation much to excuse a passing reflection that perhaps, after all, the people of Erewhon were wiser than ourselves in destroying their machines, lest, as Marx predicted, the machines reversed the original relation and the workmen became the tool and appendage of a lifeless mechanism.

There is a popular fallacy, to which Sir Richard Gregory alluded in his recent address to the Bristol branch of the Independent Labour Party, which regards science as synonymous with mechanical invention, and therefore as largely responsible for the mechanisation of the age and its attendant evils. From this point of view the undoubted increase in the volume of unemployment which has accompanied the improvement of the means of production may well be regarded as a high price to pay even for the elimination of some of the grosser forms of labour to which in the past men were compelled to submit. To-day in the Ruhr ninety per cent, and in Belgium eighty per cent, of the coal produced is mined with pneumatic picks, and the mine of the future will probably be a brilliantly illuminated underground workshop, operated by electricity, the miner a skilled mechanic. The magnetic crane enables a workman to operate from a control-house at one time tons of pig-iron which formerly men handled in discomfort, pig by pig. The comfort and the welfare of the few, on this view, may, however, be too dearly purchased when we consider the lot of the displaced workers, and perhaps still more the repression of individuality and the retarded development which, as Marx predicted, have often accompanied mass production. Moreover,

although, contrary to prediction, the hours of labour have been shortened and not lengthened, and the standard of living has been raised considerably, in the modern Press, and in certain phases of broadcasting and the cinematograph, mechanical science has tended to project its mechanising influence into hours of leisure and intensify that mechanisation of the mind which is one of the symptoms and evils of our age.

If science, therefore, were nothing but mechanical invention, it would not be easy to plead that civilisation requires not less but more science in the control of affairs. The truth is that inventive ingenuity has often little in common with science, and even in the case of mechanical science, which is only one branch of science, unsatisfactory social conditions are a consequence not of scientific discoveries and advances, but of incapacity to use them aright. On the other hand, the discoveries with which in every branch of science scientific workers are most closely associated are creative discoveries, and these are responsible not for displacing labour, but for creating new demands and new industries in which labour is absorbed. Nearly a hundred years ago the discoveries of Faraday in the laboratory of the Royal Institution provided the fructifying idea which soon bore fruit as the dynamo. From these purely scientific discoveries has developed the vast electrical engineering industry, which in its light, power, and traction companies, electrochemical plant, and the companies manufacturing electrical equipment and apparatus, provides employment for millions of workers.

The radio industry is similarly the outcome of the scientific researches of Maxwell and of Hertz on the properties of electromagnetic waves, and the film industry, the automobile industry, the rayon, the aircraft, and the synthetic ammonia industries are all the result of fundamental scientific investigations, the practical importance of which was undreamt of at the time. Yet to-day, as Dr. Little pointed out in his presidential address to the Society of Chemical Industry at Manchester last year, each of these industries employs thousands of workers, reaching more than four million in the case of the automobile industry.

It is to creative science that society must look for the best hope of an ultimate solution of the unemployment problem. Indirectly, therefore, the problem of unemployment is linked with the problem of fostering the most vigorous intellectual activity among scientific workers and attracting into the service of science the most able minds the present generation can provide. Conditions which tend to lower the standard of recruitment for the various branches of the profession of science may react dangerously upon the welfare of the community. If full contact is secured between the finest type of such scientific work and industry, a fertilisation of industrial research will result from which all branches of the community must and will benefit.

So competent an observer as Prof. Henry Clay remarks in this connexion that industrial expansion takes place less as the result of the establishment of entirely new firms to exploit new processes and new demands than as a result of existing firms, which are making profits by the efficiency of their management, applying these profits to finance expansion in new directions. It would seem that only through the rationalisation of industry can creative science exert its full influence in expanding employment.

It is significant that the recent Trades Union Congress has shown some appreciation of this fact, and in his presidential address Mr. John Beard pointed out that the unemployment situation must be judged in relation to the last quarter of a century's concentration upon invention and scientific discovery. Mr. Beard went on to urge the need of a bolder, more *scientific*, and more energetic attack on the problem of unemployment than had been thought of so far. The emphasis placed upon industry rather than upon politics by this Congress encourages the hope that labour will tend more to assist in the process of industrial growth and not limit its discussions to the distribution of profits.

The more carefully the problem is considered, the clearer it becomes that defective leadership is largely responsible. Over-production is not so much a necessary consequence of the more rapid and abundant production of goods made possible by scientific invention as of the errors in judgment on the part of those who assumed the risks and direction of industry. Prof. Henry Clay, in the discourse before the Royal Institution to which we have already referred, described over-production as the production of more than can be sold at the price anticipated when production was undertaken, and points out the effect of such failure in checking further production.

Such failures in judgment must not, however, necessarily be interpreted as involving culpable negligence on the part of those responsible. They are merely an example of the far-reaching effect of human mistakes in industry and in politics to-day. Society probably still suffers less from the evil

wrought by heartlessness than from the inability of the individual human factors to comprehend the complexities of the situations and their reactions in a world which science in one sense has bound so closely together. Modern technical achievement and scientific thought foreshadow a new economic structure for society, and the greatest danger to civilisation to-day is the divorce between science and politics. There is little hope for society unless its political institutions are sufficiently elastic to allow scientific and technical knowledge to exercise decisive influence upon the major policies of the State.

Modern society suffers from two evils, of which the unemployment problem is only one symptom. The first is its inability to control the results of its own thinking, as exemplified in the achievements of modern science, pure and applied. A main task of our epoch is the reconciliation of industrial and political practice with progressive scientific thought. Neither the disarmament problem nor the unemployment problem, for example, would present the same problem in the world to-day if the scientific thought, the application of which has revolutionised the conditions of warfare and of industry, exercised its proper and rational influence in political and diplomatic quarters. Fulfilment of such tasks involves wise direction of mechanisation, and this is the fundamental case for scientific management. The freer the play of creative scientific thought, the easier industry in particular and society in general will find the transition or adjustment to reasonable social conditions under the impact of the new economic forces.

Perhaps still more important is the contribution of creative science to the amelioration of that other evil of society, the mechanisation of mind, which, originating under the conditions of mass production, is often perpetuated into the hours of recreation by such agencies as the Press, the cinema, and even broadcasting. The loss of the power of self-amusement, the absence of the knowledge of the right use of its increased leisure, are characteristic of the age, and there is no more urgent duty than the encouragement of individualism. The fountain-heads of human progress, from Plato onwards, have been the fundamental thinkers, and the problem is not only to bring thought of this quality into closer touch with public affairs, but also to enable the common man to appreciate more vitally the quality of such thinking. The more standardised the conditions of labour become for the mass of mankind, the less the demand for handicraft and the creative spirit during the hours of employment, the more important it is for society that the common man should be stimulated to self-expression in his hours of leisure.

The application of that stimulus may not be left to art alone. Science must bring to sociology that spirit of adventure and experiment which have ever led to those great creative discoveries from which mankind has reaped the greatest benefit, whether of thought or of action. The most startling and successful pieces of reconstruction in the post-War world have resulted from the handling of complicated economic, social, and international problems along new rational and scientific lines. Efficient organisation is an indispensable factor in human progress to-day, but originality of thought and character are still its mainsprings. Such thought and such character can bring into the rationalisation movement to which industry is bound that humanising influence and elasticity which can make it the liberator and benefactor of industry and not its tyrant.

If there is a sense in which science, through the uncontrolled development of its mechanical applications, has seriously threatened the physical and mental development of man, it is still to the free play of creative scientific thought in industry, in politics, in society, that we must look for the liberation of man from mechanisation and for the control of the material and economic forces in his environment which at times assume such threatening proportions. In truth, science, after liberating the world from the thraldom of baser superstition and the irrational fear of natural phenomena, has made the continued expression of certain of man's acquisitive and combative instincts in industrial and international rivalry inconsistent with the safety of civilisation. It has now the task of revealing to man the channels in which his instincts and individuality can find a safer and a finer expression in co-operation in the exploration of yet unravelled secrets of Nature, the conquest of disease, and of those other factors in his environment which still take their toll of human life and happiness.

It is creative science which must lead society in that search of truth for the control of Nature and transformation of matter for the service of mankind, the liberation of the human spirit from ignorance, superstition, and slavery to the forces of Nature, and the reformation of social and political institutions for the benefit of the greatest number, which Hu Shih declared to be the characteristic of an ideal and spiritual civilisation.

Letters to the Editor.

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A New Phenomenon in the Change of Resistance in a Magnetic Field of Single Crystals of Bismuth.

FROM many investigations it is well known that bismuth shows very variable behaviour. We have investigated a very pure specimen ; Hilger's bismuth was purified still further. The crystals made from this material proved to be excellent. With X-rays they show very sharp interference spots or lines, and when compressed nothing could be observed of the phenomenon of 'cracks' as described by Borelius, Lindh, and Kapitza (*Proc. Roy. Soc.*, A, vol. 119, p. 366 ; 1928). From these crystals we measured the change of resistance in the magnetic field at different temperatures.

First we determined the change in resistance of several crystals having the principal axis parallel to their length. The current flows in the length direction of the crystal. The rod is put in the magnetic field with its length (that is, principal axis) at right angles to the lines of force of the field, and it is possible to turn it round an axis coinciding with the principal axis.

We determined the curves giving the change of resistance as a function of the intensity of the magnetic field, when one of the binary axes was either parallel to or at right angles with the field. These curves show a very complicated form, extremely so if the binary axis is at right angles with the field.

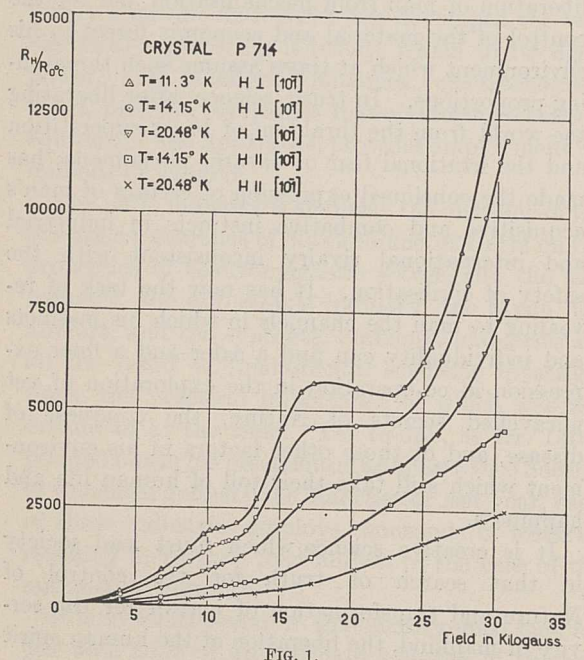

FIG. 1.

In Fig. 1 these curves are given for the temperatures 20·48° K., 14·15° K. and 11·3° K. The abscissæ are the intensities of the magnetic field ; the ordinates are the values of $R_H/R_{0°\,C.}$ R_H is the resistance in the magnetic field at low temperatures ; $R_{0°\,C.}$ the resistance without a field at 0° C. It will be seen that the curves do not show a parabolic part in the beginning which gradually changes into a linear part at higher field strengths. It has been found that the whole phenomenon strongly depends on temperature : at higher temperatures the curves become more and more simple. This can already be seen at 20·48° K. Here the first flat part found at about 9·5 kilogauss, and prominent at 11·3° K., has nearly disappeared. Measurements at higher temperatures, for example, 64·25° K. and 77·40° K., show a very simple curve, just as has been found hitherto at all temperatures.

In order to investigate the phenomenon more thoroughly we measured the change of the resistance, keeping the field constant, but changing gradually the angle between a binary axis and the lines of force, and

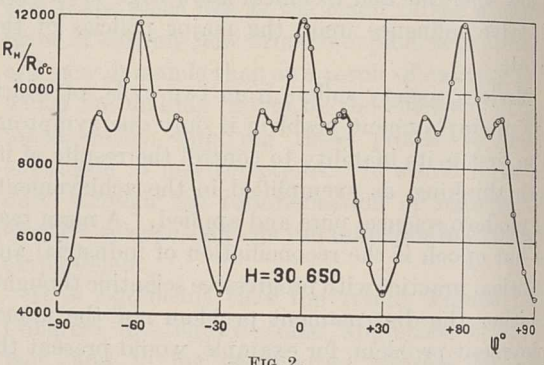

FIG. 2.

reading the resistance and the angle after each displacement. In Fig. 2 the abscissæ are the angle ϕ, between the crystallographic direction [11$\bar{2}$] in the crystal and the lines of force, ordinates are the values of $R_H/R_{0°\,C.}$ at those different angles, in a field of 30·650 gauss at a temperature of 14·15° K. This curve does not show cosine form, but gives a much more complicated relation of the resistance to small changes of the angle. Simple cosine curves have been found only at very low field strengths. At higher temperatures we do not find the complicated form.

We are now investigating some crystals having two different orientations. Both these orientations have the principal axes at right angles with the length of the crystal. For the first orientation, the length coincides with the direction of a binary axis (and with the axis round which the crystal can be turned, it being also at right angles with the lines of forces and coinciding with the direction of the current). For the second one all this is the same, but the length coincides now with the direction of a bisectrix of two binary axes. Here, too, we investigated the change of resistance with temperature, field strength, and angle of the principal axis with the field. The most important result of these investigations is that the curves have much in common with those given above for the other orientation (Figs. 1 and 2).

Here, too, we find at low temperatures that the resistance in the field changes rapidly with small changes of ϕ. This phenomenon disappears only when we pass to high temperatures and to weak magnetic fields. Of course the form of the curve giving $R_H/R_{0°\,C.}$ as a function of ϕ is in this case quite different from the one given in Fig. 2.

The results are very much influenced by the purity of the material used for the crystals. As an indication of this purity, it may be stated that our crystals show at 1·3° K. a resistance having a value of some thousandths of that at 0° C. At 11·3° K. the resistance in a magnetic field of 31 kilogauss is 922·000 times higher than that without the field.

L. SCHUBNIKOW.
W. J. DE HAAS.

University of Leyden.

Intensity of Total Scattering of X-Rays by Monatomic Gases.

RAMAN (*Indian J. of Phys.*, **3**, 357; 1928) and A. H. Compton (*Phys. Rev.*, **35**, 925; 1930) have calculated according to classical electrodynamics the scattering of X-rays by an atom in which the electrons are arranged with random orientation and with arbitrary radial distribution. The intensity of the X-ray scattered at an angle θ to a distance R is given by

$$I_\theta = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2c^4}\left\{Z+(Z^2-Z)\left[\int_0^a 4\pi r^2 p(r)\frac{\sin kr}{kr}dr\right]^2\right\} \quad (1)$$

where I is the intensity of the primary beam, $k=(2\pi/\lambda)\sin\frac{\theta}{2}$, $4\pi r^2p(r)$ is the probability that any electron shall lie between r and $r+dr$ from the nucleus, a is the maximum radius of the atom, and Z, e, m, and c have their usual significance. In comparison with Wentzel's theory of X-ray scattering, Compton has separated I_θ into two parts, namely, I_1 representing the intensity of coherent scattering and I_2 the intensity of incoherent scattering, where

$$I_1 = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2c^4}Z^2F^2, \qquad I_2 = \frac{Ie^4(1+\cos^2\theta)}{2m^2R^2c^4}Z(1-F^2),$$

and

$$F=\int_0^a 4\pi r^2 p(r)\frac{\sin kr}{kr}dr.$$

Raman (loc. cit.) has come to the same conclusion from simple classical considerations. When corrected for the change of wave-length, equation (1) becomes (cf. Compton, loc. cit.)

$$I_\theta = \frac{I_2}{[1+\gamma(1-\cos\theta)]^3}+I_1 \quad . \quad . \quad (2)$$

where $\gamma=h/mc\lambda$. We expect this formula to give a closer approximation to the intensity of the total scattering.

If instead of the probable position of a single electron, we regard $4\pi r^2Zp(r)dr$ as the probable number of electrons between r and $r+dr$, we see therefore that the calculation of the intensity of the total scattering depends entirely on the evaluation of the radial charge distribution of the electrons in the atom. It is well known that Thomas (*Proc. Camb. Phil. Soc.*, **23**, 542; 1927) and Fermi (*Zeit. f. Phys.*, **48**, 73; 1928) have independently derived an approximate expression for the charge distribution of the electrons in the atom by considering the electrons as a degenerate gas surrounding the nucleus, an idea which seems to be in accordance with the atomic model postulated by Raman and Compton in deducing equation (1). If the charge density of the electrons in the atom evaluated by the Thomas-Fermi method is substituted in place of $Zp(r)$ in equation (2), the intensity of the total scattering for any scattering angle can be numerically calculated. Owing to the interference effect due to neighbouring atoms in diatomic molecules, we expect equation (2) to be directly applicable only to the scattering of X-rays by monatomic gases and vapours. A calculation has been made of the intensity of the scattering of X-rays by helium and argon, and the results are compared with the experimental data recently obtained by Barrett (*Phys. Rev.*, **32**, 22; 1928) in Fig. 1, where the scattering per electron is plotted against the scattering angle θ.

While the curve I represents the scattering from helium for a wave-length equal to 0·49 A., the curves II and III represent the scattering from argon for wave-lengths equal to 0·40 A. and 0·48 A. respectively. The classical theory of J. J. Thomson for the scattering from a single electron is plotted as the broken curve marked *C*. Since Barrett's measurements give relative values of scattering per electron for different angles and for different gases, but not absolute values, so in each case the experimental data have been multiplied by an arbitrary factor throughout. It is seen that the agreement between theory and experiment seems to be satisfactory.

Recently Waller and Hartree (*Proc. Roy. Soc.*, A, **124**, 119; 1929) investigated theoretically the intensity of total scattering of X-rays by atoms of a monatomic gas on the basis of quantum mechanics. For the case of argon a strict comparison of their

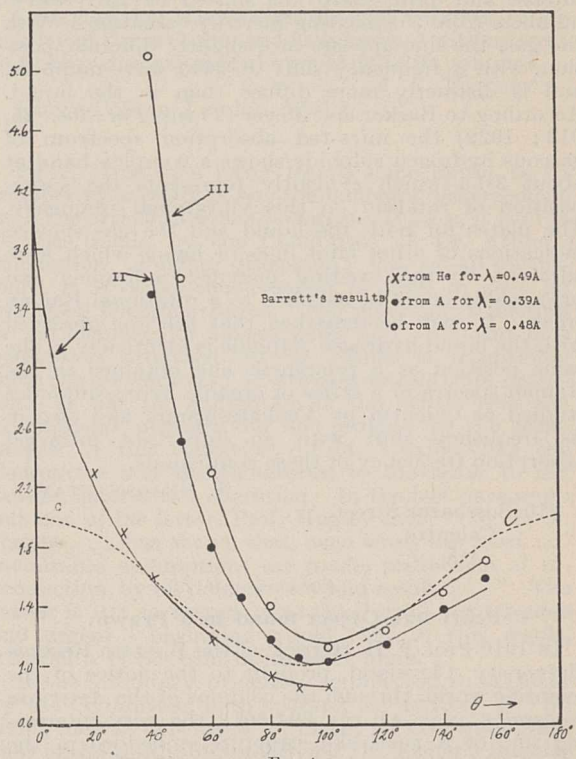

FIG. 1.

calculation with Barrett's results seems not to be possible. This is ascribed by these authors to the fact that the wave-lengths used by Barrett are rather short, so that for the experimental results 'relativity effects' are appreciable, whereas in their derivation of the theoretical formula these effects are completely neglected. A comparison of Waller and Hartree's results for argon with those of the present calculation indicates that the absolute value of the intensity of scattering per electron for the large angle of scattering given by Waller and Hartree is much higher than that calculated according to equation (2). Unfortunately, no experimental data are available to decide this point. Moreover, owing to the factor introduced to correct for the change of wave-length, equation (2) shows that the quantity R defined by Waller and Hartree is not a function of $\sin\frac{\theta}{2}/\lambda$ only, a result not in agreement with the conclusion drawn by these authors.

Finally, it may be remarked that by the method outlined above the scattering by all monatomic gases and vapours can be approximately estimated. I have evaluated numerically the scattering from helium,

argon, neon, krypton, sodium, potassium, and mercury for molybdenum $K\alpha$ and copper $K\alpha$ radiation and experiments are in progress to test these results.

A detailed account of this work will be published elsewhere.

Y. H. Woo.

Department of Physics,
National Tsing Hua University,
Peiping, China, July 28.

Raman Effect in Hydrogen Sulphide.

THE Raman spectrum of hydrogen sulphide, both in the gaseous and liquid states, has been successfully photographed by me. The liquid exhibits a single intense and quite sharp line shifted by 2578 wave-numbers from the exciting mercury radiation. With the gas, the line appears in a slightly different position, with a frequency shift of 2615 wave-numbers, and is distinctly more diffuse than in the liquid. According to Barker and Meyer (*Trans. Far. Soc.*, **25**, 912; 1929) the infra-red absorption spectrum of gaseous hydrogen sulphide shows a complex band at about $3{\cdot}7\,\mu$ which evidently represents the superposition of rotation on this vibrational frequency. The plates for both the liquid and the gas showed indications of other faint lines or bands which were adjacent to the exciting mercury radiations and presumably could be ascribed to a rotational Raman effect. It may be remarked that the line observed with the liquid hydrogen sulphide is identically in the same position as a prominent line obtained in the Raman spectra of a series of organic hydro-sulphides studied at Calcutta by Venkateswaran, and also in its frequency shift with an important infra-red absorption frequency of these compounds.

S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta,
Aug. 9.

Pearl-like Object found in a Prawn.

IN 1910 Prof. F. H. Herrick, of the Western Reserve University, Cleveland, brought to the notice of the scientific world, through the columns of the *American Naturalist* (vol. 44, pp. 294-301), the very interesting find of a pearl-like structure embedded in the muscles inside the claw of a lobster. The object, which was believed to be unique, was first examined by some pearl dealers, and declared to be a true 'lobster pearl'. It was more or less spherical, with one flat side, and was 11 mm. in diameter. Its specific gravity was 1·45 and hardness 'about 3'. After a careful examination of the object, Prof. Herrick came to the conclusion that the 'pearl' was only an ingrowth of chitin due to some "vagary of the process of regeneration".

Recently a similar 'pearl' has been brought to me by Mr. D. D. Mukerji, of the Zoological Survey of India. It was really discovered by his sister, Miss Jutheca Mukerji, who, while eating a prawn (a small Peneid), felt something hard between her teeth. As only the abdominal region of the prawn is eaten, it seems evident that the 'pearl' must have been embedded in the thick abdominal muscles.

The 'pearl' is spherical in shape, with slight protuberances and hollows. There are two or three fairly large irregular depressions on the surface, but these are probably due to some mechanical cause, perhaps to the action of the teeth while the prawn was being eaten. The 'pearl' is more or less uniformly round, without any flat pole. It is slightly less than 3 mm. in diameter and its absolute weight is 0·0174 gm. Its specific gravity is about 1·32 and the refractive index 1·558. It is practically colourless and has a somewhat pearly lustre. It is transparent and has no nucleus. Its hardness is about 2·5. Dr. J. A. Dunn, Curator, Geological Survey of India, who has kindly measured the specific gravity, refractive index, etc., for me, is of the opinion that it is made of material which "grew radially from the centre, the crystalline direction radiating outwards from the centre, so that the sphere shows a dark cross between crossed nicols, which rotates with the nicols, analogous to a radiating fibrous mineral". On a careful examination the 'pearl' appears to be formed of close concentric layers. The outer surface is covered throughout by extremely fine meridional striations, and in places, when the outer layer is broken, the striations can be seen on the inner strata also. Another remarkable feature of the 'pearl' is that it is apparently somewhat porous. In the course of the specific gravity tests, spread over two or three days, it absorbed 0·0004 gm. of water, the weight returning to normal (0·0174) on its being allowed to dry.

FIG. 1.—Pearl-like object (enlarged) from a prawn.

There seems to be scarcely any doubt that the 'pearl' is made of chitin, similar to the hard shell of the prawn. Sollas has shown (*Proc. Roy. Soc. London* (B), 79, pp. 474-481; 1907) that the specific gravity of chitin precipitated from its solution in strong acids approximates to the value of 1·398, and that its refractive index lies between 1·550 and 1·557. In the present case the refractive index agrees with the figure given by Sollas, but the specific gravity is somewhat lower, which may perhaps be due to the concentric formation of the object and its apparent porosity to air and water.

Apart from its lower specific gravity, the present 'pearl' differs from that examined by Herrick in one or two very important respects. The previous specimen had a flat end, which, according to Herrick, represented its place of attachment with the outer shell; the present 'pearl' does not show any signs of ever having been attached. The latter is also formed of close concentric layers, while Herrick's specimen was apparently one homogeneous mass. Further, the surface of the 'pearl' examined by Herrick was punctate, the punctations, according to Herrick, representing the 'hair-pores' of the crustacean shell; in my specimen there are only very fine close striations on the surface.

It is very difficult to express any definite opinion about the origin of this curious object. Herrick was of the opinion that it must have been formed by an ingrowth or pocketing of the outer shell due to some mechanical injury, probably soon after a moult. As

a connexion would be retained with the outer shell, this would involve the shedding of the 'pearl' at the next moult, and unless the irregularity of growth is obliterated, similar structures would be formed and shed at subsequent moults. The present specimen, however, does not show any point where it could have been attached to the shell. Further, the apparently concentric nature of its formation suggests that layer after layer of chitin has been added at each moult. It seems possible, therefore, that some cells of chitin-producing epithelium may have got pushed into the mesoderm, probably due to some injury when the skin was soft; and the connexion with the outer shell being cut off, the cells went on producing chitin, and, according to their function in normal conditions, went on adding layers at subsequent moults. There is still another, though remote, possibility. It is conceivable that some of the mesodermal cells themselves, as a result of some peculiar, unknown stimulus, have taken on the function of the chitinogenous epithelial cells. Differentiation and dedifferentiation of tissues is known to occur at the time of regeneration, metamorphosis, and similar phenomena. Perhaps something similar has happened in this case also.

My best thanks are due to Dr. J. A. Dunn for all the help he has so kindly given me.

B. N. CHOPRA.

Zoological Survey of India,
Calcutta.

Eugenic Sterilisation.

As a member of the Committee of the Eugenics Society for Legalising Eugenic Sterilisation, I should like to be allowed to say a few words concerning the leading article in NATURE of Aug. 30 on our proposals. It is stated there: "Is there not a real danger that the advocates of such legislation as here may mistake the assent of the political machine for victory? If assent were gained, would it not be much more accurately determined as the hall-mark of failure? It is not the assent of the State, but the initiative and creative power of the State, that is needed to secure essential progress. . . ."

With the last sentence I entirely agree; but I fail to perceive how a step in the right direction can be regarded as the hall-mark of failure—unless, indeed, the Committee should be so stupid as to believe that the taking of this one step had brought us to our final goal, which is certainly not the case. The article opens with references to the difficulties in the way of progress which are created by timid and ignorant public opinion, and continues, "if, as Sir Walter Fletcher has lately pointed out, a mere ailment, like cancer, has only been made accessible to scientific study through the lifting of foolish and superstitious taboos, how can we expect the direr social maladies to be approached courageously?" I think I can speak for the Committee in saying that we realise to the full the extent of these intangible difficulties, and that it is precisely for that reason that we have concentrated on a small but tangible and urgent beginning. Somehow or other the public has to be made race-conscious, has to be imbued with the eugenic idea as a basic political and ethical ideal. We believe that a campaign of the kind we have launched, directing attention to a gross racial defect, will be the best possible way of turning their thoughts in the desired direction.

Comment is also made on the fact that the prevention of reproduction by all defectives would only lower the incidence of mental defect by about 17 per cent in one generation. The article fails to remind readers that the process is cumulative, and also does not point to any other way in which it could be reduced more rapidly. Finally, the most relevant fact of all is omitted, namely, that one of the greatest obstacles to securing assent to the sterilisation of defectives has been and is the widespread belief that, since two normal persons may have a defective child, therefore preventing defectives from reproducing will have no effect on the proportion of defectives in later generations. Dr. R. A. Fisher has gone carefully into the matter, and has shown that, even when the most unfavourable assumptions are made, prevention of reproduction by all defectives would result in a reduction of some 17 per cent—which to me at least seems considerable, as it would mean that there would be above 50,000 less defectives in Great Britain after the lapse of the, biologically speaking, trivial span of one generation.

I am glad that NATURE has directed attention to the gravity of the problem, and look forward with interest to further discussion of the problem in its columns.

J. S. HUXLEY.

King's College, London, W.C.2.

PROF. HUXLEY'S letter leaves some doubt as to whether he is really in any fundamental disagreement with the article to which he refers. If he is, it is over the use made by the Committee of Dr. Fisher's calculation. Further discussion: yes, by all means. Only, it is rather inconvenient to have to keep an eye upon changing terms. The minimum reduction of the incidence of defectiveness of 17 per cent in a generation promised by Dr. Fisher is conditional upon the prevention of *all primary aments* from breeding. It was the contention of the article that the Committee's measure did not provide for the satisfaction of this condition. Prof. Huxley, like the Committee and the signatories to the letter to the *Lancet*, ignores this condition. In the last paragraph but one of his letter, Prof. Huxley says: "Dr. R. A. Fisher . . . has shown that, even when the most unfavourable assumptions are made, prevention of reproduction by all defectives would result . . ." The reader is left to assume that the "small but tangible and urgent" beginning would lead to this result, whether a 17 per cent decrease or more.

If the voluntary principle, emphasised so strongly by the Committee, is to operate, the fertility of "all living mental defectives" will not be prevented, and that is the condition underlying Dr. Fisher's calculation. Experience of the ways of the relatives of defectives and the insane would lead most people to the conviction that they are far from tractable. Ascertainment, again, the basis of the English figures, shows an amplitude of variation that suggests very serious differences in the efficiency of investigators or in the sense of responsibility of elected persons. In such matters the Committee aims at improvement.

It was certainly not intended to suggest that the Committee is stupid. The criticism is directed towards the machine it is trying to use. While the political wedge is often held to possess the same properties as its mechanical prototype, its thin edge seems at times to acquire graft-like properties which inhibit rather than facilitate further progress.

If the eugenic problem were only a biological problem, a generation would be, of course, a trivial span. It is often held to be a social problem as well, a problem created by man in the very short time that he has been occupied in making it possible for several men to live where one lived before. If that is true, should correctives be allowed to lag?

The present state of the law is so absurd that one would think the self-respect of legislators would secure its alteration.

THE WRITER OF THE ARTICLE.

Microphotometric Analysis of Movietone Sound Records.

IN a letter published in a recent number of NATURE (July 19, p. 93), Dr. Louis V. King announced a method of microphotometric analysis of movietone sound records. Evidently Dr. King has overlooked that this method was described by me seven years ago in a paper, "Photographic Recording and Photoelectric Reproduction of Sound", published in the *Transactions of the Society of Motion Picture Engineers*, No. 16, 1923. On page 113 of the paper, Fig. 24 serves to illustrate this method of sound analysis. A comparative study of analysis of sound records by means of Moll's thermoelectric microphotometer and Koch's photoelectric microphotometer was made in 1927. A brief report thereof was published in the *Bulletin of the American Physical Society*, vol. 4, p. 2, April 1929, and also in the *Physical Review*, vol. 33, p. 1094, 1929, under the title "Application of Microphotometers for the Analysis of Photographic Sound Records".

J. T. TYKOCINER.

Electrical Engineering Laboratory,
University of Illinois,
Urbana, Illinois, U.S.A., Aug. 16.

I AM greatly interested in Prof. J. T. Tykociner's comment on my short letter to NATURE on the microphotometric analysis of movietone sound records. Had I known of his work on the subject, I should certainly have referred to it. In view of some fog-alarm tests I was planning at the time, the purpose of the letter was to bring out any work which might have been done along these lines, as well as to direct the attention of lighthouse engineers to the extremely convenient method of recording the performances of fog-alarm installations afforded by the use of the movietone camera. I do not believe, however, that the records would have their full value without the use of a standard of sound of some kind, and I directed attention to this in view of the possibility of having some firm of instrument makers take up the design I had in mind, should there be a sufficient demand for this method of sound measurement. It should be possible, on the basis of Prof. Tykociner's researches, to have available for general use portable and easily operated instruments for recording and measuring sound.

LOUIS V. KING.

Metis Beach, Que., Sept. 14.

A Galvanometric Method of Measuring Electrolytic Resistance.

THE ordinary laboratory bridge method of measuring electrolytic resistance employing a telephone is somewhat unsatisfactory, owing to the difficulty of accurately judging the position for minimum sound in the telephones. Experiments made by different observers are, for this reason, often liable to give results which vary considerably. A method in which the telephone is replaced by a galvanometer possesses, therefore, a decided advantage, and the following simple device, which I have not seen described elsewhere, has been found quite satisfactory for ordinary purposes.

The points P and Q of the bridge (Fig. 1) are connected through a thermionic valve (Mullard type PM. 5) to a galvanometer. The grid and anode of the valve are joined, so that it constitutes a diode. An alternating potential difference between P and Q produces a unidirectional current through the galvanometer, since the diode acts as a 'half wave-rectifier'. The resistances in the arms of the bridge are adjusted until the galvanometer indicates zero, calculation being made in the usual way.

Owing to the high impedance of the valve, a sensitive galvanometer is required. Using a 'Pye Unipivot' instrument, of sensitivity about 2 divisions per micro-ampere, with resistances of 100 ohms in the bridge arms, and an applied potential of 30 volts, a change in resistance of 1 ohm in any of the four arms

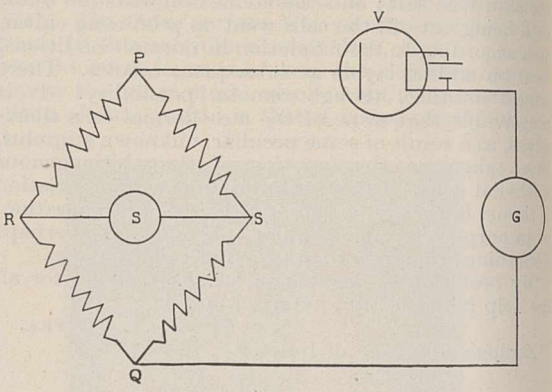

FIG. 1.

of the bridge produces an out of balance deflection of 2 divisions. For higher sensitivity a more sensitive galvanometer is required, but in such cases a very steady source of supply is essential. Obviously the deflection of the galvanometer is always in the same direction for all out of balance conditions, and does not pass from a positive value through zero to a negative value, as when the bridge is supplied with direct current.

Other methods of employing the thermionic valve in connexion with bridge determinations of electrolytic, and of very high wire resistance, in which use is made of the amplifying and rectifying properties of the valve, are to be published later in the *Indian Journal of Physics*.

J. A. C. TEEGAN.

Physics Department,
University College,
Rangoon, Aug. 16.

Wireless Reflections and Echoes.

A REMARK has just occurred to the writer, on turning over the account of cognate phenomena in Rayleigh's "Theory of Sound" (vol. 2, § 270), which seems to be of weight in this subject and may indeed be already familiar as a guide to observers. Long waves can penetrate a heterogeneous atmosphere of the lumpy type much better than shorter waves the length of which is comparable with the dimensions of the patches scattered through the medium. But in reflection from a layer of transition the opposite conditions prevail, the longer waves being most turned back: for reflection is only sensible when the gradual change of properties is completed within a depth small compared with the wave-length, though the new values must afterwards be maintained for a depth at least comparable with the wave-length. Atmospheric reflection downward must be in any case slight so that the augmenting of the effect by lengthening the waves may be an effective mode of test.

JOSEPH LARMOR.

Cambridge, Sept. 3.

Veterinary Science and Agriculture.*

By Dr. P. J. Du Toit.

THE prominent position which veterinary research occupies in the scientific life of South Africa to-day and the valuable practical results which have been obtained in this field of work have encouraged me to choose as the subject of my address the rôle which veterinary science plays in the agricultural development of a country. For obvious reasons my remarks will be confined almost exclusively to the live-stock side of agriculture in the wider sense ; and for equally obvious reasons most of my examples will be quoted from South Africa.

Since the beginning of the present century the growth of veterinary science has been remarkable. Indeed, it may be said that a new veterinary science has arisen unobserved by the general public. A quarter of a century ago the veterinarian was looked upon as a moderately useful though obscure member of the community, whereas to-day he is regarded as an essential factor in the economic machine of the State. In this transformation of veterinary science the British Dominions and Colonies played no unimportant part. The veterinarians who had migrated to those countries and taken with them the stock of knowledge which they had obtained at the European veterinary schools, found themselves confronted with new problems which required solution. Research work on a large scale became necessary. Novel methods of attacking disease had to be devised. The farmer soon came to realise that his very existence depended on the protective measures of the veterinary staffs.

I propose to review briefly some of the most notable achievements of veterinary science in recent years, and to indicate how the work of the veterinarian has become interrelated with that of workers in other branches of science.

Animal Diseases.

Trypanosomiases.—Probably no other single group of disease-producing organisms has retarded the agricultural development of the continent of Africa more than that of the trypanosomes. If the cattle population of Africa be estimated at about 40 million head, it is quite safe to say that this number could easily be doubled if the danger of trypanosome infection were removed. In Nigeria, for example, only a portion of the drier northern provinces is suitable for cattle ranching ; the much more fertile southern provinces are practically devoid of cattle on account of the ravages of trypanosomiasis. Similar conditions obtain in almost every territory in Africa (except the extreme south). The soil is fertile, grazing is plentiful, the climatic conditions are favourable, but the presence of tsetse flies and trypanosomes renders cattle farming impossible.

Fortunately, we can record considerable progress in this field of work during recent years. The problem has been attacked along two lines mainly. A direct attack has been launched against the parasite by means of drug treatment ; and an indirect attack on the disease has been made through a campaign against the transmitter, the tsetse fly. The third line of attack, the immunisation of animals against infection, has not yielded very promising results.

One further trypanosome disease should be mentioned here, namely, dourine. Known for about a hundred and fifty years, this disease has been responsible for very heavy economic losses to horse breeders in Europe and other countries. With the aid of modern methods the disease was eradicated from most of the closely settled and well-organised western European States. But in the vast open spaces of Canada and other countries its eradication proved to be a much more difficult problem. It was only when Watson in Canada succeeded in perfecting a delicate diagnostic test for the detection of the infection that the eradication of the disease could be attempted seriously, and the results of the subsequent campaign in Canada have been entirely satisfactory. It should be added that Watson's success has stimulated further research into the problem of diagnosing other trypanosome infections by serological methods. A fair amount of success has attended these efforts and quite recently Robinson at Onderstepoort has reported further progress in the serological diagnosis of *Trypanosoma congolense* infection.

Piroplasmoses.—Under this heading are included diseases like redwater or Texas fever of cattle, biliary fever of dogs and horses, ' gallsickness ' or anaplasmosis, and East Coast fever of cattle.

Their etiology was completely obscure until Theobald Smith and Kilborne in America, in a series of brilliant researches extending over the years 1888–92, succeeded in elucidating the nature of the first-named disease. Not only did these investigators discover the causal organism in the blood of infected cattle, but they also proved that the disease was transmitted by ticks and that the infection passed through the egg of the tick from one generation to the next. All this was completely new to science ; it was the first time that the transmission of a mammalian disease through an invertebrate host had been proved experimentally. This contribution to science by two veterinarians is worthy of special note.

In the case of redwater, great advances can be recorded. The direct method of attack is eminently satisfactory, thanks to the discovery by Nuttall and Hadwen in 1909 that the drug trypanblue has a specific action on the parasite of redwater of cattle and biliary fever of dogs. The treatment is so successful that the disease has lost much of its terror since the discovery of the value of this drug.

In the case of anaplasmosis, a method of immunisation has been practised in South Africa for nearly twenty years and has been the means of saving thousands of animals.

Of the diseases mentioned in this section, East

* From the presidential address to Section M (Agriculture) of the British Association, delivered at Bristol on Sept. 8.

Coast fever is the most formidable, because of the very high mortality attending it. This disease must have cost South Africa several million pounds since its first appearance nearly thirty years ago. The loss to the country has been partly direct through the death of many thousands of animals, partly indirect through the costly organisation which it is necessary to maintain to fight the disease.

It is impossible in this brief review to discuss the methods employed in the eradication of East Coast fever, or the many practical difficulties encountered in this campaign. For our purpose it is sufficient to state that the dipping of cattle in an arsenical bath has proved to be a very valuable aid in the fight against East Coast fever or any other tick-borne disease.

In South Africa dipping has been practised since the beginning of this century, and has now become an integral portion of the daily routine of farming. No up-to-date stock farm can be found to-day without at least one dipping tank. Even if all the tick-borne diseases should now disappear, the majority of farmers in South Africa would continue to dip their animals regularly. The extent to which dipping is practised to-day may be gauged by the fact that there were in the Union of South Africa in 1929 more than 13,500 dipping tanks.

In the United States of America, where Texas fever (redwater) is the only serious tick-borne disease, an attempt is being made to eradicate completely the transmitter, *Boophilus annulatus*, by means of dipping. Large areas have already been cleared of these ticks, and the economic advantages to which these areas are entitled after being declared tick free, more than compensate for the expenses incurred.

Virus Diseases.—The vast sums of money which have been spent in Great Britain during the last few years on the eradication of foot-and-mouth disease should convince even the layman of the importance of this group of diseases.

In the olden days it was rinderpest which caused the severest losses. It has been calculated that the losses in Europe during the eighteenth century amounted to 200 million head of cattle. The disease made its appearance in England in 1865. A Royal Commission was appointed and its report is of value to this day. Later on, improved methods of eradication and prevention were evolved, and to-day most countries are free of rinderpest. However, in the Far East and in Central Africa the disease is still prevalent, and causes serious losses.

Two recent outbreaks of rinderpest, one in Belgium in 1920 and the other in Australia in 1923, both of which were eradicated completely within a few months, have again shown how far veterinary science has advanced during the last century.

South Africa has been free of the two diseases just named for many years. But there are several other virus diseases which play a very important rôle. Among these, horsesickness and bluetongue of sheep are perhaps the most important. An extensive study of the former disease by Theiler and his co-workers has yielded some very valuable results, but the problem of horsesickness cannot be said to be solved. At present a method of immunisation with hyperimmune serum and virus is practised, and this method has given excellent results in mules. About 4000 mules are immunised annually, and it has been stated that if the Onderstepoort Laboratory had produced nothing else except this method of immunising mules, its existence would have been justified.

The second important virus disease of South Africa is bluetongue of sheep. The disease is of great economic importance and would have been a very serious hindrance to the sheep farmer had it not been for the fact that Theiler discovered a simple method of vaccination by means of which the losses from the disease can be reduced to a negligible quantity. Every year two to three million doses of this vaccine are issued to the farmers, and the ultimate saving to the country must be enormous.

Of the many other virus diseases of animals, only one more need be referred to here, namely, rabies. This most dreaded of all human and animal diseases has been eradicated from many countries, and is being kept out by strict quarantine measures. In 1918 the disease was introduced into England with a dog which had been smuggled in in an aeroplane. Strict measures were put into force and in a comparatively short space of time the disease was stamped out completely. Methods of preventive inoculation of dogs, in countries where the eradication of the disease is very difficult, have been tried on a large scale. The results have, on the whole, been very good; but it is too early to predict the future scope of these methods.

Bacterial Diseases.—Of the host of bacterial diseases, only a few need be mentioned here. The deadly glanders, which was known before the time of Christ, and even twenty-five years ago still caused severe losses amongst horses and constantly threatened the human population, has now been practically eradicated from all civilised countries—thanks to the accuracy of the diagnostic tests which are used to identify the disease.

Another disease which at one time was responsible for very serious losses and which has now practically disappeared is pleuro-pneumonia (lungsickness) of cattle. In the year 1860 about 187,000 head of cattle are stated to have died in Great Britain of this disease; and the mortality in other European countries at that time was corresponding high. Towards the end of last century the disease was stamped out in Britain and to-day the greater part of Europe is free of the disease. South Africa, in spite of the fact that neighbouring countries are still infected, has been free of lungsickness since 1915.

Only one other bacterial disease can be mentioned here, namely, tuberculosis. In 1901, Robert Koch, who about twenty years previously had discovered the cause of the disease, startled the scientific world by announcing to a Tuberculosis Congress in London that human tuberculosis and bovine tuberculosis were two distinct diseases which were not communicable from the one species to the other. Unfortunately, this statement proved to be wrong. We know to-day that human beings do contract bovine tuberculosis, and for this reason most

civilised countries adopt measures for the suppression of the disease in cattle. The United States and Canada are leading the world in this respect and have spent millions of pounds in compensation for the destruction of tuberculous reactors. Denmark, Germany, England, and other countries are also doing much and have achieved a large measure of success in their efforts to supply to the population milk and beef free of tubercle bacilli. But very much remains to be done. In human beings the mortality from tuberculosis is still high in all countries, and a considerable percentage of the deaths must be ascribed to the bovine strain of the organism. The disease in cattle *can* be stamped out provided enough money is made available.

Recently great interest has been shown in the attenuated strain of tubercle bacilli produced by Calmette and Guerin of the Pasteur Institute. Experiments in which it is attempted to immunise children and young animals, with this strain, are in progress throughout the world. It is sincerely hoped that all this work will prove that the method of Calmette and Guerin has given us yet another weapon against this insidious disease.

Internal Metazoan Parasites.—The only group that need be mentioned in this brief survey are the worms. These parasites have become more and more important and to-day they actually constitute the ' limiting factor ' in successful sheep farming in many parts of the world. This subject forms a highly specialised science of its own, the science of helminthology—in which many notable successes have been achieved in recent years.

The ordinary stomach worm of sheep (*Hæmonchus contortus*) is world-wide in its distribution and is the cause of very severe losses. Better farming methods will undoubtedly improve the position, but in the meantime farmers look to the veterinarian to rid their sheep of these deadly parasites. Various chemicals have been tried with varying degrees of success, but perhaps nowhere has the success been so marked as in South Africa, where, as a result of the researches of Theiler, Veglia, Green, and others, a method of treatment was recommended which has proved the salvation of many sheep farmers. The method consists of the accurate dosage of a mixture of arsenite of soda and copper sulphate ; and the extent to which this method has been applied may be gauged from the fact that at present some 25 million doses of the mixture are issued annually from Onderstepoort. The method is not perfect, but it has been a great factor in making sheep farming a success where otherwise it would have been a dismal failure.

One further fact must be emphasised here. The menace of worm infection has become so great that no sheep farmer can hope to be successful if he disregards the teaching of modern science. Overstocking of farms must be prevented at all costs ; marshes must be drained or the sheep kept away from them ; the sheep must be treated regularly according to the best methods known. If these precautions are adopted, the parasites can be kept in check and profitable sheep farming will become possible ; if the advice is ignored, then the financial loss to the farmer will be the smaller the sooner he gives up farming.

External Parasites.—The two most important groups of ecto-parasites, the ticks and the tsetse flies, have already been referred to.

A further very important group are the mites. These minute parasites are responsible for the diseases known as scab or mange in animals, and have caused untold losses. In the fight against these diseases the British Dominions have had very signal success. Australia and New Zealand have eradicated sheep scab completely, Canada is practically free of it, and in South Africa, where the presence of a large native population owning a very inferior class of sheep has made the campaign particularly difficult, the incidence of the disease has been reduced to infinitesimal proportions and complete eradication is hoped for within a short time.

Another very important ecto-parasite of sheep is the so-called blowfly. The trouble is caused by these flies depositing their eggs in the wool of sheep, especially in the soiled and moist parts, and by the resulting maggots causing serious damage to the wool and the sheep itself. The pest has assumed alarming proportions in Australia and is becoming more and more important in other countries, including South Africa. Determined efforts are being made to combat the pest and valuable progress has been achieved. In this research entomologists and veterinarians are working hand in hand.

Diseases due to Poisonous Plants.—That certain plants are poisonous and may have fatal effects when consumed by animals has probably been known for centuries. However, it is only during recent years that plants have been studied which produce diseases comparable with epizootic diseases. In this field of research South African workers have been prominent.

One of the most remarkable of these diseases is that known in South Africa as gousiekte (rapid disease) of sheep, which was studied some years ago by Thieler, Du Toit, and Mitchell. The cause of the disease was shown to be the plant *Vangueria pygmæa*. The poison contained in the plant acts on the heart muscle, causing a myocarditis with subsequent dilatation of the ventricles. As soon as the process has reached a certain stage the animal dies of ' heart failure'. To the casual observer the disease presents all the characteristics of an infectious disease.

Other no less remarkable diseases were studied by Theiler and his co-workers. A disease called geeldikkop (yellow thick head) in sheep was shown by Theiler (1928) to be due to a plant *Tribulus terrestris*, although more recent work by Quin, Steyn, and others at Onderstepoort has shown that there are other factors to be considered in the causation of this disease.

Vomiting disease of sheep was studied by Du Toit (1928) and proved to be caused by *Geigeria* spp. The disease may produce very severe losses in certain years, especially after droughts, when the plant is very widespread.

The study of poisonous plants is now being actively pursued in various countries, and further

interesting developments may be expected. It is obvious that the co-operation of botanists is essential for the success of this work.

Deficiency Diseases.—The great importance of the vitamins in the nutrition of human beings is so well known that it need not be stressed here. In the case of the common domestic animals (except perhaps the pig, the dog, and the fowl) the vitamins seem to be of far less importance than in human beings. On the other hand, mineral deficiencies are, generally speaking, much more important in animals than in human beings. In recent years it has been found that large portions of the earth's surface are deficient in some mineral or other essential for the normal health and growth of animals.

In South Africa, as well as in other African territories and in Australia, the most serious deficiency is that of phosphorus. Theiler and his co-workers have investigated the ill-effects of this deficiency on cattle very fully. They have shown that cattle grazing on phosphorus-deficient pastures develop a depraved appetite for bones and other carcase debris, and this may lead to the ingestion of toxic material with fatal results (lamsiekte in South Africa); further, that such cattle remain stunted in growth, are late in maturing, are frequently unfertile, produce very little milk, and are very susceptible to various diseases. By the addition of a small daily ration of phosphorus to the diet, they were able to bring about an almost miraculous improvement in the condition of the animals.

As a result of the general feeding of phosphorus compounds in the deficient areas of South Africa, the disease lamsiekte, which a dozen years ago caused enormous losses, has practically disappeared and cattle farming in those areas has again become profitable. The significant fact may be recorded here that the village of Vryburg in Bechuanaland, where ten years ago milk was very scarce, to-day owns a creamery which handles a larger volume of cream than any other creamery in South Africa.

Other Veterinary Problems.

Problems in connexion with the nutrition of animals are now receiving attention in many countries. The vast importance of correct feeding can be illustrated best by referring again to the phosphorus deficiency which exists in the pastures of South Africa and other countries. The astounding results which have been achieved with the addition of a small quantity of phosphorus compounds to the ration of the animals promise to revolutionise the beef and dairy industries.

Animal breeding also presents problems of great importance and these are intimately bound up with the problems of disease and nutrition. In South Africa, as in other countries, there is a constant cry for the replacement of the scrub bull by pedigree sires. This demand would be met to a far greater extent were it not for the fact that in many parts of the country pedigree bulls cannot live because of disease or nutritional difficulties.

In South Africa control over the diseases mentioned above is gradually improving and, in regard to the deficient areas, recent investigations by Du Toit and Bisschop have shown that the grading up of native stock can be carried out with complete success provided the deficient mineral is supplied. Both beef cattle and dairy cattle have been bred on the extremely deficient veld of Bechuanaland without signs of deterioration, and the cost of the supplementary ration has been negligible in comparison with the advantage derived from such feeding.

Gratifying though the success which has been achieved may be, the need for further research on live-stock problems has never been greater than it is to-day. The development of enormous areas in the British Dominions and Colonies is entirely dependent on the progress of research. With the aid of further scientific measures, these new countries could absorb a very much larger population than they now harbour. Over-population will not make itself felt for generations, nor need over-production be contemplated seriously.

The prosperity of a very large percentage of the population, both European and native, in the Dominions and Colonies depends on the live stock industry—breeding of pedigree stock; beef, mutton, or pork production; dairy farming; wool or mohair production; skin and hide trade; poultry farming, etc. These farmers look to the veterinary service of their countries more and more for assistance and protection. Without this assistance, profitable stock farming, especially in the tropical and sub-tropical countries, is impossible. The assistance, if it is to be effective, must be based on the latest achievements of scientific research. Rule-of-thumb methods will not suffice.

In a humble way South Africa has proved the wisdom of maintaining an adequate veterinary research service. At Onderstepoort the Government twenty-one years ago established what must be regarded as a fairly large research institute, if the size of the population be taken into consideration. This institute, under the brilliant directorship of Sir Arnold Theiler, soon proved to be not a liability but a valuable asset to the country. The results obtained in any one of its various sections would probably have justified the maintenance of the entire institution.

I have said that the Dominions and Colonies have played an important part in the recent growth and development of modern veterinary science. The quality of the research work produced by veterinarians in these countries has been of such high order that it soon placed veterinary science (which not many years ago was regarded as the Cinderella of sciences) abreast of the other sciences. As a matter of fact, in South Africa it can be said, without disparagement to any other group of workers, that veterinary science occupies a very high, if not the leading, position. This has had a wholesome influence on the science itself and on the type of worker who was recruited in its service. The stigma of inferiority which for so long was attached to the veterinarian has disappeared. To-day, veterinary science is looked upon as a field of work which offers almost unlimited scope for research and, in its practical application, may bring untold material benefit to a country.

Correlation of the Archæological and Geological Records.

By M. C. BURKITT.

FOR the prehistorian the problem of correlating the archæological and geological records is a thankless task. No sooner has a satisfactory correlation been obtained in the study than field workers produce fresh factors which have to be accounted for and the problem is demonstrated to be still more complicated than before. However, recent researches, especially those undertaken by Mr. Reid Moir and Dr. K. S. Sandford, have thrown a flood of light on the whole matter, and while it is still too early to hope for a final solution of the knotty problem, a comparison of their work with that of earlier continental investigators does bring out certain salient points.

Although it has undergone some vicissitudes, the fourfold glacial system of Penck certainly seems to meet the facts in Nature, although the length and the intensity of the glaciations of that scheme seem to have differed in various areas, not only according to latitude (as might be expected) but also according to the longitude of the site. However, for the purpose of this article, Penck's scheme will be adopted, not least because both Mr. Reid Moir and Dr. Sandford, as well as many continental prehistorians, have a fourfold glacial system in their minds. Before tabulating the recent work in East Anglia and the Oxford district, it will be well to summarise some of the results obtained abroad: chiefly must the results of investigations at three sites, namely, Bouchiéta, Conliège, and Cotencher, be combined together.

Bouchiéta.—This site is a small cave half-way up the steep side of the Soudour hill, which rises in the middle of a tributary valley of the Ariège, close to the village of Bedeilhac and not far from Tarascon-en-Ariège. The section in the cave revealed morainic material overlaid by a deposit containing Mousterian implements. Below the level of the cave, along the hillside, can be seen the remains of another lateral moraine due to a glaciation which was not sufficiently intense to rise to the height of Bouchiéta. This glaciation must, of course, have been subsequent to the one which did reach the cave, as its moraines have not been thereby obliterated. If it *had* been sufficiently intense to reach the cave, doubtless the contents would have been cleaned out, and the remains left by the previous glaciation, with the deposit containing Mousterian implements resting on it, largely destroyed. *The evidence at Bouchiéta thus demonstrates that some Mousterian industries are subsequent to a glaciation which was not the last.*

Conliège.—In eastern France two terminal moraines can be determined, one considerably farther out in the plains than the other, due of course to the fact that the glaciation which formed it was the more intense of the two. But that the greater glaciation was not subsequent to the lesser is obvious, because if it had been, the terminal moraine of the former would have been largely destroyed. In a deposit resting on the earlier moraine, that is, the one farthest out in the plains, and beyond the range of the subsequent and lesser glaciation, was found an Acheulean implement. It is hard to dogmatise about the exact age of a single specimen, but so far as can be judged from pictures, it does not seem to be of very early Acheulean date. *The evidence at Conliège demonstrates that a part at any rate of the Acheulean culture is subsequent to the last but one important glaciation of a district.*

Cotencher.—This site is in Switzerland (Neufchâtel). It is a small cave lying just within the orbit attained by Penck's Würm glaciation at its maximum, and it was completely filled by morainic material assignable to this last great glacial epoch. Within the morainic material were found some Mousterian tools, which must therefore have been fashioned and dropped before the Würm glaciers picked them up and deposited them at Cotencher. *Cotencher demonstrates that the Mousterian culture, in part at least, was anterior to the maximum of the Würm glaciation.*

But the Mousterian in France * is found with an arctic fauna and is stratigraphically later than the Acheulean, which is associated with a cool fauna. It follows, therefore, that the French Mousterian must be, in part at any rate, correlated with the Würm glaciation, it and a part at least of the Acheulean being subsequent to the Riss glacial period. Confirmation of this is given by the finds in the Somme Valley, where Acheulean industries occur in the older loess, which is found covering, and is therefore newer than, the lowest but one terrace, while it never overlies the bottom terrace—for the simple reason that at the time of its formation the bottom terrace was not there. Mousterian industries are found at the base of the younger loess, which does occur over the bottom terrace as well as over the lowest but one. Comparisons of the Somme Valley terraces with those of the Oxford district are very striking. Again, in the valley of the Garonne, Acheulean industries are found in a deposit resting on the lowest but one terrace and in the gravels of the bottom terrace—in the latter case in a rolled state. Once again the evidence shows that a part at any rate of the Acheulean industries can be dated to a period before the last glaciation but after the last but one.

Turning to Great Britain, the key sites in East Anglia are, in my opinion, those of Hoxne and the Cromer cliffs, to which must be added the recent discoveries in brown boulder clay at Hunstanton. Our knowledge of all three is due to the indefatigable energy of Mr. Reid Moir. Composite sections from

* I use the terms 'Mousterian in France' and 'French Mousterian' to distinguish these industries from the many flake industries found elsewhere, for example, in Great Britain, which have often been erroneously classed as Mousterian but are better designated 'Levalloisian' or 'Clactonian', and are often considerably earlier in date, being contemporary with various phases of the Acheulean culture.

these sites, together with those of the Oxford district, are given in the table below. The archæological finds from the Wolvercote channel have been correlated with the upper beds of Hoxne, the succession of industries being most helpful. The foreign evidence just detailed allows us to name the glacial periods according to the Penckian scheme.

sands with the more temperate beds, probably lower Acheulean in date, of Hoxne and elsewhere. But the recent suggestions of Simpson (NATURE, Dec. 28, 1929) postulate a cold or at least cool inter-glacial at just about that time in the geological sequence of events. Assuming that the climate was temperate, as indicated by the Hanborough

TABLE OF CORRELATIONS.

Locality.	Oxford Region.	Hoxne.	Hunstanton.	Travellers' Rest, Cambridge.
Post Würm I	Modern flood plain gravels.	Sand and sandy-loam (? Upper Palæolithic in age).	Brown boulder clay containing derived Upper Palæolithic implements = Würm II.	Evenly bedded gravel at top.
Glacial Times = Würm I	Sunk channel (mammoth found). [Wolvercote channel] Denudation to sunk channel. 1. Warp sands (climate very cold and wet). 2. Clays with rare Mousterian tools (climate cold). 3. Peats with subarctic flora.	[No industries found but presumably they would prove to be late Mousterian and early Upper Palæolithic.] Glacial deposits = chalky boulder clay. Brick earth.		Twisted loam and sand.
Interglacial Times = Riss-Würm	Upper Summertown—Radley terrace. (Hippo and *Corbricula flummalis* found.) 4. Sands with temperate Mollusca. 5. Layer with *Elephas antiquus* and unrolled Upper Acheulean and Micoque tools.	Early 'warm' Mousterian floor and temperate flora.	[Cromer District.]	Twisted sand (Moust.). Warm level-bedded sand (derived Chellean and Acheulean tools).
Glacial Times = Riss	Lower Summertown—Radley terrace. (Mammoth and derived Chellean and Acheulean tools found.) Wolvercote (40 ft.) terrace = outwash of Moreton ice sheet (derived Chellean tools found).	Gravel with Acheulean tools mammoth and reindeer bones. Arctic bed (sterile).	Runton sands (Upper Acheulean tools found). Contorted drift.	Scratched boulders.
Interglacial Times = Mindel-Riss	Hanborough (90-100 ft.) terrace = pause in a period of denudation of the Thames valley.	Warm lacustrine beds (sterile).	? Perhaps represented by such a deposit as the Mundesley sands.	
Glacial Times = Mindel	Plateau drift.	Kimmeridge boulder clay.	Till (derived late Chellean tools found at base). Upper part of Cromer Forest Series.	
Interglacial Times = Günz-Mindel			Lower Cromer Forest Series. (Horizon of ancient Chellean land surface at base.)	
Glacial Times = Günz			Weybourne Crag, etc.	
Pre-Günz Times			Earlier Pliocene deposits to chalk.	

It would seem from the above that the whole period from the Eolithic industries of the sub-crag until close on chalky boulder clay times is occupied by Chellean and Acheulean industries, with which are associated at certain periods flake industries of Clactonian and Levalloisian types. The so-called 'warm' Mousterian which is earlier in date than the true Mousterian of France should, properly speaking, be included here. The only difficulty in the scheme is the correlation of the cold Mundesley

terrace at Oxford and the lower bed at Hoxne, it is possible that in the intensely glaciated area around Cromer, which was more or less under the influence of the Scandinavian ice-sheets, the climate of this cool inter-glacial period was never warm enough to permit of our recognising an inter-glaciation, but that nevertheless the Cromer Till and the contorted Drift, far from being the result of one great glacial movement, are the result of two successive glaciations.

Obituary.

Prof. H. B. Dixon, C.B.E., F.R.S.

THE sudden death of Prof. Harold Baily Dixon, of the University of Manchester, on Sept. 18 last, removed a distinguished chemist whose work upon gaseous explosions during the past half-century opened a new era in combustion research.

He was born on Aug. 11, 1852, the second son of William Hepworth Dixon (1821–79), traveller and writer, and for some years (1853–69) editor of the *Athenæum*. The family came of an old puritan stock, the Dixons of Heaton Royds in Lancashire; but in 1846 Hepworth Dixon, who had been born in Manchester, migrated to London, where his children were reared.

Harold went to Westminster School, from whence, in 1871, he gained a close classical scholarship at Christ Church, Oxford. Owing chiefly to the zest with which he threw himself into the social and athletic side of university life, he scarcely fulfilled the expectations of his tutors in classics; but in 1873, at the instance of Dr. A. Vernon Harcourt, he turned his attention to science, with such signal success that two years later he graduated first class in the Natural Science School. Afterwards he was elected to fellowships successively at Trinity in 1875, and at Balliol in 1881, teaching at both Colleges and carrying out researches in a cellar at Balliol which formerly had been used by Benjamin Brodie for his researches on ozone.

It was also at the instigation of Vernon Harcourt that Dixon commenced studying gaseous explosions in 1876. During the sixty years which had elapsed since Humphry Davy's pioneering work on the subject, only R. W. Bunsen amongst chemists had much explored it, and for twenty years his results had been accepted without question as authoritative. More particularly the results of Bunsen's experiments (1853) on the explosion of mixtures of electrolytic gas with increasing amounts of carbonic oxide were held to be inconsistent with the principle of 'mass action' enunciated by Berthollet in 1805, and led to the erroneous view that a continuous alteration in the composition of such a gaseous medium produces a discontinuous ('per saltum') alteration in the course and products of its explosion.

It was during a research primarily undertaken to test this conclusion that Dixon made the epoch-making discovery that the prolonged drying over phosphoric anhydride of a mixture of carbonic oxide and oxygen in combining proportions renders it non-explosive when subjected to electric sparks of an intensity sufficient to ignite quite readily an undried medium. This astounding result, announced at the Swansea meeting of the British Association just fifty years ago, immediately made him famous, and (as he was wont to say) loosed a hare which, though since pursued by the hounds in full cry, is still uncaptured.

These early Oxford researches (1876–81) not only proved, *contra* Bunsen, the validity of Berthollet's 'law of mass action' in gaseous explosions, a conclusion simultaneously established by the independent work of Horstman in Heidelberg, but also led to the remarkable discoveries of H. B. Baker, who assisted Dixon at Balliol in 1884–85, regarding the incombustibility of rigidly dried and purified systems containing phosphorus or sulphur vapour and oxygen, even when strongly heated. Thus Dixon laid a firm and lasting foundation on which much later work has been built.

Up to 1880, on the strength of Bunsen's observations (1857), it was generally believed that gaseous explosions travel at rates not exceeding a few metres per second only; but in that year a disastrous explosion in a large gas-main in Tottenham Court Road, London, afforded conclusive evidence of much higher speeds, and caused Dixon to begin measuring 'rates of explosion', which was his next important work. He had not got far with it, however, before Berthelot and Vieille announced (1880) their discovery of the high constant flame speeds finally attained on the development of 'l'onde explosive' ('detonation') in gaseous explosions; this revelation, together with Mallard and Le Chatelier's classical "Recherches sur la combustion des mélanges gaseux explosifs" (1883), showed that the comparatively slow flame speeds observed by Bunsen apply only to the mild initial phase of such explosions. Working on parallel lines with them during the next twenty years, Dixon so successfully developed the methods initiated by the French savants that he became the leading authority upon such matters. In 1893 he gave the Bakerian Lecture to the Royal Society on "The Rates of Explosion in Gases", and nine years later published in the *Philosophical Transactions* a brilliant memoir embodying his photographic researches on "The Movements of Flame in the Explosion of Gases".

Dixon's third principal line of research, which chiefly occupied him during the last twenty years, was on the 'ignition temperatures' of explosive gaseous media, which he was the first to determine with any real accuracy; and only recently he made the important discovery that such 'ignition temperatures' are, or may be, profoundly affected by the presence of small amounts of impurities in the media, a matter of great importance in regard to coal-mine and other industrial explosions.

In 1886 Dixon was appointed to succeed Sir Henry Roscoe in the chair of chemistry at Owens College, Manchester; and this he occupied until his retirement in 1922, when he became honorary professor at the University while still continuing his experimental researches there. Under Roscoe the Manchester School of Chemistry had been so dominant in the country that some doubted whether his successor would maintain its great reputation. But Dixon's outstanding administrative gifts, his devotion to experimental research, his singularly clear and penetrative mind, his brilliance as a lecturer, his power of arousing in his students the true spirit of inquiry, and the way in which he always identified himself with the social and athletic interests of the University,

proved more than equal to the test, so that the reputation of the School continually increased under his leadership. He was indeed the *beau ideal* of a University professor.

Dixon's scientific and educational activities were by no means confined to the University of Manchester. He was president of the Manchester Literary and Philosophical Society during 1907–9 and of the Chemical Society during 1909–11. He served on the Royal Commissions on Explosions of Coal-dust in Mines (1891–94) and on Coal Supplies (1902–5); also he was a member of the Home Office Executive Committee on Explosions in Mines (1911–14), and since 1927 acted as Supervisor of Researches on the Ignition of Gases under the Safety of Mines Research Board. During the War he was Deputy Inspector of High Explosives for the Manchester area, in recognition of which he was appointed C.B.E.

In 1916 Dixon became chairman of the Royal Technical College, Salford, and afterwards of the Salford Education Committee, both of which positions he continued to fill until the end with conspicuous success and great advantage to the public. Latterly he also devoted much time to the establishment of the new Queen Mary's Secondary School for girls at Lytham, which is to be opened in the near future, and was returning from a meeting at Lytham in this connexion when he was suddenly taken ill and died.

Amid his manifold other interests, Dixon never lost his early love of the classics, and while voyaging to South Africa with the British Association in 1906 he produced for private circulation a verse translation of the Odes of Horace which for scholarly treatment and real feeling could scarcely be surpassed. Indeed Horace and Omar Khayam were his favourite authors, and he was filled with the spirit of the "Novum Organon" of which his scientific work was the fruit.

The Royal Society elected Dixon to its fellowship in 1886, and awarded him a Royal Medal in 1913; in 1922 the University of Manchester conferred upon him its D.Sc. *honoris causa*, the University of Prague having similarly conferred its Ph.D. some years previously. But, as he often said, his chief reward was the deep satisfaction which came to him through the affection and devotion of his many old pupils, and from the knowledge that, inspired by his example, they were handing on the torch which he had lighted.

Dixon was not only himself a great exponent of the experimental method, but also a master-trainer of those who were privileged to be his pupils in research; and it was here that the influence of his personality was most markedly felt. At all times he was unsparing in the guidance of his ripe experience, and unrelaxing in impressing the paramount duty of accuracy and truth, together with the highest standard of experimental work. Eschewing all rash speculation, and attaching little importance to theories save as working hypotheses, the dry light of science shone clearly throughout all his work; and he had a singular felicity in choosing just the right words in expounding it.

In his youth, Dixon was a good athlete, gaining his football 'blue' at Oxford; and well into middle life he continued to play both cricket and tennis. His chief physical recreation, however, was mountaineering, in which he excelled. During 1890–93 he accomplished more than twenty first-class climbs in the Alps, and was elected to the Alpine Club in 1894. Afterwards, in 1897, he climbed in the Selkirks, Canada, making first ascents of both Pollux and the Dome, and the second ascent of Castor with C. E. Fay and others. Also, in the Canadian Rockies, he made the first ascents of Mounts Lefroy and Gordon with C. E. Fay, Norman Collie, and C. S. Thompson.

He was twice married, first in 1885 to Olive Beechey Hopkins of Montreal, who died in 1917, and by whom he had a son and a daughter; and then in 1918 to Muriel Kinch of Yelverton (S. Devon), who survives him, by whom he had a daughter. All three of his children also survive him.

It is pleasing to know that even on the last morning of his life, Dixon was personally experimenting in his laboratory; within a few hours he had passed away, in the fullness of years and plenitude of powers, without pain or sadness of farewell, leaving behind him a host of pupils who will ever remember him with deep affection and gratitude.

Nihil tetigit quod non ornavit; fama semper vivat!

WILLIAM A. BONE.

SIR WILLIAM SMITH, C.B.

THE death of Sir William Smith, the well-known naval constructor, took place at Craiglands, Herne Bay, on Sept. 16. Though he was not fortunate enough to fill the office of Director of Naval Construction, there have been few in the Admiralty service with a higher reputation, and as Superintendent of Construction Accounts and Contract Work during the period 1902–12, he held a position second only to that of the directorship itself.

Born at Portsmouth on April 4, 1850, William Edward Smith began work in the rope-house at Portsmouth at the early age of eleven, but at fifteen became a shipwright apprentice, and four years later, as the result of a severe competitive examination, gained a scholarship at the Royal School of Naval Architecture and Marine Engineering at South Kensington. Passing out in 1873 as an assistant constructor, he was employed on the designs of the old ironclads *Northampton*, *Colossus*, and *Inflexible*, and later on succeeded Sir William White as instructor in naval architecture at Greenwich. Returning to the Admiralty, in 1887 he was appointed Inspector of Contract Work and later on was concerned with the designs of many of the ships built under the Naval Defence Act of 1889.

During his forty years' active career Smith served under Sir Nathaniel Barnaby, Sir William White, and Sir Philip Watts, and it was under the latter that he held the important post of Superintendent of Contract Work. From this appointment he

(*Continued on p.* 541.)

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Reviews.

Contributions to the History of British Surgery.

Plarr's Lives of the Fellows of the Royal College of Surgeons of England. (Thelwall Thomas Memorial.) Revised by Sir D'Arcy Power, with the assistance of W. G. Spencer and Prof. G. E. Gask. Vol. 1. Pp. xxvi + 752. Vol. 2. Pp. 596. (Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1930.) Cloth, 42*s.* net; half bound, 57*s.* 6*d.* net.

THE published registers of a college are not usually books of wide interest, but the two volumes of "Plarr's Lives of the Fellows of the Royal College of Surgeons of England" which have just been issued, edited by Sir D'Arcy Power, are very much more than a biographical register, for they provide a history of English surgery during the last hundred years. The Royal College of Surgeons in London was founded in 1800 to take the place of the Corporation of Surgeons, which had separated in 1745 from the joint Company of Barber Surgeons but came to an end through the negligence of its court after a life of about half a century. The College was thus the direct legal successor of the various guilds and companies into which the surgeons of London had successively grouped themselves since the middle of the fourteenth century. In this capacity the College continued to perform the important office of examining and licensing would-be practitioners of the "art and science of surgery", granting to the successful candidates its diploma of membership.

From its very foundation, however, the College was also entrusted with the care of the great collections John Hunter had gathered together to illustrate life in all its branches, which had been purchased for the nation in 1799, six years after Hunter's death. Much money was expended both by the Government and the College on the satisfactory establishment of the museum in Lincoln's Inn Fields, at the beginning of the century; but it was not until 1830 that the catalogues began to be published, chiefly through the labours of Richard Owen, who had been appointed an assistant in the museum in 1826. In 1828 the first librarian, Robert Willis, was appointed; and in the early 'thirties the College was rebuilt, practically in its present form.

The College was thus firmly establishing its important position in the medical education of Great Britain, organising and making efficient its museum and its library, and in 1843 this good work was completed when a supplemental charter was obtained incorporating the College as the Royal College of Surgeons of England and instituting the order of fellows. The first fellows were to be elected by the Council from among the members—not less than 250 or more than 300 were to be elected within three months, and further fellows were to be added at discretion in the first year; after that, election to the fellowship was to be decided by a special examination supplemental to the examination for the diploma of membership. This very important development was chiefly due to Brodie; and, as is stated in the account of him in the collection under review, the institution of the fellowship has been largely instrumental in raising the College to be "the exemplar of surgical education to the whole kingdom".

It is, then, with the first 300 fellows elected in 1843 and with all their followers in the fellowship, whose life and work are already ended, that these volumes are concerned. As a preface to the actual lives, the text of the 1843 charter and the list of the first 300 fellows are printed in full at the beginning of the first volume. A perusal of this list will provide the reader with a clearer historical terminus than the mere date '1843' can convey. The great surgeons who had been Hunter's pupils and successors will not be found among the fellows—their labours were already finished when this new

order was established. Brodie is the senior vice-president in the first list of fellows, and other outstanding names are: William Lawrence, Benjamin Travers, J. H. Green, Liston, Ranald Martin, Syme, Cæsar Hawkins, Le Gros Clark, and James Paget; and of the second group of fellows, elected under the terms of the charter in 1844, George Murray Humphry, founder of the Cambridge school of medicine, is the last on the list.

The lives of these men and of their successors at the head of the profession form the body of the work. Each life is headed by a tabulated list of academic and civic (or military) degrees and honours, with the dates of their attainment. The lives follow, on the whole, the admirable models of the "Dictionary of National Biography", though they are not so severely utilitarian—anecdote and reminiscence are freely, but judiciously, drawn upon to make a portrait vivid; for, as the preface states, a considerable number of the fellows have been known to the editors either as their teachers, their contemporaries, or their pupils. Under the more important names, while a sketch has been given of the subject's whole career and general interests, chief attention has rightly been paid to his professional work, and this study is made more valuable by the select but exact bibliography appended to each life. Full references and acknowledgment are also given, in most cases, of the sources from which the material of the lives has been drawn. As an example, the most important article — Lister — which runs to nearly a dozen pages, gives a sufficient outline of his life and includes an essay, woven round his research and teaching, on "Antisepsis ensuring Aseptic Surgery"; and finally the reader is referred to the "Collected Papers", and to a number of biographies and general articles. But while there are many lives of detailed interest, there are many also which come to little more than a list of appointments gathered into a few lines. It is at first sight a little disappointing that more information should not have been forthcoming about many of these lesser figures. Possibly the publication of these volumes in their present form will elicit additional information from sources which have not been tapped.

The labour of collecting the material for these lives was undertaken by the late librarian of the College, whose name appears in the title, and to him is largely due the credit for such completeness as has been obtained, particularly in the accounts of the lesser men. The editors have prefixed a memoir of him to the collection. Victor Plarr in early life had been a member of the Rhymers' Club, that brilliant but tragic group of poets in the 'nineties, and some of his verses may still be met with in the anthologies of to-day. But for more than thirty years he was librarian of the College and did much useful work, including the completion of the catalogue of the library, which had been started by his predecessor. The volumes now issued will form a lasting memorial to his labours; but the editorship of Sir D'Arcy Power ensures that the student of medical history will find here not merely a collection of lives but also a series of valuable contributions to the history of British surgery.

The period covered begins before the introduction of anæsthetics and passes right through the conflict of opinion over Lister's teaching of antisepsis—here may be found lives both of his opponents and of his supporters and successors, down to the most recent times. The student can find, under the appropriate names, the history of ovariotomy and of the introduction of abdominal surgery, and the rise of scientific ophthalmology and other specialisms. Here also are many names important in the history of the Indian Medical Service. The rise of the modern science of public health is recounted in the lives of Sir John Simon and his fellow-workers. The excellent account of Sir Victor Horsley provides a detailed and worthy summary of his varied and important researches. These are but a few examples, and beside the pioneers and heroes of surgery itself, the amateur of medical history will find much to note in the varied pursuits to which many of these fellows turned aside and in which also they gained success. Many of the leading figures in the development of natural science in the last century are here—Richard Owen, Gideon Mantell the geologist, Bennett, one of the early investigators of Australian zoology, Busk the palæontologist. There are heroic missionaries, and even one bishop. Literature has had her worthy followers in this section of the medical world, and, as might be expected among surgeons, there are several artists of merit, of whom Seymour Haden may be mentioned. He is so deservedly well known as an etcher that his important career as a surgeon, here outlined, may be easily forgotten.

All who care for the history of science must be grateful to Plarr and to Sir D'Arcy Power and his fellow-revisers for their labours, which have so well supplied a long-felt need; and to complete the usefulness of "Plarr's Lives" the editors promise "a supplement every ten years". W. R. L.

Colloid Miscellany.

(1) *Kapillarchemie: eine Darstellung der Chemie der Kolloide und verwandter Gebiete.* Von Prof. Dr. Herbert Freundlich. Band 1. Vierte unter Mitwirkung von J. Bikerman umgearbeitete Auflage. Pp. viii + 566. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930.) 39 gold marks.

(2) *Die Globuline.* Von Dr. Mona Spiegel-Adolf. (*Handbuch der Kolloidwissenschaft in Einzeldarstellungen*, herausgegeben von Prof. Dr. Wolfgang Ostwald, Band 4.) Pp. xv + 452. (Dresden und Leipzig: Theodor Steinkopff, 1930.) 33 gold marks.

(3) *Traité de biocolloïdologie.* Par W. Kopaczewski. Tome 1: *Pratique des colloïdes.* Deuxième édition entièrement remaniée et mise à jour. Fascicule 2: *Mesure des concentrations moléculaires et ioniques.* Pp. 165-361 + vi. (Paris: Gauthier-Villars et Cie, 1930.) 40 francs.

(4) *Colloid Symposium Annual (formerly Colloid Symposium Monograph): Papers presented at the Seventh Symposium on Colloid Chemistry, Johns Hopkins University, June 1929.* Edited by Prof. Harry Boyer Weiser. Pp. viii + 300. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 22*s.* 6*d.* net.

(5) *The Chemistry of the Colloidal State: a Textbook for an Introductory Course.* By Prof. John C. Ware. Pp. xiv + 313. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 18*s.* 6*d.* net.

(1) IN the welter of books on colloid chemistry, Freundlich still stands like a great rock in a weary land. The new edition indicates that his great achievement is not to remain as a venerated antiquity; indeed, the growth of the subject is so rapid that the work is now to appear in two volumes, each as large as the original edition of 1909. The classical treatment of surface action originally adopted was so soundly conceived that little alteration in the general scheme has been found necessary to accommodate the additional matter now available. Hence this first volume includes the actual "Kapillarchemie", together with consideration of the kinetics of formation of new phases and the Brownian movement—the detailed treatment of sols and gels being reserved for the second volume. The increase in size is not due to the process of acervation so common in text-books, or to any sensational new developments, so much as to an increase in the intensity of our knowledge of domains hitherto incompletely explored. The author has not hesitated to prune in order to make room for recent work, which is nevertheless frequently introduced in an unobtrusive manner.

Among the new matter in this edition, an extended discussion of the relations between chemical composition and surface tension has been rendered necessary by the recent work on parachors. Adsorption is another branch of the subject which has been brought up-to-date, and in view of the tendency to deal experimentally to such a large extent with charcoals and silica gel as adsorbents for gases and vapours, a short section on the action of metals in this direction is to be welcomed. The portion of the work dealing with electrical phenomena at surfaces has also been extended, and throughout one finds that careful modification of statement in the light of experience which has characterised the earlier editions. It would indeed be difficult to find any important piece of work within the scope of the subject and capable of summarised treatment at the present time which has not been adequately dealt with.

(2) The increase in intensity of colloidal research during the last twenty-five years is indicated also by the important monograph of Dr. Spiegel-Adolf on the globulins. These proteins, even apart from their intrinsic interest, will always have a special appeal to English physiologists on account of the fundamental investigation of them by Sir William Hardy and the subsequent work of other English biochemists. The globulins have not hitherto received in the literature of the proteins the attention which their importance warrants, and it is very convenient to have in one volume such a masterly account of their behaviour. Hitherto such information has remained scattered through the numerous journals in which it was originally published, and, indeed, some of the matter here included has not been published before.

Although the greater part of the work is naturally devoted to the physical chemistry and colloid chemistry of the globulins and their reactions with acids, bases, and salts, there is an interesting section on their importance in biology and medicine which should appeal to the serious student of human physiology and pathology. In completeness and clarity this monograph leaves nothing to be desired.

(3) This second portion of the first volume of Prof. Kopaczewski's treatise represents a distinct advance in French scientific text-books, which hitherto have too often been written with an airy detachment from work carried out in other countries. The references to literature are reasonably numerous and

have not been dictated by geographical considerations. One would expect, however, in a work of this kind some mention in the chapter on osmometry of the determinations of the molecular weight of hæmoglobin by G. S. Adair, as direct measurements of osmotic pressure of biological substances have so seldom been made. The other chapters deal with cryoscopy, conductivity measurements, and the determination of *p*H. The usual methods are described, illustrated with diagrams which are mostly clear enough and large enough to be intelligible, and the tables of results of the most varied nature make interesting reading even for those who will never carry out the determinations themselves.

The main purpose of the whole work is seldom lost sight of, and special apparatus for biological use is a feature of the author's material; and while those engaged in practical work in this sphere may prefer to use more detailed works on the various subjects, this volume will appeal to those whose needs are somewhat broader.

(4) The unsuitability of the use of the term 'monograph' for a work containing twenty-three papers by as many different authors has been recognised by the substitution of the word 'annual' in this seventh year of issue: no doubt in time 'symposium' will give place to some term more descriptive of the occasions when these papers are presented. In general quality the contributions are well up to the standard which readers have come to expect from this publication, and in variety of subject ensure an appeal to a wide circle. It is almost invidious to select separate papers for comment, but the two papers on adsorption and crystal growth carry an interesting subject a stage further in definiteness and are distantly related to the one on the taking up of dyestuffs by hydrous oxides. Again, the articles on clays and the nature of flow have a marked practical bearing; the perennial fascination of gels is indicated by three papers on different aspects of their behaviour, and adsorption and the measurement of the surface area of adsorbents also claim attention. Biological problems are represented by three papers, including one on the projected methods of analysis of bacteria in quantity.

One has the feeling, however, that both the meetings and the report of them in this volume would be improved by the selection of a few dominant issues, to be treated with less detail of experimental work than is here included. Discussions on the papers are not included in the book, and there seems no direct way in which criticism of the papers could be brought forward by anyone not at the meeting. There is no doubt, however, that this annual meeting of American colloid chemists performs a useful function, and many will wish that a similar event might be organised in Great Britain.

(5) Dr. Ware states in his preface that "the purpose of this text is to present the fundamentals of colloid chemistry as they are disclosed by an analysis of the material available at this time and not in accordance with the facts of twenty years ago", as he alleges that in the elementary books on the subject both material and method of presentation are very largely obsolete. One therefore hoped to find in this volume a lucid and up-to-date account of a growing science; unfortunately, it is so marred by inaccuracies in detail that it would be inadvisable to place it in the hands of any but a very intelligent student. On the very first page the criterion of size of particles is stated to be insufficient as a definition of the colloidal state, but no clear definition is given, and the next forty pages are devoted to a description of some of the methods used to determine particle size. This discussion, and indeed the whole of the first half of the book, must leave the student wondering when the materials which have these queer properties are going to appear, for he has to wait until p. 170 before he is allowed to know how the simplest colloidal solution is made. His difficulties will be further increased if "any source of light falls at any angle on any particle" (p. 87), or if he uses a large block of uranium glass with the cardioid condenser (p. 11). The author is particularly pleased with a photograph of the Brownian movement showing a series of wavy lines as indicating the 'vibratory' movement of the particles, and gives the usual diagram of erratic lines with apologies; he does not seem to realise that the photograph was obviously taken with a moving sol or a moving plate (p. 110). On p. 224 the reader is told that particles in emulsions do not carry an electric charge; while on p. 250 the swelling of rubber in benzene is quoted as curious behaviour on the part of a *lyophobic* colloid.

These examples of ill-digested statement are casually selected—there are many more; and while the reviewer is not in agreement with the order of presentation, there is little object in discussing that while the facts presented are so inaccurate. The author suggests that to begin with Graham's experiment on dialysis produces "a combination of entertainment and confusion"; it would be difficult to find a more suitable expression for the results of his own work. P. C. L. Thorne.

Wave Mechanics.

(1) *An Introduction to the Study of Wave Mechanics.* By Prof. Louis de Broglie. Translated from the French by Dr. H. T. Flint. Pp. vi + 249. (London: Methuen and Co., Ltd., 1930.) 12*s.* 6*d.* net.

(2) *Wave-Mechanics.* By Prof. Arnold Sommerfeld. Translated from the German edition by Dr. Henry L. Brose. (Supplementary volume to "Atomic Structure and Spectral Lines".) Pp. xii + 304. (London: Methuen and Co., Ltd., 1930.) 21*s.* net.

HERE we have two books on wave mechanics dealing with the most recent advances in theoretical physics, written by two distinguished authors, each prominent in his own country in the ranks of constructive thinkers. It is of great interest to compare the imaginative work of Louis de Broglie with the more critical and exhaustive treatment of Arnold Sommerfeld.

To de Broglie (1924) we owe the almost bizarre conception which led later to the more complete formulation of wave mechanics by Schrödinger. Every particle possesses some of the attributes of a wave. A particle in motion must be associated with a certain periodicity and with a wave-length, the latter calculated very simply by dividing Planck's constant by the momentum of the particle. This relation is in some measure imposed by the fundamental principles of relativity. A ray of light possesses corpuscular properties, but the light corpuscle is guided by a wave. Such was the paradoxical view which suggested itself to the French physicist. At first it seemed to many only a fanciful and unpractical vision, but the young man's vision led to unforeseen experimental and theoretical developments. Several experimenters brought forward evidence, somewhat vague at first but later clear and definite, to show that moving electrons do behave as though they were controlled by waves when they encounter reflecting surfaces or thin films of matter. Even this experimental evidence would probably not have attracted so much attention, had not the theory of wave mechanics been developed in Schrödinger's papers of 1926 and 1927.

The new method is based on the century-old work of Sir William Hamilton, of Dublin, on the relation between optical and dynamical principles. The principle of Fermat in optics makes the time a minimum for the path which is actually taken by a ray of light travelling from one point to another. This is analogous to the principle of least action, which asserts that a certain integral representing the action has a stationary value for the actual trajectory of a particle. Classical dynamics presents a close analogy to geometrical optics; quantum mechanics presents a close analogy to physical optics. Instead of Fermat's principle we must now employ the principle of Huygens, according to which any point which is reached by a wave becomes the origin of a secondary wavelet which spreads outwards with the same velocity as the original wave. This principle may be expressed in a way familiar to mathematicians as a differential equation involving a complex quantity which Schrödinger calls ψ. The fundamental equations of mechanics must be replaced by a wave-equation in configuration space.

It has been said that Englishmen, who incline to concrete ideas, are less readily accessible to progressive abstraction than the older peoples of the Continent. Certainly many of them confess that they favour a 'picturesque' (*anschaulich*) description of physical phenomena whenever that is available. What, then, is the meaning of Schrödinger's field scalar ψ, or what is the interpretation of his waves? At first it seemed as if the experimental physicist were to be made happy with a concrete representation. The simplest idea is that which regards the particle or the electron as constituted by a group of waves; it is a 'wave packet'. "Unfortunately, when we pass to the domain proper of the new theory it appears scarcely possible to support this idea which is so attractive on account of its simplicity. . . . If they were simple wave packets the particles would have no stable existence." On another view, formerly supported by de Broglie, the particle is considered as a singularity in a wave phenomenon, but to this there are serious objections and it is not discussed at length in his present work. Another suggestion was published in his report to the Fifth Solvay Congress and may be called the theory of the pilot wave. The wave is considered as a reality and as occupying a certain region of space, while the particle is regarded as a material point having a definite position in the wave which serves to guide it on its way. This view also meets with serious difficulties and can only be retained by giving it a modified form.

Schrödinger attempted to interpret his field scalar, ψ, by connecting it with the density of electrical charge, and in dealing with the one-electron problem he obtained striking results by making the product of ψ and $\overline{\psi}$, the conjugate complex quantity, proportional to an electric

density. It is, however, difficult to see how this is to be generalised so as to apply to the case of many electrons. Sommerfeld refers to the view that the charge of the electron is continuously distributed in space as a somewhat unattractive hypothesis, and says: "We refuse from the outset to take literally the charge-cloud to which Schrödinger's theory leads. Rather we shall retain the well-founded view that the electron is point-like in form or at any rate is a configuration of sub-atomic dimensions." He concludes that the charge-cloud can have only a statistical meaning. "Giving up the idea of individual orbits we regard the charge-cloud as the sum total of possible paths of the electron and imagine the average time of stay of the electron in each individual position as determined by the charge-density at that point." On this statistical view, first given a logical basis in the papers of Born, the wave becomes no more than a purely symbolic and analytic representation of certain probabilities, and no longer constitutes a physical phenomenon in the old meaning of the term.

There seems to be little doubt now that the statistical interpretation, unwelcome though it may be, lies closer to the real truth than the earlier suggestion. It has the advantage that it harmonises with the "uncertainty principle" of Heisenberg, for Bohr has shown how the interplay of wave and particle concepts may be closely related to the lack of precision which is inherent in all physical measurements, and how the mathematical formulation is an expression of this unavoidable uncertainty. In conformity with this view, the ψ-function itself is only a mathematical auxiliary quantity, and it is its *Norm* (the German expression for the square of the absolute value), when multiplied by e, that has a real physical meaning, namely, the density of charge. In the same way, the electromagnetic field intensities, which satisfy the differential equations of Maxwell, may also be regarded as mathematical auxiliary quantities introduced for calculating the actual physical relationships between the energy and the motion.

As Dirac has pointed out, the trend of modern theory makes things less easy for the learner of physics. "The new theories, if one looks apart from their mathematical setting, are built up from physical concepts which cannot be explained in terms of things previously known to the student, which cannot even be explained adequately in words at all"!

All those who attempt to follow with halting steps the strides made by the expounders of the new wave mechanics will welcome these two volumes. The translators and the publishers are to be congratulated on the accomplishment of such imporant work, and many English readers will be grateful to Dr. Brose for providing at the end of Sommerfeld's book a list of German expressions and their English equivalents.

H. S. Allen.

Experimental Research on Cancer.

Some Aspects of the Cancer Problem: an Account of Researches into the Nature and Control of Malignant Disease commenced in the University of Liverpool in 1905, and continued by the Liverpool Medical Research Organization (formerly the Liverpool Cancer Committee), together with some of the Scientific Papers that have been published. Edited by Dr. W. Blair Bell. Pp. xiv + 543 + 90 plates. (London: Baillière, Tindall and Cox, 1930.) 63*s.* net.

THE aims and objects of this book are clearly set out on the title-page, and the work of the Liverpool Medical Research Organization is sufficiently well known to medical and pathological readers to need no introduction here. Since practically the whole of the contents have appeared previously in various scientific and medical journals, it will not be necesary to review the work in detail. Speaking generally, it may be said that this large volume is in the nature of an *apologia pro vita sua* on the part of the director and the Organization as a whole, and it concludes with an earnest plea for more financial assistance so that the work may go on.

As is the case when claims are made for therapeutic measures in malignant disease, this Organization has in the past encountered a great deal of criticism and hostility. It is well known by those attending meetings in recent years that the attacks have frequently been made with extreme bitterness, so that to disinterested observers it has appeared that whilst scientific problems have been forgotten, personalities have held the day. It naturally occurs, therefore, to look through the book to see what Prof. Blair Bell has to say to his enemies. The author or editor of a monograph has had a wonderful opportunity of hitting back at his attackers without their being able to reply except by publishing another monograph, but one is struck by the fact that Prof. Blair Bell entirely avoids personalities and does not in the least take advantage of his position as editor of the volume. One must admire the fairness of the editor's mind and

congratulate him on overcoming what must have been a severe temptation. Briefly, the contents of the book are as follows :

First, the introduction leads up to the hypothesis of the Liverpool school that malignant disease is similar to chorion in its power of invading normal tissues. From this the whole thesis is built up, and the editor points out that the adoption of lead as a therapeutic agent was due to the well-known fact that this metal causes abortion, possibly by destroying the chorion epithelium. It follows naturally that there must be a great many pitfalls in so wide a type of argument, and it must be admitted, at least by the reviewer, that the collected papers which appear in the later sections of the book do not altogether allay the various doubts arising in the mind. The first series of papers is concerned with physico-chemical considerations on cell membranes by a group of workers under Prof. Lewis. The majority of these observations are of a negative type; for example, the hydrogen ion concentration of the blood in cancer is shown not to differ from that of ordinary blood.

Then follows a long series of investigations by a group of biochemists on the measurement of the metabolism of isolated tissues, working with the methods of Prof. Otto Warburg. It will be remembered that Prof. Warburg showed the widespread nature of the property of glycolysis—conversion of carbohydrate to lactic acid—in all classes of tissues in the absence of oxygen. Only certain kinds of tissue, however, are able to continue producing lactic acid when they are placed in oxygen. At first the suggestion was made that this property was characteristic of tumour tissue, but recent work has made untenable this view of aerobic glycolysis as a specific defect in tumour tissue. Warburg himself, in a paper translated in the volume under review, recognises this fact. This being so, the somewhat elaborate investigations on the metabolism of chorionic epithelium lose some of their interest. Certainly, the fact that chorion has a positive 'U-value' is no criterion of its supposed malignancy, since it is now generally agreed that there are a number of examples of malignant tissues with negative 'U-value', and that this classification is unsound and must therefore be abandoned.

Metabolic studies designed to show the possible mechanism of the action of lead on tissue glycolysis are also included. The fact is recorded that minute concentrations of lead may actually increase tissue glycolysis. Otherwise there appears to be little difference between the action of lead and any other heavy metal. The poisonous effect of heavy metals on enzyme action is a well-known phenomenon, and we cannot agree with the statement on pp. 69-70 that hitherto the actions of poisons on enzyme action have not been found to follow a unimolecular law. In fact, several frequently quoted examples, such as the experiments of Euler and Svanberg on poisoning of saccharase action by aniline, come to mind.

Certainly, therefore, the metabolic measurements, whilst of some interest considered on their own merits, do little to support the general theme with which the book is concerned, namely, the treatment of cancer with lead preparations. There is no evidence from metabolic measurements that the action of lead is exceptionally valuable in destroying the cancer cell by depriving it of the energy necessary for its growth, under conditions where it does not also damage normal tissues to at least the same extent. In addition, the effect of lead in this respect does not differ from that of other metals (p. 511).

This section is followed by a long series of pharmacological observations on lead, the preparation of suspensions and colloidal solutions of the metal, and some observations on organic lead compounds. The changes in the blood during lead therapy are also described at length, and the latter part of the book is concerned with the treatment of cases. Perhaps the most interesting part of the whole work appears on p. 458, where the editor has set out in tabular form the results of their treatment from November 1920 to November 1928. In all, 566 cases were treated, but of these 360 died before the treatment could be completed and a further 77 after the treatment. Various others died of concurrent infections, and some refused treatment. Of the remainder, it is believed that 2 were completely cured but died of other affections later, whilst in 12 the disease was completely arrested, and in 51 the Organization considered the cure had been complete. This tabulating of the results is undoubtedly the most valuable part of the book, as it will enable future investigators to judge whether the risks, etc., of the treatment are justifiable.

In conclusion, a word of praise must be said concerning the general lay-out of the book. The indexing is very good from the point of view of both reference and subjects ; the amount of work involved in collecting the reprints, etc., must have been very great indeed. As to whether the book will be of permanent value and so justify all this reprinting, time alone will prove. The general impression given by reading the work is that the

investigators have strained every argument to support their theory, with the result that in many instances they would rather appear to beg the question. For example, on p. 511 the author does not appear to be quite clear about the Aschheim and Zondek test for pregnancy. Whilst it is true that the presence of a growth-promoting hormone has been noted in the urine in certain cases of cancer (among many other conditions) by these authors, the same principle is not that upon which the pregnacy test is based. This latter test is dependent upon the demonstration of the presence of a luteinising hormone affecting the ovaries and having no effect on general bodily growth in experimental animals. The use of this, therefore, to assist the argument for an analogy between pregnancy and cancer, loses much of its point.

As no general review of modern cancer research work would be complete without a consideration of the work at Liverpool, this volume, in presenting the view of the Liverpool school up-to-date, is of considerable value.

Mathematical Physics.

(1) *Foundations of Potential Theory.* By Prof. O. D. Kellogg. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 31.) Pp. ix + 384. (Berlin: Julius Springer, 1929.) 19·60 gold marks.

(2) *The Electromagnetic Field.* By Max Mason and Warren Weaver. Pp. xiii + 390. (Chicago: University of Chicago Press; London: Cambridge University Press, 1929.) 27*s.* net.

THE scope and quality of the two works under review are very different, but they are both concerned with branches of theoretical physics, and attack them rather from the point of view of the pure mathematician. This raises an important question of pedagogy, on which there may be differences of opinion. In introducing the differential calculus, for example, is it best to base it on crude ideas about the tangents of curves, or should we begin with the full machinery of the theory of limits? Most teachers adopt the former course, for the reason that it quickly opens out wide ranges for application, whereas, though the logical introduction may sharpen the student's faculties, he may become so busy suspecting the soundness of all the ordinary mathematical processes that he will never learn why anyone should ever want to differentiate anything.

The same divergence applies with even more force to the subjects of theoretical physics. The theory of attractions was developed to study such things as the figure of the earth and the electrical capacity of condensers, and most students learn it for such purposes. The teacher therefore aims at a rapid introduction, making the results appear reasonable to common sense, and opening the subject up as fast as possible so as to show the applications. If this is to be done, it is not admissible to enter into the noble sport of axiom-chasing, but the consequence is that every teacher will remember some clever student who objects to the looseness of the presentation. The student is really experiencing the inherent difficulties of the subject itself, but in trying to puzzle them out has found the weakness of the argument, and naturally blames that. Such troubles should be removed as soon as they are felt, but this is a different thing from carrying the whole exposition through rigorously from the start; for to do that would be to suggest many other difficulties the student has not yet perceived, which will give him far less trouble later when he is more familiar with the whole subject. The present works will find a most useful place in this way as commentaries to be read by a student who has already gained some knowledge of the subjects but has the tidy mind which cannot for a moment tolerate results, however reasonable, unless he can follow every logical step in their derivation.

(1) Prof. Kellogg has written so admirable a book on gravitational attractions that the above comments are perhaps a little ungracious to him. The excuse for them lies in a certain disparity between the first and the last part of the book. Thus the beginner will find that the first three chapters, and a few other parts of the book, will give him all that he needs for an elementary knowledge of the principles of potential theory. But interspersed with this he will find rigorous proofs of such things as Green's theorem, based on the theory of sets of points and the rest of the apparatus of pure mathematics. Seeing how elaborate the discussion becomes, he will be impressed with the difficulty of the subject, and there is a danger that he will think that this difficulty extends to all the applications. On the other hand, the advanced student, who will be a pure mathematician and not a physicist, will not want to waste his time over the elementary part, but will go right on to the rigorous proofs, integral equations, and existence theorems which constitute the important part of the book.

Among all this excellent matter we may single out as of special interest the historical account in

the last two chapters of the various attacks on the fundamental existence theorem. This is a brilliant piece of work, which describes and criticises the successive attempts to prove the existence of the potential, and their limitations; it will be of great interest to those who are not specialists in potential theory as well as to the experts.

(2) The book of Messrs. Mason and Weaver does not contain any such advanced mathematical theory, but is a straightforward working out of the ordinary principles of elementary electrical theory with a careful analysis of the postulates involved. It falls into four chapters, each of which enters in detail into the principles concerned and also gives many useful examples. The first two traverse the subject of electrostatics. We may single out one point in the treatment which is superior to that of most text-books, and this is the early introduction of the idea that the potential may have a discontinuity at the surface of a conductor; much of the confusion of thought about the Volta effect arises from the unwarranted assumption, made in most elementary treatises, that the potential of the conductor is the same as that just outside. The third chapter, on magnetism, is novel in that it takes as starting-point the magnetic interaction of electric currents, instead of beginning with permanent magnets. Consequently the vector potential comes in very early, and its curl, the magnetic induction, becomes more fundamental than the magnetic force. The last chapter discusses the field equations of Maxwell in the same detailed manner.

We may only comment on a rather vehement dislike expressed for the ether, which has an old-fashioned flavour. The ether is now usually only regarded as 'the subject of the verb to undulate', and should have passed into a state where it is beyond the passions. The work goes perhaps a little too slowly to be used as an introduction to electrical theory, but it may be recommended for students who were not contented by their first reading of the subject, and especially for those who are more interested in logical principles than in the applications.

Small Talk about Linnæus.

Linné und Berlin. Von Felix Bryk. Berliner Festschrift zu Linné's Hundertfünfzigstem Todestage, 1778–1928. Pp. xv + 59. (Neubrandenburg: Gustav Feller, n.d.) n.p.

THIS seems to be a publication intended for the collector rather than for that large circle which is genuinely interested in the scientific work of Linné. The title scarcely indicates either its subject or the variety of curious and entertaining matter which the booklet contains. It expresses indeed little more than the fact that the hundred-and-fiftieth anniversary of Linné's death, in 1928, was celebrated more in Berlin than in any other place, and that an article on Linné's relations with Berlin, which Dr. Bryk of Stockholm wrote for the *Berliner Tageblatt*, but which did not appear, is now first published. The editor, C. L. Hansen, has, however, included the address Linné as artist, delivered on that occasion by Dr. Bryk, as well as a lecture that he gave on Linné from the bibliophil point of view.

The value of the book to the collector does not depend only on the small size of the edition, 67 copies: it will be prized also for its facsimiles of Linné's diploma from the Berlin Academy (signed, be it noted, by two Frenchmen, Maupertuis and Formey), Linné's letter of acknowledgment to Formey, and Linné's original sketch for his arms; also, possibly, for the facsimile of part of the proof of the *Berliner Tageblatt* article. None of these has been published previously. Other facsimiles comprise the notification of Linné's death and numerous rough drawings by Linné himself, among which the most notable is the diagram of an egg in section, intended for his arms but objected to by the herald, Tilas, who eventually admitted the egg under protest but not without the decent covering of its shell.

Linné's relations with Berlin may be summarised in the facts that Celsius, then in Berlin, got a review (written by Linné) of the "Lapland Journey" translated into Latin and published at Nuremberg; that Gronovius brought him to the notice of the Berlin Academy, with results already mentioned; and that Gleditsch confirmed Linné's views on the sexuality of plants by a notable experiment. The female palm which Gleditsch fertilised is still growing at Dahlem.

Linné's artistic sense appears not so much in the rough sketches with which he explained his meaning, as in some small head- and tail-pieces, in his care for typographic style, in his accurate appreciation of colour, and above all in his continual praise of the beauty found in Nature. He constantly urged the employment of competent scientific draughtsmen, and Archbishop Benzelius is responsible for the assertion that the Archiater knew more about painting than anyone else in Uppsala.

Linné appears as bibliophil in his formation of a private library and in the bibliographic references

contained in his "Systema Naturæ". The interest of bibliophils in Linné is due partly to the enormous literature concerning him and his work, partly to the difficulty of deciding whether certain theses were due to his pen or to that of their nominal authors, partly to the minor variations in title-pages and the like so dear to the collector, and partly to the excessive rarity of some publications. The rarest must surely be the panegyric of which my Lord Baltimore in 1780 printed only two copies. That eccentric travelled through Sweden in a carriage so large that bridges had to be widened for him to pass with his retinue, including two cooks, eight mistresses, but only one physician. His reason for perpetually travelling was that he did not wish to know where he would be buried. Let this digression serve as a sample of the entertainment to be found in Dr. Bryk's enthusiastic pages.

The booklet is well produced and is provided with three indexes: to personal names, to literature quoted, and to place-names. The only serious omission is that of a date of publication on the title-page. F. A. B.

Design and Operation of Chemical Plant.

(1) *Filtration and Filters: an Outline of the Art.* By J. A. Pickard. With a Section on the Mathematical Aspects of Filtration, by A. J. V. Underwood. Pp. 488. (London: Ernest Benn, Ltd., 1929.) 45*s*. net.

(2) *Sulphuric Acid and its Manufacture.* By Dr. H. A. Auden. Pp. viii + 231. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 16*s*. net.

(3) *A Handbook for Cane-Sugar Manufacturers and their Chemists.* By the late Dr. Guilford L. Spencer. Seventh edition, revised, re-written, and enlarged by George P. Meade. Pp. xix + 560. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 30*s*. net.

(4) *The Chemistry of Leather Manufacture.* By Dr. John Arthur Wilson. (American Chemical Society Monograph Series, No. 12.) Second edition. Vol. 2. Pp. 497-1181. (New York: The Chemical Catalog Co., Inc., 1929.) 10 dollars.

A GREAT deal of scattered information is available relating to the design and operation of chemical plant. Some of it is contained in technical pamphlets, many of them excellent, which are issued from time to time by the actual plant manufacturers; some of it appears in the form of articles in technical journals; much of it is hidden away in the plant records of the chemical manufacturer. This scattered information may usefully be collected and summarised from the point of view either of plant design or of plant operation.

Of the books under review, the first is of use to the student of plant design; the others deal more particularly with operating conditions.

(1) Mr. Pickard's volume is primarily a useful collection of some four hundred illustrations with appropriate descriptive matter, showing the types of filtering apparatus and plant that are available for dealing with the different kinds of filtering problem. The treatment adopted in the book is almost entirely descriptive; little is said about the quantitative aspect of filtration. The arrangement of the book is somewhat uneven; considerable space is given to gravity oil separators, whereas such a useful appliance as the electrostatic precipitator is barely mentioned. Nothing is said about the effect of precipitating conditions upon the filtering characteristics of the precipitate. The book contains a valuable chapter by Dr. Underwood upon the mathematical theory of filtration.

(2) Dr. Auden's work is essentially a comprehensive notebook on the subject of sulphuric acid manufacture. It is addressed primarily to the student of applied chemistry. In his treatment of the subject, the author does not seek to obtrude his viewpoint to any great extent on the reader. He is satisfied to correlate and submit the opinions and conclusions of other workers in the field, drawn from the vast amount of published data available. In giving copious references to original articles, he provides the reader with a suitable jumping-off ground for a more extended study of the subject.

Chap. xii., on the theory of the chamber process, might well be cast somewhat earlier in the book—say, in place of Chap. ii., which treats of the handling and transport of acid. In many places there is a scarcity of diagrams; in others, too little descriptive matter accompanies the diagrams submitted. These points are small, but, as the work is intended primarily for students of industrial chemistry, the first suggestion would seem an obvious advantage, while the second would prove a decided help to those whose experience of plant has yet to be obtained.

It is remarkable how much information the author has succeeded in compressing into the relatively small space of sixteen chapters and two

hundred and twenty-one pages. That he has carried out a very creditable piece of work there can be no doubt. We have no hesitation in recommending this book to all those interested in the technical development of the sulphuric acid industry.

(3) A new edition of Spencer's well-known handbook on the cane sugar industry has been issued. Five new chapters are included, dealing, respectively, with the economic phases of the sugar industry, the keeping and refining qualities of raw sugars, hydrogen ion control, colour determination in the sugar industry, and fermentation. The book is a model of what a handbook to a large industry should be. The author describes clearly and completely the kind of plant that is used at each stage of the process, and discusses fully the design and operation of each plant, both from the chemical and the chemical engineering points of view. The book might equally well form a basis for a detailed chemical engineering study of the design and lay-out of a cane sugar factory.

(4) Vol. 2 of Dr. Wilson's important treatise on leather manufacture deals from the physical chemical point of view with the practice and theory of both vegetable tanning and chrome tanning, as well as of numerous other special tanning methods. The underlying principles of the various processes to which the leather is afterwards submitted are described very clearly and in great detail. Finally, the chemical and physical properties of the finished leather are considered both from the theoretical and practical aspects.

The leather industry, although one of the oldest industries in the world, is actively developing in numerous directions, thanks to the application of physical chemistry to the investigation of its problems and processes, and this book is a first-rate account at first hand of the newest developments in leather chemistry, written by one of the leading and most active workers in this field. It is a fascinating book, not only for the leather manufacturer, but also for the physical chemist and the chemical engineer.

Dinosaurs in East Africa.

The Dinosaur in East Africa: an Account of the Giant Reptile Beds of Tendaguru, Tanganyika Territory. By Dr. John Parkinson. Pp. 192 + 12 plates. (London: H. F. and G. Witherby, 1930.) 12*s.* 6*d.* net.

IN 1907 the late Prof. E. Fraas, of Stuttgart, discovered at Tendaguru in Tanganyika Territory (then German East Africa) an extensive deposit of bones of gigantic Dinosaurs comparable with the bone-beds in which startling discoveries had already been made in Wyoming, U.S.A. From 1909 until the end of 1912, Dr. W. Janensch and Dr. E. Hennig explored this deposit with remarkable success, and made a great collection of the Dinosaurian remains which are now in the Museum für Naturkunde in Berlin. They also studied the geology of the country, and published a valuable report on the subject, showing that the African and North American formations were of about the same age and had accumulated under similar conditions. Dr. Janensch is also still publishing a series of important monographs on the skeletons as they are prepared. After the war the British Museum undertook to continue the exploration, and among those who were engaged both to collect specimens and to re-examine the geological structure of the district was Dr. John Parkinson, who had already had much experience of field-work in Africa. Dr. Parkinson not only collected materials for a scientific report, but has also prepared a popular general account of his expedition in an attractive little book which is now before us.

Dr. Parkinson deals with a technical subject in a non-technical and entertaining manner, and enlivens each chapter with apt quotations ranging from Shakespeare and Dickens to H. G. Wells. As he proceeds from one aspect of the investigation to another, he imparts to the reader some of the enthusiasm of the discoverer. In less than two hundred pages he succeeds in giving a good idea of the problems which arise for solution.

The main bone-beds of Tendaguru extend over an area about $3\frac{1}{2}$ miles from north to south and $1\frac{1}{2}$ miles from east to west. There are also outlying deposits of similar bones in the surrounding region, all dating back at least to the beginning of the Cretaceous period, some perhaps a little older. The skeletons must have been washed together by river-floods in an estuary or lagoon, which was invaded at intervals by the sea; for there are layers of sand and clay full of marine shells intercalated at intervals in the river sands and clays.

The Tendaguru Dinosaurs themselves are much the same as the Dinosaurs which have been found in the corresponding rocks in North America and elsewhere. One of them, *Gigantosaurus* or *Brachiosaurus*, is interesting as being at least as large as the largest hitherto found in North America, probably well over 100 feet long. They formed the same kind of community, with strange lack of brain-power, yet dominating the world of life.

Dr. Parkinson refers to this strange dominance, and devotes one chapter to the mode of life of the Dinosaurs, and some possible reasons for the extinction of these and all the other giant reptiles at the end of the Cretaceous period when small mammals appeared ready to take their place. He particularly refers to the effect of parasites on the existing mammals of Africa, and suggests that the known change in the flora at the end of Cretaceous times may have led to an increase in certain injurious insects. The mystery still remains, however, for the sea-reptiles disappeared as suddenly as the land-reptiles, and the pterodactyls gave place to birds.

Dr. Parkinson, in discussing the Dinosaurs, brings together much curious information which, though familiar to palæontologists, will be new to most readers; and he concludes with a bibliography which will be useful to those who wish to pursue the subject in detail. We would only add that he might well have included a reference to the late Dr. W. D. Matthew's excellent Handbook of Dinosaurs, published by the American Museum of Natural History, New York. A. S. W.

Orchids.

(1) *Orchids for the Outdoor Garden: a Descriptive List of the World's Orchids that may be grown Outdoors in the British Isles; for the Use of Amateur Gardeners.* By A. W. Darnell. Pp. xx + 467 + 22 plates. (Ashford, Kent: L. Reeve and Co., Ltd., 1930.) 42*s.* net.

(2) *Our Wild Orchids: Trails and Portraits.* By Frank Morris and Edward A. Eames. Pp. xxxi + 464 (130 plates). (New York and London: Charles Scribner's Sons, 1929.) 30*s.*

(1) THE cultivation of orchids out-of-doors has never been developed to the same extent as that of their hothouse allies, but with the increasing popularity of rock-gardening a greater interest is being taken in those species of orchids, mostly terrestrial, which can be grown in the open in Great Britain. So far only a few of the more striking European species such as *Orchis purpurea*, *O. militaris*, *Himantoglossum hircinum*, and various American species of *Cypripedium* have been cultivated at all frequently.

There are, however, many species which, judging from their native habitats, should be hardy in the British Isles and would well repay the trouble of growing them. Mr. Darnell, in the work here noticed, describes all the species which in his opinion fall into the above category. Generic descriptions are also given, while notes on distribution, habitat, time of flowering, and suggested cultural methods are added. A glossary of scientific terms and a short introductory chapter on methods of propagation and importation are also provided. Some of the more interesting species are figured.

In consequence of the wide scope of the work the number of species included is about one thousand, and it will be several years before even a tithe of them can be brought into cultivation. The book, however, should be a useful guide for anyone visiting any part of the world as to which orchids are worth collecting. Unfortunately there are few people who would be able to name the species collected in many countries even with the aid of Mr. Darnell's book. Anyone who has studied, for example, the genus *Habenaria*, of which there are 94 species included in the book, knows how difficult the species are to name even in a large and relatively complete herbarium. For many years it will be necessary to submit specimens of this and other genera mentioned to expert orchidologists in order to be sure of their identity.

Nevertheless, Mr. Darnell's book demonstrates in a convincing manner what a wealth of orchids there is available for growth out-of-doors in Great Britain, and should encourage those interested in gardening to endeavour to introduce as many as possible of such species. When growing, these may be studied more thoroughly by taxonomists than is possible from herbarium specimens alone. Our greater knowledge of the hothouse species can be attributed directly to such study in the living condition.

(2) The fascination which orchids have for the amateur in almost every country is no doubt bound up with the remarkable form and intricate structure of their flowers. For the same reason pictures of orchids are usually relatively more valuable than those of other plants since orchids are more difficult to describe adequately in words. Consequently by obtaining photographs of all the species of orchids growing in eastern North America, the authors of the present volume are rendering a considerable service to science.

However, the photographs, which might with advantage have been taken on an even larger scale, are only a portion of the book. Each species is described shortly and its popular names are given, while detailed notes on habitat, distribution, and flowering period are provided. The bulk of the book is taken up by accounts of the authors' searches for the various species, their adventures

on the way, and their final successes, often accompanied by charming pen-pictures of the areas visited and of the orchids themselves. The photographs, several of which are coloured, are all taken in the field, and therefore show effectively the natural habitat of each species. Keys to the genera and species are supplied at the end, together with a glossary of scientific terms used. The features mentioned above, together with the excellent format, render the book a useful and attractive addition to any botanical library. V. S. S.

Classification of Ore Deposits.

Ore Deposits of Magmatic Origin: their Genesis and Natural Classification. By Prof. Dr. Paul Niggli. Translated from the original German edition by Dr. H. C. Boydell. Revised and supplemented throughout by Dr. Niggli and Dr. R. L. Parker. Pp. xi + 93. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1929.) 9*s.* 6*d.* net.

PROF. NIGGLI has followed his important monograph of 1920 on the function of the volatile constituents in petrology by an interesting essay on their importance in the classification of ore deposits. He adopts the view that an ore is a rock and should be studied as such, and that "ore deposition is a part problem of magmatic differentiation in its widest sense". He regards as magmatic all products that arise originally from the interior of the earth, and holds that "magmatic processes are to no small extent involved in the formation" of even such materials as glass sands and those used for cement and pottery. He divides magmatic products into three kinds: the orthomagmatic, or directly igneous, to which some authorities limit the term; the pegmatitic-pneumatolytic; and the hydrothermal. He remarks that the meaning of the term pneumatolytic has been altered, since it was proposed by Bunsen for volcanic exhalations; but as the essential agent, according to Bunsen's conception, is superheated steam, the modern development seems justifiable. The author's introduction of the term orthomagmatic is useful, as its adoption would avoid the ambiguity as to the implication of the term magmatic.

The author is a master of the principles of physical chemistry, and his treatment of ore formation is throughout clear, though technical, and suggestive. He introduces many new terms, such as 'exogeospheric' for the processes of the atmosphere and lithosphere, and 'endogeospheric' for those of the interior, and 'telemagmatic' for operations that take place remote from the site of the magma.

The author lays stress on the threefold division of ores, based on depth and nature of formation, on geological age, and on geographical distribution. He applies to ores his well-known views on petrographic provinces, and adopts Pacific and Mediterranean groups of ores. That those terms are not used in a strictly geographical sense is shown by the remark that there are many Pacific provinces. His classification develops the well-established gradual passage from the deep-seated orthomagmatic to the superficial or hydrothermal ore deposits. He differs from many economic geologists in his conclusion that "complete sequences of ore deposits are connected with folding movements". He explains the poverty of the Alps in ore deposits as due to the movements which made the mountains having been promptly followed by the sinking of the area as a geosynclinal. There is much to be said for the alternative view that the ascent of the hydrothermal solutions takes place mainly along deep-seated normal faults in regions of tension.

The book refers briefly to a large number of ore deposits and there are naturally a few slips, such as the pre-Cambrian age of those of Mount Lyell, and reference to the titaniferous iron ore of Taberg in Sweden as an example of an orthomagmatic ore of great economic importance.

The careful translation by Dr. H. C. Boydell has been revised and supplemented by Prof. Niggli and Dr. Parker.

Peruvian Antiquities.

Dress and Ornaments in Ancient Peru: Archæological and Historical Studies. By Gösta Montell. Pp. viii + 262 + 3 plates. (Göteborg: Elanders Boktryckeri A.-B.; London: Oxford University Press, 1929.) 15*s.* net.

IT is characteristic of the cosmopolitan learning of our time that this study in Peruvian antiquity should be prepared at Gothenburg, translated into English, and published, with a generous Swedish subsidy, by the Oxford University Press. Besides the splendid ethnographical museum in Gothenburg over which Erland Nordenskiöld presides, more than a score of other museums and galleries have contributed material and illustrations.

For the cultures which preceded the Inca régime, the material is mainly archæological. A sufficient number of actual garments have been preserved by

dry climate, in early graves, to control the interpretation of the vividly pictorial art of the contemporary potters, not only as to the decoration of the clothing, but even as to its shapes and construction. The modelled and painted Chicama pottery is naturally the most eloquent, but the modelled black-ware from the Lambayeque and Trujillo districts contributes much interesting detail. Headgear, head-ornaments, and hairdressing are, of course, included in the survey; and the difficult question (p. 92) whether tattooing coexisted with face-painting is settled by Dr. Folke Henschen's examination of a piece of mummified skin, which shows dead black "exogenous pigmentation, arisen during life, that is to say, the result of tattooing", though he has not been able to identify the pigment chemically. Its resemblance to coal-dust pigment, in the human lung, supports the obvious guess that soot was used.

For the Inca period, and especially for the culture of the Inca-folk themselves, the evidence is different. The damp climate of the Andes has wrecked most of the original garments, and apparently the pottery does not clearly distinguish between pre-Incan costume and Incan. But the Spanish descriptions, referring, as they do, to the higher ranks of society mainly, and consequently reproducing Inca habits, supply the deficiency of archæological material. Especially valuable, both for garments and for textile processes, are the naïve sketches in Huaman Poma de Ayala's manuscript. Another curious source of evidence is in the myths which describe the divine institution of certain venerable and unalterable costumes; and it is probable that this conservatism, as well as the skilled workmanship noted on p. 195, explains the "surprising consistency in the measurements of Inca shirts found in graves in the highlands, where more clothing was worn and conditions were more favourable for its preservation".

Numerous excellent illustrations and a full bibliography add greatly to the usefulness of this careful and well-written memoir.

Species-Hybrids in Plants.

Artbastarde bei Pflanzen. Von O. Renner. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Lieferung 7, Band 2.) Pp. iv + 161. (Berlin: Gebrüder Borntraeger, 1929.) 28 gold marks.

THE eighteenth-century hybridisers—Kölreuter, Knight, Sageret, Gärtner—studied almost exclusively interspecific crosses, although Sageret, like Mendel, gave his attention to pairs of contrasted characters. This method of choosing the most complicated rather then the simplest cases in investigating the laws of heredity continued largely in vogue, with the great exception of Mendel, until near the end of the nineteenth century, and retarded for at least half a century the understanding of these laws. Following the rediscovery of the Mendelian analysis, investigators for many years dealt with variety differences, mainly in domesticated plants and animals. But with elucidation of the Mendelian principles, research on species-hybrids soon began again in such work as that of Baur on *Antirrhinum* and of East on *Nicotiana*. Later genetical work has drifted more and more into the investigation of genera by crossing and cytological study of their species.

This application of the Mendelian weapon to the more complicated problems of specific structure and relationship, in conjunction with chromosome study, together with taxonomic and distributional treatment, is one of the newer and most promising lines of development in genetics. Such studies have already led to important results, and are bringing us to new points of view in phylogeny and evolution.

Prof. Renner has done a valuable service to biology in summarising this recent genetical work on species-hybrids in plants. The first section of his book deals with the F_1 phenotypes, including intermediate hybrids, cases of unlike reciprocal hybrids (especially in *Œnothera*, *Epilobium*, and *Digitalis*), multiformity and vegetative segregation in the first generation. The structure of the pollen, the chromatophores and the chromosomes of such hybrids is discussed, as well as questions of hybrid vigour (heterosis), dwarfing, new formations, and sterility in these forms.

In another section the methods of reproduction and the offspring of species-hybrids are considered at length, including their chromosome behaviour during meiosis. A short chapter is concerned with the cases, mostly quite recent, where a constant hybrid has been produced through a doubling in its chromosomes. Here are cited *Œnothera gigas* and *Primula kewensis*, as well as cases in *Rosa*, *Nicotiana*, *Ægilops-Triticum*, *Raphanus-Brassica*, *Papaver*, *Crepis*, etc.

A final page only is devoted to species-crossing in Nature. This section could have been profitably much extended, but perhaps deserves separate treatment. Following the extensive bibliography there is unfortunately no index.

R. Ruggles Gates.

Our Bookshelf.

Archæology and Ethnology.

Akan-Ashanti Folk-Tales. Collected and translated by Capt. R. S. Rattray. Pp. xx + 276 + 12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 21*s.* net.

With this volume of folk-tales, Capt. Rattray completes a series of four works in which the customs, laws, and beliefs of the people of Ashanti have been surveyed. It is by no means the least valuable of the series, for in these stories the mentality of the people is revealed, more artlessly perhaps, but by no means less effectually, than in the analytical studies of the more formal investigations. These *Märchen* have been taken down in the actual words of the narrators just as they were told around the fire at night in the villages. Facing each page of native text on the opposite page is Capt. Rattray's translation, the incidents and persons of the tales being illustrated by drawings by native draughtsmen.

The translation has been made as literal as possible, allowing for the difference of idiom, but without altering the spirit and style of the original. All the tales have members of the animal world for their characters and, as usual, a large proportion are etiological. Although known generically to the native as *Ananse* stories, the spider (*ananse*) is not the hero of each. The stories in which the spider figures are, however, the most spirited and the most humorous. It is interesting to note that this prominence of the spider survives in the *Anancy* of some collections of stories told by American negroes.

Some interesting points relating to the stories are raised by the author in his introduction. He discusses the reason why animals are the actors in these stories, and why a vein of coarseness runs through them which is foreign to the mode of thought and act of the people. In regard to the former, he is of the opinion that it is not due to a confusion of the human and animal world, as has been suggested, but to the fact that it permits of a greater licence than if the names of persons were used; and in regard to the second point, that the fact that the stories are related at night admits of a freedom of action in the representations which sometimes accompany the stories and in the stories themselves which is not allowed by day. Something analogous is to be observed in the apologetic remarks prefacing the stories and in the text signifying that what follows is not to be taken too seriously.

The Archæology of Middlesex and London. By C. E. Vulliamy. (The County Archæologies.) Pp. xx + 308 + 12 plates. (London: Methuen and Co., Ltd., 1930.) 10*s.* 6*d.* net.

This volume inaugurates a new series of County Archæologies of which the general editor is Mr. T. D. Kendrick of the British Museum. The need for such a series has doubtless been felt by many students for some time. Although the archæological sections of the Victoria County Histories are still invaluable, it is many years since most of them were written. During the last decade many new facts have accumulated; and fresh interpretation of the facts has profoundly modified many views on the prehistory of Britain.

Mr. C. E. Vulliamy's volume deals with the County of Middlesex and that part of the modern county of London that lies north of the Thames. The area is one which presents special difficulties from both the geological and the archæological points of view—not the least being the fact that a large proportion is under bricks and mortar, and direct evidence is obtainable only at haphazard as excavations for building and other works allow. Hence reconstruction is based to a great extent on museum material—too often, especially when in, or after having passed through, private hands accompanied by inadequate and imperfect data of origin and conditions of discovery. Much of the material also has been dredged from the Thames, and therefore affords little direct evidence bearing on archæological problems. There are also gaps in the time-series in respect of London itself. On this account Mr. Vulliamy sets aside the arguments which have been adduced for a Celtic settlement prior to the Roman, and concludes that is was practically deserted for some time after they left. Mr. Vulliamy makes no attempt to ignore all these difficulties; but this only serves to enhance the value of a book which promises well for the future of the series.

Minoans, Philistines and Greeks, B.C. 1400–900. By A. R. Burn. (The History of Civilization Series.) Pp. xv + 273 + 16 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1930.) 15*s.* net.

It is scarcely necessary to stress the difficulties which Mr. Burn has had to overcome in attempting a continuous narrative of events in the eastern Mediterranean between B.C. 1400 and 900, that is, from the supremacy of Minoan Crete to the entry of the Dorians into the Greek world. There is, as he says, "in all human history, no period, no subject either of greater interest or of more profound importance". It would be almost equally true to say there is no period which offers more moot points for diversity of opinion.

Mr. Burn has divided his book into two parts. In the first certain controversial matters are discussed as necessary prolegomena—archæology and the legends, the Homeric question, the language problem, the origin of the Achæans, chronology and the like. For his second part—the narrative—the author claims no originality, and apologises for his temerity in trying to do what is not even attempted in the "Cambridge Ancient History". His fears are unfounded. Not only has he produced an eminently readable and interesting story, but also his wide knowledge of the facts and his critical

ability in handling the evidence enable him to make out a good case for his views on controversial matters. For those who are not specialists in Mediterranean archæology he has produced a narrative which will serve as the necessary framework for the appreciation of opposing arguments on questions in suspense. The free use made of the evidence from legends is eminently skilful and ingenious, in fact, a valuable demonstration of the legitimate employment of this somewhat elusive source.

A Scheme of Babylonian Chronology: from the Flood to the Fall of Nineveh; with Notes thereon, including Notes on Egyptian and Biblical Chronology. By Duncan Macnaughton. Pp. xii + 189. (London: Luzac and Co., 1930.) 7*s.* 6*d.*

An adequate commentary on this book would require a space as great as its text. The author apologises for his temerity in putting forward his theories, and excuses himself on the ground that he has no reputation to lose. He has, in any case, produced a stimulating book in which many of the arguments, astronomical, astrological, and chronological, are suggestive in that they frequently open up a new point of view on a vexed problem. It is interesting to note that he finds, for example, that the flood began on Jan. 6, 3181 B.C. in the Julian Calendar; that Hammurabi's reign falls considerably earlier than is usually held; and that Abraham was born not earlier than 2275 B.C. and not later than 2100, and in any case did not live in the reign of Hammurabi as is generally thought. Another interesting suggestion is that the Hebrew story of the Flood is an independent version, having originated in the Armenian mountains, and thus accounting for the fact that the Babylonian Flood began two days earlier. The fabulous number of years assigned to early dynasties by Berosus is ingeniously interpreted to bring them within a reasonable compass—perhaps the most pregnant suggestion in the whole book.

Astronomy.

The Magic of the Stars. By Maurice Maeterlinck. Translated by Alfred Sutro. Pp. 155. (London: George Allen and Unwin, Ltd., 1930.) 6*s.* net.

A book by a writer with the reputation of M. Maeterlinck must be approached with respect, but to be quite frank we must say that we have left this little volume with our respect greatly diminished. The book is partly an exposition of the latest views of astronomers and physicists on the more general problems of astrophysics, and partly an account of the author's own mystical ideas. Our objections to it are two: namely, that the exposition contains far more inaccurate than accurate statements, and secondly, that the science and mysticism—between which no connexion is shown—are so intermingled that the unenlightened reader cannot tell what is a generally accepted conclusion of science and what a fancy of the author's. It is easy, and generally idle, to quibble at inaccuracies of detail in a book by a non-specialist, and the criticism is particularly futile when the argument of the book requires only the broader aspects of science. We should not raise the matter here if the science in the book were merely the basis on which the mysticism was built, but it is not. It is definitely in the form of an exposition, intended to instruct the ignorant simply for the sake of instruction. When, therefore, we find the author frequently wrong in his statements, and, further, using scientific terms in that indefinite and 'woolly' sense which is fatal to clear thinking, we feel that protest is not only justified but necessary.

Our second objection also must be protected against misunderstanding. We do not object to mysticism, or even to M. Maeterlinck's particular brand of mysticism, although we may not find ourselves able to accept it. What we do dissent from is the random association of ideas arrived at by the scientific method with ideas conceived in some other way. It is profitless and confusing to mix ordinary geological facts and arguments with the notion that the earth is a conscious intelligent being with a purpose in view. When Tyl-tyl says: "There are no dead", we are impressed, but when we read, in an account of the universe of the astronomer, that "there are, strictly speaking, no dead and no cemeteries", we are simply irritated. Books of this kind can have no effect but a harmful one, and we hope that M. Maeterlinck's example will not be followed by other writers with metaphysical doctrines which they wish to impart.

H. D.

Modern Cosmologies: a Historical Sketch of Researches and Theories concerning the Structure of the Universe. By Dr. Hector Macpherson. Pp. vii + 131 + 12 plates. (London: Oxford University Press, 1929.) 7*s.* 6*d.* net.

This little book is a companion volume to the author's 'Modern Astronomy' published a few years ago. It consists of eight lectures delivered under the 'David Elder' foundation in the Royal Technical College, Glasgow, during the winter of 1928–29. The word 'modern' is always somewhat indefinite, and it may perhaps be well to state that, excluding an introduction on Greek ideas and a short initial chapter on the transition from the Ptolemaic to the heliocentric conception, the subject-matter ranges from the work of Herschel to that of the present day. It is treated in the main in a descriptive manner, with numerous quotations and references. There is very little independent criticism, but a conspicuous exception to this statement is found in a discussion of Sir William Herschel's cosmology, in which the author gives reasons for dissenting from the opinion of Struve and Proctor that Herschel abandoned the disc-theory of the sidereal system in his later years.

The book is well constructed and gives an excellent bird's-eye view of our present ideas on the structure of the galaxy, the local star system, and the nebulæ and star clusters. Such a summary is very welcome, but in these days of rapid advance by methods inconceivable to an earlier generation, it is perhaps even more timely that the principles employed by the astronomers of the last century in

dealing with this greatest of astronomical problems should be recalled to our memory for their validity to be re-estimated. The book is excellently illustrated, and the form in which it is reproduced makes it a pleasure to handle.

Tychonis Brahe Dani: Opera Omnia. Edidit I. L. E. Dreyer. Tomus 15. Pp. v + 54. (Hauniæ: Libraria Gyldendaliana, 1929.)

This volume completes the sumptuous and scholarly edition of the works of Tycho Brahe which Dreyer began and Ræder has completed. A monument of patriotic piety like this edition may not directly promote astronomical science, but there can be no doubt that it tends to foster an enthusiasm for the science to which Tycho Brahe devoted himself, and neither Dreyer himself nor Denmark as a whole can be charged with failing to take a full share in the progress of astronomy.

The present volume contains two short poems and an index to the whole work. Where portions have been separately indexed, references are given, but the details are not repeated. The original design was to include a bibliography and iconography, but we are told that the omission of these is made good by the copious treatment which Tycho Brahe's works and the literature which has gathered round him have received in Ehrencron-Mueller's Danish Bibliography.

One last word of thanks and congratulation is due to G. A. Hagemann and to the Carlsberg and Rask-Œrsted Institutes, the munificence of which has permitted the works to appear in a form worthy at once of the author and of the loving labour of the editors. J. K. F.

Biology.

Biology for Beginners. By Dr. E. J. Holmyard. (Dent's Modern Science Series.) Pp. vii + 172 + 8 plates. (London and Toronto: J. M. Dent and Sons, Ltd., 1930.) 2*s*.

In this little book, Dr. Holmyard has organised a very comprehensive course in biology for the pupils in the lower forms of public and other secondary schools. When examining the amount of material which receives consideration, one feels that the author has been a little too ambitious. Although, as he claims from experience, the pupils might grasp all the facts dealt with, one suspects that they might miss the wood for the trees, and it is doubtful whether they would gain a sound knowledge of the general principles of life.

The physiological aspect in biology is probably the most controversial of all. Very judicious handling, therefore, is clearly essential when presenting such a subject to young beginners. By omitting certain facts, that is, by hiding part of the truth, wrong impressions may easily be conceived. The author must plead guilty of this, in some cases. For example, he leaves his readers with the impression that all green plants manufacture starch and that the food of plants is essentially different from the food of animals. In several places, too, terms and conceptions appear which are now out-of-date. The book, unfortunately, contains several points of this nature which, though not exactly errors, might well, with advantage, have been avoided.

Many good illustrations accompany the text, and each chapter is followed by useful questions. The book would probably be more useful to pupils who have already made a still more elementary study of the subject, rather than to actual beginners. It is well written in the author's inimitable style, which makes a free use of humour as a means of maintaining interest.

Further Illustrations of British Plants. By Roger W. Butcher. Drawings by Florence E. Strudwick. Forming with Fitch's Companion Volume to Bentham's Handbook a Collection of Illustrations of most of the Species in the British Flora. Pp. vii + 476. (Ashford, Kent: L. Reeve and Co., Ltd., 1930.) 12*s*. net.

This book should prove an invaluable guide to students of the British flora. To trace the identity and relationships of a species is often a difficult problem, and, in such difficult cases, good illustrations are helpful. Illustrations, however, in many so-called handbooks, are often so poor that they are useless to the systematist. The illustrations given in this volume are distinct, and, although in most cases the whole of the plant is portrayed, many of the diagrams are accompanied by enlarged drawings of the more diagnostic features.

The Angiosperms are, of course, very fully represented among the illustrations; but a few Gymnosperms and Pteridophytes are included at the end of the book. Concise descriptions of the habit and habitat of the plant accompany each illustration.

The authors are to be congratulated on their admirable work, chiefly for its clarity and brevity, thus making possible the consideration of a large number of plants in a comparatively small volume. This work, together with Fitch's "Illustrations of the British Flora", will undoubtedly be accepted as authoritative. It has been compiled by authors who are clearly conversant with their subject, and this, together with the fact that much help has been given by specialists on various plant groups, will enable students of botany to consult it with confidence.

Chemistry.

Oxidation-Reduction Potentials. By Dr. L. Michaelis. Translated from the German Manuscript by Louis B. Flexner. (Monographs on Experimental Biology.) Pp. xii + 199. (Philadelphia and London: J. B. Lippincott Co., 1930.) 12*s*. 6*d*. net.

Prof. Michaelis's monograph is divided into two parts: in the first the theory of oxidation-reduction potentials is described, while the second is devoted to the physiologically important systems. The work may be considered the second volume of the author's "Hydrogen Ion Concentration", and the treatment stresses the relationship between oxidation-reduction potentials and hydrogen ion concentration. It provides a clearer and a thermodynamically

correct approach to cell energetics, and should lead to new investigations of the metabolism of the living cell. An oxidation is characterised by addition of oxygen or loss of hydrogen or loss of electrons, and a reduction by one of the converse processes.

In the first part, both inorganic and organic reversible oxidation-reduction systems are submitted to a mathematical exposition: in the second, the results are applied to sulphydryl and reversible respiratory systems of importance in biology; while the final chapter reviews the methods and results of measurements of the potentials in living cells. A bibliography is appended. The author does not claim an exhaustive treatment of the subject, since he does not consider our knowledge sufficiently advanced for a complete discussion of the physiological applications. The book gives an interesting and readable account of oxidation-reduction potentials, and should serve both to disseminate knowledge on the subject and to provide a stimulus to further research.

Lehrbuch der physikalischen Chemie. Von Prof. Dr. Karl Jellinek. Fünf Bände. Band 3: *Die Lehre von der statik homogener und heterogener Gasreaktionen.* Erste und zweite Auflage. Lieferung 8. Pp. 337-656. (Stuttgart: Ferdinand Enke, 1930.) 30 gold marks.

Physical chemists will welcome the appearance of a further portion of Prof. Jellinek's "Lehrbuch der physikalischen Chemie". Despite its somewhat misleading title, this part of Vol. 3 is chiefly concerned with equilibrium in liquid systems. About 30 pages are devoted to systems composed of non-electrolytes, and the remainder of the volume (270 pp.) deals with the properties of electrolytes in solution. The experimental methods for measuring conductivity, transport number, etc., are first described, followed by a thermodynamical discussion which includes a very complete account of activity coefficients and their determination. The volume concludes with an account of the modern kinetic theory of electrolytes as developed by Debye, Hückel, and Onsager. The whole is treated in the detailed and lucid manner which has characterised the earlier volumes of this valuable treatise.

Periodisches System: Geschichte und Theorie. Von Dr. Eugen Rabinowitsch und Dr. Erich Thilo. Pp. xii + 302. (Stuttgart: Ferdinand Enke, 1930.) 29 gold marks.

This book is essentially an essay on the periodic system from the point of view of modern physics. It opens with a historical account of the classification of elements; this is followed by an excellent description of the physicist's atom model, concluding with the Pauli principle and the allocation of electrons to the main and subsidiary energy levels of the atom. The evidence for the building up of the short and long periods is set out in detail and is illustrated by a large number of tables and diagrams of spectral terms. The properties of the elements and their principle compounds are then considered in the light of this physical evidence. Ionised compounds are of necessity discussed at greater length than covalent compounds, since the physical theory of the former type has proved to be more amenable to mathematical treatment.

Chemists in particular will be grateful to the authors for this useful and readable survey of the physical theory which underlies their science.

Electrical Engineering.

The Electrical Industry of Great Britain: Organization, Efficiency in Production and World Competitive Position. Pp. xvi + 233. (London: Beama Publication Department, 1929.) 42*s.* net.

This book has been prepared by the economic and statistical department of the British Electrical and Allied Manufacturers' Association; the statistical data given in it can therefore be trusted as approximately correct. It is very difficult to deduce rigorous conclusions from statistics, but some of the data given are instructive. It is interesting to note, for example, that the countries which exceed the 48 hour week convention are, in order of excess, Switzerland, Holland, Germany, and Hungary among European countries. Actually, 41·6 per cent of all Swiss employees are working in excess of 48 hours per week. Recent returns show that there are practically no unemployed in Switzerland during the summer months.

In Switzerland the 48 hour week can only be exceeded for economic reasons, such as for national security and for the countering of foreign competition at home. The result is that practically the entire Swiss engineering industry is now on the permissible maximum of 52 hours a week. Beyond 52 hours, overtime must be paid at the rate of 25 per cent extra, and not 50 per cent as in Great Britain.

Great Britain alone among the main competing countries is adhering to the exact letter of the 48 hour week. The authors consider that it would be inadvisable to advocate any reactionary move. They are in favour of establishing, with the help of cheap electricity from the grid, rural industries. They point out that in parts of Germany, particularly in Württemberg and the Black Forest, there has been a great industrial revival during the last five years, and that a large volume of applied art and furniture products are being exported from there to Great Britain.

Elektrische Gleichrichter und Ventile. Von Prof. Dr. A. Güntherschulze. Zweite erweiterte und verbesserte Auflage. Pp. iv + 330. (Berlin: Julius Springer, 1929.) 29 gold marks.

Electrical rectifiers and valves are used for converting alternating current into current which practically always pulsates in the same direction or into continuous direct current. This can be done in a great many ways, the most desirable in any given application depending on a great variety of circumstances.

In large power distributing schemes, rectifier sub-stations are used to replace small direct current generating stations. For broadcasting purposes there is a considerable demand for small rectifiers. Valves are also used for producing

high frequency current for laboratory use, for making cut-out switches, for producing alternating current having a special wave form, and for making measurements of very small alternating currents.

In the book under notice, mercury arc and mercury jet rectifiers are fully described. In addition we have good descriptions of contact, thermionic, electrolytic, and gas discharge rectifiers. In describing their action it is necessary to explain the many physical processes involved, and to get numerical relations advanced, mathematical theorems have to be employed. The author has done excellently in the space at his disposal, and the full bibliography given at the end of the book will be a great help to the researcher who wishes to probe more deeply into the subject. A list is also given of the patents which have been taken out for rectifiers, beginning with the aluminium condenser patented by Siemens and Halske in 1901.

The Theory of Electrical Artificial Lines and Filters. By A. C. Bartlett. Pp. ix+155. (London: Chapman and Hall, Ltd., 1930.) 13*s.* 6*d.* net.

All engineers who are engaged in one or other of the numerous branches of electrical communication should know something of the theory of 'repeated' networks. These networks occur in artificial transmission lines, in line balances, in filters, and in phase shifters, all of which are of increasing practical importance. This book gives a very good account of the mathematical theory of these devices. Fifty years ago it was not uncommon for physicists to consider that the theory of numbers and subjects like determinants and continued fractions might well be omitted from a scientific or engineering curriculum. This book shows that it is lucky these ideas did not prevail. The theory of determinants—the author quotes Muir's "Theory of Determinants" as a book that should be consulted—is specially useful.

The generalised 'ladder artificial line section' is best solved by using continuants, a special form of determinants.

The methods of solving difference equations are also very useful in finding solutions of the physical problems involved in these networks. The author states that the literature of the subject is now so vast that he made no attempt to give a bibliography. From the engineer's point of view, however, it would have been helpful to give references to some of the classical papers.

Geology.

Geologisches Wanderbuch der westlichen Dolomiten. Von Dr. Maria M. Ogilvie Gordon. Pp. xv+258+3 Tafeln. (Wien: G. Freytag und Berndt A.-G., 1928.) 15 gold marks.

Dr. Ogilvie Gordon's monumental treatise on the geology of the western Dolomites (see Nature, vol. 121, p. 83; 1928) has been followed by the guide-book now under review. The region is famous for the beauty of its scenery, and is visited annually by many thousands of tourists; to the geologist it is of exceptional interest, as is evidenced by the numerous classical localities (St. Cassian, Heiligkreuz, the Marmolata, the Schlern, the Seiser Alpe, etc.) that lie within it. The picturesque jagged ridges and peaks and the elevated plateaux are formed by the various dolomitic stages of the Upper Trias, while the lower stages of the Trias and the underlying Permian may be well studied on the mountain sides. Other formations are of more restricted occurrence, but Jurassic rocks are found here and there, and the Neocomian beds of the Puez Alpe, in particular, are well worth a visit. The tectonics have not the bewildering complexity of many other Alpine regions, but nevertheless present many features of interest.

The first part of the book contains a useful summary of the stratigraphy and tectonics, and is illustrated by three plates of fossils. The area is then thoroughly explored in thirty-two excursions, each occupying a full day or rather less. Most of these follow the usual marked mountain tracks, and, if equipped with a large-scale topographical map, the geologist should have little difficulty in finding the way and in locating the exposures described. No particular experience in mountaineering appears to be called for except perhaps in the excursions to the Marmolata and the Sella group. Numerous vertical sections and excellent photographs illustrate the text, while the author's detailed geological map of the area between the Fassa and Gröden valleys is inserted in a pocket at the back of the book. The profuseness of its illustrations must be held responsible for the rather high price of this work. It will undoubtedly prove a most instructive and trustworthy guide to the geology of the region.

A Textbook of Geology. Part 1: *Physical Geology*, by Prof. Louis V. Pirsson; Part 2: *Historical Geology*, by Prof. Charles Schuchert. Part 1. Third edition, revised by Prof. William M. Agar, Prof. Alan M. Bateman, Prof. Carl O. Dunbar, Prof. Richard F. Flint, Prof. Adolph Knopf, Prof. Chester R. Longwell; revision edited by Prof. Chester R. Longwell. Pp. vii+488. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 18*s.* 6*d.* net.

Pirsson's "Physical Geology" has deservedly been one of the most successful geological text-books during the last decade, although, like its many competitors, it had its weaknesses. Many of these are now removed from the very thoroughly revised edition that has recently appeared. The awkwardness of treatment involved by the former twofold division into dynamical and structural geology has been avoided by abandoning these divisions and changing the order of presentation. The treatment of stream erosion now emphasises the cycle of erosion for both humid and arid climates, and there is a new chapter on land forms in which the relations between landscape and geological structure are systematically and adequately dealt with. The chapter on volcanoes suffers from the absence of any reference to the work of Day, but is otherwise a well-written general account. The outer 2000-mile shell of the earth is regarded as 'solid', whereas the seismic evidence merely indicates that

it is rigid; there is no proof that it is crystalline below the crust. Isostasy is well treated, but recent work on near earthquakes and the crustal layers is not given. An up-to-date account of the structure of the Alps now appears. It is admitted that the cause of compressive deformation of the crust is one of the great mysteries of geology, and that it can at present be discussed only in a speculative way.

Many new illustrations have been added to the new edition, including admirable aeroplane photographs and block diagrams. Altogether the book is a well-balanced and effective presentation of a subject that is unusually difficult to deal with in an elementary way. Prof. Longwell and his collaborators have preserved the conservative spirit of the original text, clearly distinguishing between facts of observation and hypotheses of interpretation. The new edition should prove even more successful than the 1919 revision.

Structure and Surface: a Book of Field Geology. By C. Barrington Brown and F. Debenham. Pp. vii + 168. (London: Edward Arnold and Co., 1929.) 10*s*. 6*d*. net.

THIS admirable book has developed from an intention on the part of one of the authors to illustrate each of the simpler geological structures by an ideal block diagram and also by an actual example from an appropriate tract of the earth's surface. This enterprise has now been amplified by a text in which the structures and their recognition in the field are clearly discussed with special reference to the resulting land forms. The very numerous block diagrams, representing geological structures in three dimensions, are extremely effective, and give interest and vigour to a subject of which the treatment has often been woefully dull. To students of geology the book presents in a most attractive form the means of deducing from field observations many of the leading principles of structural geology and geomorphology, while for geography students it provides a sound basis for understanding intelligently the connexion between land forms and the rocks and structures out of which the surface relief has been carved. Two chapters are devoted to the construction of block diagrams, and notes on equipment and surveying instruments and field problems are added in three appendices. The book is one for which both students and teachers may well be grateful. Its production has clearly been a labour of love.

Mathematics.

Leçons sur quelques problèmes aux limites de la théorie des équations différentielles. Par Émile Picard. Rédigées par Marcel Brelot. (Cahiers scientifiques, Fascicule 5.) Pp. viii + 271. (Paris: Gauthier-Villars et Cie, 1930.) 60 francs.

IN continuation of Prof. Picard's course at the Sorbonne, this work is the third volume published in the 'Cahiers scientifiques' series. As would be expected from so distinguished an author, the book is a distinct mathematical contribution to both pure analysis and physics. The text is, for convenience, divided into two sections. The first, consisting of seven chapters, deals with ordinary differential equations which take their origin in mathematical physics. These equations in effect reduce to a study of the troublesome second order equation, and the author develops rigorously from both geometrical and analytical methods the powerful method of successive approximation. This involves an analytical consideration of the properties of certain functions, the conditions under which such functions exist in uniformly convergent series, and finally the theorem of Schmidt. The way is thus prepared for some important applications to the main problems of mathematical physics—the propagation of heat along a bar, vibrating strings, and the well-known problem of Fourier ("Œuvres", vol. 1, p. 85). The remaining chapters of Part I. are devoted to periodic integrals and infinite systems of linear algebraic equations which arise therefrom.

Part II. (Chaps. viii.-xii.) is concerned with partial differential equations. A consideration of harmonic functions, Dirichlet's problem, and the formulæ of Green and Poisson leads to a skilful extension of the contour method to that of a bounded surface. This yields greater generality in dealing with certain types of classical problems. Some instructive applications on the flow of heat in two dimensions and radiation in space are given. Finally, the equation of Fredholm and the potential functions of Laplace are studied together with some valuable deductions in analysis and physics.

The whole volume is most interesting and stimulating; it is undoubtedly a substantial contribution to the accessible literature on the theory of differential equations and their application.

The Theory of Approximation. By Prof. Dunham Jackson. (American Mathematical Society Colloquium Publications, Vol. 11.) Pp. viii + 178. (New York: American Mathematical Society, 1930.)

As the author of this work points out in his preface, "it is a brief essay in a field on which an encyclopædia might be written", namely, an investigation of the degree of approximation with which a continuous function can be represented by a polynomial of given degree.

Starting from the well-known theorems of Weierstrass on the approximate representation of a continuous function either by a polynomial or by a trigonometric sum, Prof. Jackson proceeds to prove other theorems on approximation by trigonometric sums, and then to examine the convergence of Fourier and Legendre series under the hypotheses of continuity over part of an interval, and of limited variation. Some generalisations of the principle of least squares are next discussed, and a very useful chapter follows on trigonometric interpolation in which some striking analogies between the theory of interpolation by means of trigonometric sums and by Fourier series are revealed. The interpolation formula analogous to the Féjer mean is especially interesting. In the final chapter is a very instructive introduction to the geometry of function space.

The book is excellently printed, and a welcome,

though somewhat rare, feature is the provision of an index of the principal theorems. This should prove a great advantage to the research student.

Cours d'analyse. (*Cours de l'École polytechnique.*) Par Prof. Paul Lévy. Tome 1. Pp. viii + 376. (Paris: Gauthier-Villars et Cie, 1930.) 120 francs.

THIS treatise is based primarily upon the course of analysis given by the author at l'École Polytechnique. It is divided into seven sections, each embracing from three to five chapters. The text covers the usual topics discussed in a modern study of continuous functions, namely, differential and integral calculus, theory of multiple integrals, geometrical applications of the calculus, and some elementary theory of differential equations.

Prof. Lévy has rightly insisted that the fundamental idea underlying an intelligent study of functions is the notion of growth in the value of a function and not mere formal calculus. The complete course is well planned and lucidly written, but the bulkiness of the volume renders it a little inconvenient to handle.

Miscellany.

The Drift of Civilization. By the Contributors to the fiftieth Anniversary Number of the *St. Louis Post-Dispatch*, including Charles G. Abbot, Richard E. Byrd, Albert Einstein, Guglielmo Ferrero, Sir Philip Gibbs, Maxim Gorky, Rudolf Maria Holzapfel, the Very Rev. Dean Inge, Count Hermann Keyserling, J. B. S. Haldane, Paul de Kruif, Stephen Leacock, Martin A. Nexö, Michael Pupin, James H. Robinson, Bertrand Russell, H. G. Wells. Pp. 254. (London: George Allen and Unwin, Ltd., 1930.) 7*s.* 6*d.* net.

MOST thinking people at the present time busy themselves more with questions of the future than of the past. A popular series on 'To-day and To-morrow' sells its ten thousands, while manuals of history are left to the few. The volume before us, however, will not attain great success, nor is it of much value, because it is a collection of scraps, not co-ordinated in any way and not throwing any clear light on the question which its title suggests. There is a confused flicker like the varied lights of cars and bicycles and lorries on a wet road in the dark. But it is difficult to tell where they are all going, and some of them are obviously going in opposite directions. The communist Nexö, for example, tells us that food must be found for the starving proletariat, while J. B. S. Haldane remarks on the "general prosperity which has nearly banished underfeeding as a cause of ill-health". Both statements no doubt are true in their different connexions and with different applications. The reader is therefore left to find out for himself what is the general drift of civilisation from the disconnected views of the various eminent and interesting persons who have been got together by an enterprising American newspaper. It need scarcely be said that they all have a vivid vision of something, but in each case it is just the one thing that happens to interest the particular writer, and none of them has written at sufficient length even to develop his own thesis to a general conclusion.

One can therefore only sum up impressions and temperaments, and this would lead on the whole to an optimist view in a limited field. Great things are ahead of us: great things mainly in the realm of science, power over Nature, and increased enjoyment for the masses. None of the writers speaks of any growth in spiritual depth or beauty, or of any spread of peace and quiet happiness in the world. The only one who deals at all with this side of the future—the Dean of St. Paul's—looks for another form of Protestantism as the religion of the future. The men of science, as one might expect, are the most definite and constructive; for the rest, the book ends, as it began, with a note of interrogation. F. S. M.

British Museum (*Natural History*), *Cromwell Road, London, S.W.: General Library. Place-numbers of the Societies and other Corporate Bodies issuing Serial Publications, and of the Independent Periodical Publications, with Alphabetical Indexes.* Second edition. Pp. v + 175. (London: British Museum (Natural History), 1930.) 5*s.*

SHELF lists of libraries possess a peculiar fascination for bibliographers, for the shelf list is the true catalogue of a collection. If its entries are sufficiently full, the student commands with its aid a complete bird's-eye view of a collection with a definite guide to the location of each unit. It represents all that an atlas is to the geographer or a directory to the local resident.

The present list, however, is not altogether a shelf list, though it closely resembles the shelf list type. It shows the order in which independent periodicals and institutions publishing one or more serial publications are arranged on the shelves with their distinctive call-numbers. Thus S 2418 = The United States Department of Agriculture, and S 2426 = The Smithsonian Institution. The information given, it will be noted, does not tell us whether the library possesses complete sets of the serial publications of the above bodies, or merely a selection of their publications relating more or less to natural science. The list is arranged upon geographical principles, the periodical publications of a region being grouped under the names of towns. The geographical arrangement has some administrative advantages, but for a research department classification by subjects is to be preferred.

The library appears to possess a fairly complete collection of the publications of British local natural history societies, but in specific branches of natural science, for example, botany, entomology, fish and fish culture, etc., it is singularly weak. One judges that the library serials are recruited mainly by exchange or gift, and that adequate funds for the purchase of serials are not available. If this is the case, it is to be hoped that the library will receive in future more generous treatment. Some of the deficiencies in its serial collection might be made good by judicious exchange with other

libraries—if exchange is permitted—for the present list shows that the library contains many serials which have no biological significance.

Eleutheros, or the Future of the Public Schools: a Desultory Dialogue. By J. F. Roxburgh. (To-day and To-morrow Series.) Pp. 94. (London: Kegan Paul and Co., Ltd., 1930.) 2*s.* 6*d.* net.

For several decades, educational reform has made enormous strides, with the result that the old established public schools of Britain have had their full share of the spotlight. The same era has seen many profound changes in these schools. Dr. Roxburgh, himself the headmaster of one of our public schools, has emphasised the aims of public school education in a remarkable manner. He has followed this up by defending these endeavours, and finally attempted to prove that such schools are the best.

Any attempt to criticise Dr. Roxburgh's efforts might leave an erroneous impression of the critic's bias against the methods which exist in our public schools. This would be unfortunate, for, whatever views the educationist may hold of the value of a public school education, he must agree that, in these days of uniformity and communism of method, it is refreshing to see that the public schools, in their independence, retain their personality and individuality. The author makes much of this point. However, one can neither dogmatise nor generalise in education. Wide views must be taken, and here the book is at fault, for a very narrow view of the subject has been assumed. To state, as the author does, that men who never went to anything but an elementary school were therefore never educated after fourteen, is a grave injustice to our State education.

We may or we may not agree with the tenets propounded in the book; but it is well worth reading, for the author has adopted the age-old dialogue style. This, at any rate, enables us to maintain an interrogative interest, thus continually asking ourselves, 'Are we agreed?'

Romance of the Machine. By Michael Pupin. Pp. v+111. (New York and London: Charles Scribner's Sons, 1930.) 4*s.* 6*d.* net.

More than fifty years ago, Prof. Pupin arrived in New York from Serbia, a mere boy unacquainted with the English language and almost penniless; to-day he enjoys both wealth and distinction. Like thousands of others from the Old World, he found the United States to be the land of opportunities of which he was not slow to take advantage. Supporting himself by lessons in wrestling and boxing, he entered on a course of study which ultimately led him to a chair in Columbia University. With teaching he combined invention, and he is known for one of the greatest improvements in telephony.

With Prof. Pupin's success has come an unfailing admiration for the constitution and ideals of the country of his adoption, and in the little book under notice he takes up the cudgels against the critics of 'machine civilisation'; endeavours to show how the telegraph, the telephone, broadcasting, and the automobile have assisted in the "Consolidation of the Union"; and tells us something of the telephone industry, "the largest and most perfectly co-ordinated industrial organisation in the world". His picture of "the roads blocked for many miles", which "makes one believe that every family in New York has an automobile, and that they are all out for a pleasure drive", will not appeal to all alike, but we are at one with Prof. Pupin in his hope that the telephone, the telegraph, the vacuum-tube oscillator, and the aeroplane "will aid in the art of cultivating international friendships". As for America's share in discovery, we like to recall Lord Playfair's remark that "science has no country though its investigators have birthplaces".

A Hundred Years of Publishing: being the Story of Chapman and Hall, Ltd. By Arthur Waugh. Pp. xvii+326+50 plates. (London: Chapman and Hall, Ltd., 1930.) 15*s.* net.

Dickens, Trollope, and Carlyle, with Meredith figuring both as client of and reader to the house of Chapman and Hall—these are the names which will attract lovers of books to this work. The story of Dickens's relations with his publishers and of his love of gain at a time when he was in comfortable circumstances is a painful one. Mr. Waugh's narrative, however, is written in a large spirit of charity and forbearance towards all who served the firm whether as clients, clerks, readers, or managers.

The work, which is well illustrated with portraits and facsimiles, is not a mere chronicle of the output and fortunes of the firm. It is relieved by disquisitions on the successive changes which have taken place in the book trade from the time when publisher and bookseller were one down to present-day conditions. Within this period revolutionary changes have taken place, and the organisation of the publishing trade has become more complex and its business more speculative. The costs of publication have materially increased, and these costs cannot in all cases be passed on to the public in the shape of correspondingly enhanced prices. The chapters dealing with the new phases of publishing and book distribution are based upon competent authorities and add considerably to the value of the book. The work will be read with interest, and should find a permanent place upon the shelves of all concerned in the history of book production.

A Bibliography of Persia. By Lieut.-Col. Sir Arnold Wilson. Pp. x+253. (Oxford: Clarendon Press; London: Oxford University Press, 1930.) 20*s.* net.

When Lord Curzon published his classical volumes upon "Persia and the Persian Question", it was his intention to add a third volume dealing with the bibliography of works about that country, but for obvious reasons this intention was never carried out. Sir Arnold Wilson has now partly supplied the desideratum by assembling in aphabetical order the names of the authors of some 6500 titles, including translations in European languages of original

Persian books and writings. From among this great mass of material the scientific specialist may pick out many details of special interest to himself, whether relating to such topics as the geology of oil-fields or local flora or to other matters, but his labour will be great until the work is completed by the addition of an analytical subject index. Among omissions we note the very informative "Quarterly Papers" of the 'Archbishop's Mission to the Assyrian Christians' at Urmi that were issued from 1890 until 1910; also R. Levy's "Bustan" and others. It would be helpful if well-known guide-books such as Murray's Handbook to Persia were entered under the name of the publisher as well as under that of the less familiar author. A brief chronological list of survey maps would also be a most useful addition. R. T. G.

Paint, Powder and Patches: a Handbook of Make-up for Stage and Carnival. By H. Stanley Redgrove and Gilbert A. Foan. Pp. xi + 170 + 16 plates. (London: William Heinemann (Medical Books), Ltd., 1930.) 7*s.* 6*d.* net.

This book gives a detailed and practical account of the art of 'making-up', both as regards the materials and technique. The authors claim that it is the first of its kind in which the subject is treated in a complete manner. Although addressed mainly to hairdressers who wish to become experts in the art of making-up, it will, as the authors point out, prove very useful to amateurs in theatrical performances, and many teachers may find it useful from this point of view. It is well written and illustrated, and gives a very large amount of information in a small compass.

Physics.

Magnetism. By Dr. Edmund C. Stoner. (Methuen's Monographs on Physical Subjects.) Pp. vii + 117. (London: Methuen and Co., Ltd., 1930.) 2*s.* 6*d.* net.

The present work is one of a series of monographs which will be very useful in the library of every physicist. It is almost impossible for any scientific worker to keep pace with the advance of any subject, even though it may be quite closely cognate with what he is himself working at. To read all the published work in the proper critical spirit would involve the same sort of trouble as that of the historian who in writing a universal history took a year to write the history of a day. The present little book will do much to remove this difficulty. It assumes a good deal of knowledge of magnetism, but concedes that the knowledge may be a little rusty, and sets to work to supply all the latest information, treating it in a sound critical spirit and not merely as a catalogue of publications. For example, anyone who studied the same author's larger work, when it appeared four years ago, will be able to understand the great changes that have supervened, and also to learn what parts of the subject are still unsatisfactory.

The book is in five chapters, and in each of them there is something new to say. The first summarises the work, old and new, of the type of the celebrated experiment of Stern and Gerlach. The second and third deal with dia- and para-magnetism respectively. The experiments measuring the exceedingly small susceptibilities of most substances are very difficult indeed, and there is still much discrepancy between different experimenters; consequently, the theorists have often had the comparatively easy task of calculating their constants only to an order of magnitude, since it is usually possible to find some experiment to support the values obtained. If the experimental values could all be known with confidence, it would not only be a good discipline for the theorists, but would also probably enable them to advance the theory of the solid state. The fourth chapter deals with ferromagnetism, the theory of which has been revolutionised by Heisenberg. There is a short sketch of his theory, but it was found too difficult to give its detail in the compass of the book; to do so would have required a complete account of the new quantum theory. The fifth chapter includes, among other matters, an account of Kapitza's work on electric conductivity. Altogether, it will be seen that it is a most useful book, not only to the researcher but also to the advanced student.

Der Ramaneffekt. Von Prof. Dr. Clemens Schaefer und Dr. Frank Matossi. (Fortschritte der Chemie, Physik und physikalischen Chemie, herausgegeben von Prof. Dr. A. Eucken, Band 20, Heft 6.) Pp. iii + 52. (Berlin: Gebrüder Borntraeger, 1930.) 8 gold marks.

This excellent summary begins with a general account of the Raman effect, in which its relationship to other similar effects is carefully considered. The theory is treated first classically, when it is shown that, in addition to the Tyndall and Raman effects, scatterings of higher order are to be expected, and the point is stressed that asymmetrical forces are required for the Raman effect to appear. The theory is then given in terms of wave mechanics, and correspondences between the two methods of treatment are pointed out. The experimental technique, the polarisation of the lines, their intensities, and the effect of temperature variation on them, are only briefly described.

Considering the small space available, the discussion of results is comprehensive. The rotational levels in gases, with special reference to the selection rules, the scattering by water in its different states, the broadening of lines scattered in liquids, and the continuous spectrum appearing in certain liquids are all discussed. Organic substances are treated separately, and examples are given of the internal and external vibrations associated with certain radicals. The non-appearance of Raman lines in the scattering by ionic lattice crystals such as rocksalt, and their appearance when the crystals have polyatomic ions as in the carbonates and sulphates, is also discussed. The appearance of inactive frequencies in great strength is mentioned, and the case of calcite is discussed in detail.

An important omission in such a survey of a rapidly developing subject is the exact date up to which material has been included. From the non-inclusion of a reference to the scattering by powdered crystals, it may be judged that this survey was concluded about September 1929.

A. C. MENZIES.

Grenz Ray Therapy. By Dr. Gustav Bucky. With Contributions by Dr. Otto Glasser and Dr. Olga Becker-Manheimer. Translated by Dr. Walter James Highman. Pp. xii + 170. (New York: The Macmillan Company, 1929.) 15*s.* net.

GRENZ ray therapy means the treatment of disease with X-rays having wave-lengths of from 1 to 3 angstroms. It was inevitable that someone should seek to give a name to the region of the spectrum occupied by long wave-length X-rays. The question is sometimes put: "Where do ultra-violet rays leave off and X-rays begin?" The term 'grenz' used to describe this portion of the electromagnetic spectrum has been suggested by Dr. Bucky. Long wave-length X-rays would seem a preferable term, as the rays are considerably longer than those used in X-ray diagnosis and therapy at the present time, especially as only an imaginary boundary separates the ultra-violet from the X-ray spectrum.

An interesting section on the physics of these rays is contributed by Dr. Otto Glasser. The remainder of the book deals with attempts that have been made by Dr. Bucky and others to use these very easily absorbed rays in the treatment of disease. They are easily absorbed by any kind of tissue. One of the greatest difficulties of their therapeutic application undoubtedly lies in their means of production. These difficulties have, however, largely been surmounted now, and there is less danger of the accidental production of more penetrating rays than is desirable. We gather from the text that there has been considerable controversy among radiologists as to the advantages of treating skin conditions with these easily absorbed rays.

A Text-Book of Illumination. By Prof. William Kunerth. Pp. x + 269. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1929.) 15*s.* net.

THIS book is intended as a text-book in illumination mainly for senior electrical engineers studying at a university. Two-thirds of the book is devoted to the theoretical aspects of the subject and the rest to short chapters dealing with general principles affecting the application of illumination to special problems. There is also a short account of twenty-four laboratory experiments involving the use of photometric apparatus and the usual photometric calculations. Some of the experiments are designed to illustrate various visual phenomena encountered in the study of illuminating engineering.

The subject matter of the book is well chosen, and it is desirable that all illuminating engineers should receive instruction somewhat on the lines indicated by the author. Indeed, a strong case could be made out for the inclusion of such a course in the training of all electrical engineers. Unfortunately, the author's treatment of the subject is not all that could be desired. The book is not free from errors of fact, and quite a number of arguments are developed in a loose and confused manner.

The Physics of X-ray Therapy. By W. V. Mayneord. Pp. viii + 177. (London: J. and A. Churchill, 1929.) 10*s.* 6*d.*

THIS is, we believe, the first book by an English author on the physics of X-ray therapy, and Mr. Mayneord, who is physicist to the Radio-Therapeutic Department of the Cancer Hospital, London, has written a book which cannot fail to be of the greatest value to medical radiologists. Three-quarters of the book is devoted to the physical properties of X-rays, their penetration of and absorption by matter, their quantitative measurement, and their means of production. The remainder of the book is devoted to a résumé of factors affecting the choice of therapeutic conditions. The author is fully alive to the fact that what is physically best is often clinically impossible. He has nevertheless shown how to make the best of necessary compromise in these matters. The information in this book has been very well selected for the particular aim that the author has had in view. Mathematical treatment is almost eliminated, so that there need be no hesitation on the part of medical readers in making use of this very valuable book.

Physiology and Anatomy.

Recent Advances in Physiology. By Prof. C. Lovatt Evans. (The Recent Advances Series.) Fourth edition. Pp. xii + 446. (London: J. and A. Churchill, 1930.) 12*s.* 6*d.*

THE new edition of "Recent Advances in Physiology" well maintains the high standard set in its three predecessors. The whole book has been carefully revised, and two chapters are entirely new. These are of great importance. The first deals with the coronary circulation; the author briefly explains the experiments which have been carried out by physiologists, particularly Anrep and his collaborators, to determine the controlling factors of this circulation, and shows that these are, in order of importance, the arterial blood-pressure, chemical changes in the blood, and reflex control by the nervous system. In the second chapter the student is reminded of the long-accepted theory that pressure high up in the neck causes slowing of the heart by stimulation of the vagus. He now learns that this cardiac slowing is due to a remarkable reflex initiated in the dilatation at the root of the internal carotid artery, known as the carotid sinus. This reflex has been closely studied by the experimental method, and Prof. Lovatt Evans points out its importance in the regulation of blood-pressure when affected by such changes as severe hæmorrhage and alteration in posture.

The rapid advance of physiological science makes it inevitable that what was new in 1925 must now

be relatively old, but our one regret must be that some subjects previously discussed have to be omitted to make room for others. So valuable is every chapter in this edition that we hope to see them all included in the next, even if limited space compels some abbreviation.

The Mechanism of the Larynx. By V. E. Negus. Pp. xxx + 528. (London: William Heinemann (Medical Books), Ltd., 1929.) 45*s.* net.

Mr. Negus presents here the results of his extensive inquiries into the form and function of the larynx. They range over the vertebrate kingdom from *Lepidosiren paradoxa* to man, and no detail of the structure of the forms examined seems to have escaped from thorough and fruitful consideration. The work is elaborate and, as a sustained effort in comparative anatomy and physiology applied to a field which is restricted but of wide interest, exemplary. In an introduction of great generosity and good humour, Sir Arthur Keith remarks that the author has the same patient power of assembling observation as Darwin had, and the same hot pursuit of function as urged John Hunter in all his quests. If these comparisons should induce a certain negativism in the attitude of some readers, the book will dispel it. Of nearly 500 pages of reading matter, there are few which do not serve as a vehicle for some point of interest, and, if the general reader were forearmed with such a knowledge of laryngeal structure as may be obtained from an hour's dissection and ten minutes' reading, he would find this work of science more interesting than most books about science. For the specialist it will endure as a major treatise. It includes under one cover as large, if not a larger body of facts than the usual specialist compilation, but in addition it casts fresh light upon problems too numerous to particularise in a short notice.

The Mycoses of the Spleen. By Dr. Alexander George Gibson. (The Anglo-French Library of Medical and Biological Science.) Pp. xii + 169 + 10 plates. (London: Kegan Paul and Co., Ltd., 1930.) 12*s.* 6*d.* net.

In this book Dr. A. G. Gibson has amplified the suggestion he put forward in 1913, that certain forms of splenomegaly were due to a streptothrix organism invading the spleen. His examination of many spleens has convinced him that the threads generally considered to be altered tissue fibres are mainly mycelial fibres, and he regards these as the causal organism of acholuric jaundice and the group of conditions known as splenic anæmia. The evidence for his conclusions is clearly described and well illustrated. The investigations of other workers who have found similar organisms are reviewed, and various criticisms are considered. Although Dr. Gibson puts forward a strong case and is convinced that his views are correct, he does not in any way regard this etiological problem as solved. He indicates a line of study requiring wider investigation, and is content to wait until results shall be general and uniform before considering his theory to be proved.

The Science of Voice: a Book on the Singing and Speaking Voice based upon the latest Research in Physics and Physiology, with advice to those interested in Talking Movies and other Mechanical Reproducing Devices. By Douglas Stanley. Pp. vi + 327. (New York, Boston and Chicago: Carl Fischer, Inc., 1929.)

In this book the scientific aspects of voice receive much more elementary treatment than in the works of Fletcher or Paget. A considerable portion of the volume is devoted to the musical uses of voice, and the attempts made at their definition in physical terms are of interest. In the chapter dealing with researches upon breath expulsion one would have expected to find a careful discussion of the influence of the resonances of the apparatus, which is described as consisting of a French gas mask strapped tightly over the singer's face and connected by a large rubber tube to an air-tight box inverted in a tank of water. Such a system having resonances within the range of the singing voice would unduly facilitate the production of certain notes. The third section of the book, devoted to interpretation and musicianship, might provide useful material for the psychologist.

Bainbridge and Menzies' Essentials of Physiology. Sixth edition, edited and revised by Prof. H. Hartridge. Pp. xii + 497 + 30. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 14*s.* net.

This is a most popular manual with junior students and is very widely used by them in preparation for examinations. The earlier editions were framed on the plan of Starling's excellent text-book of physiology and constituted readable and connected summaries of the latter, which the beginner found rather formidable. Emanating in the first instance from St. Bartholomew's Medical School, this little text-book has undergone improvement under the successive heads of physiology. The present edition has been subjected to drastic revision, with a resulting improvement which places it as the most up-to-date manual now at the disposal of students.

Psychology and Philosophy.

John Dewey, the Man and his Philosophy: Addresses delivered in New York in celebration of his Seventieth Birthday. Pp. vii + 181. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1930.) 10*s.* 6*d.* net.

Thirty years ago, the young American who wanted to pursue the higher learning was apt to betake himself to a German university for three or four years. But, independently of the changes brought about by the War, that custom has become greatly modified. If he comes to Europe at all, he is more likely to stay only one year, and it is not a foregone conclusion that the year is spent in Germany. The fact is that America has been growing her own science and her own philosophy. In philosophy she had, following the European model, her school

of neo-Hegelians, represented by such a man as W. T. Harris. But she seems to have cast aside the *-isms* of the Old World, and to have excogitated a philosophy more in keeping with her own genius and her own outlook. The names of William James and John Dewey stand out in this connexion as names of which any nation might well be proud. Through them the influence of American thought is being felt to the ends of the earth. James died young, but Dewey is happily still with us. He passed his seventieth birthday in October last, and the occasion was marked by a celebration in which some of the foremost of American thinkers took part. This book places on record what was said on that occasion. The speeches constitute a worthy tribute to a very distinguished man; and we may add, for the benefit of people who have not read Dewey, that a good general idea of what has been going on in recent years in philosophical and educational America may be gathered from a perusal of these speeches.

Psychologies of 1930. By Alfred Adler, Madison Bentley, Edwin G. Boring, G. S. Brett, Harvey Carr, John Dewey, Knight Dunlap, J. C. Flugel, Walter S. Hunter, Pierre Janet, Truman L. Kelley, K. Koffka, Wolfgang Köhler, K. N. Kornilov, William McDougall, John Paul Nafe, I. P. Pavlov, Friedrich Sander, A. L. Schniermann, C. Spearman, Leonard T. Troland, Margaret F. Washburn, Albert P. Weiss, Robert S. Woodworth. Edited by Carl Murchison. (The International University Series in Psychology.) Pp. xix+497. (Worcester, Mass.: Clark University Press; London: Oxford University Press, 1930.) 27*s.* net.

The editor of this volume is to be congratulated heartily upon having brought about a sort of quinquennial stock-taking of psychologies. A comparison of this collection of papers with that which appeared in 1925 shows fairly clearly the changes of attitude and conviction which have meantime taken place.

To the interested onlooker the conflict between the rival schools of psychology has its amusing as well as its edifying aspect. According to the tradition in which most of us were reared, psychology is the science of the mental life, and ascertains its facts by the method of introspection. According to the behaviourist school, which is strong in the United States, a study so pursued is no science at all, since science truly so called is conversant only with the objective facts, which in this case are the facts of human behaviour. So the behaviourist can make no terms with introspection. Similarly, as Prof. Spearman points out in his spirited contribution, the Berlin 'gestaltists' 'throw cold water' upon refined analysis; the structuralists would have the problems of function indefinitely postponed; and the functionalists think 'very small beer' of the structuralists. For his part, Prof. Spearman, who curiously labels himself a factorist, regards his school as a school to end schools, the destined healer of all these unhappy divisions.

Prof. McDougall indicates his position by an advance from the 'purposive' psychology of 1925 to the 'hormic' psychology of 1930. This volume also gives, for the first time in the English language, an account of the three leading Russian psychologies. Prof. Murchison claims that psychology is rapidly coming of age. The more controversial papers in this collection rather suggest that psychology is still suffering from growing pains.

The Creed of a Biologist: a Biologic Philosophy of Life. By Prof. A. S. Warthin. Pp. viii+62. (London: Constable and Co., Ltd., 1930.) 7*s.* 6*d.* net.

In this little book, Prof. Warthin has put forward an argument in favour of a completely scientific basis of life. Yet, with scientific knowledge in its present state, this propounded philosophy appears to contain as much untrustworthy dogma as is commonly associated with religion. That there is no proof of an anthropomorphic deity and that life is governed completely by scientific law are two maxims which the author accepts without reserve. Yet there are still many cloaks of mystery, and where we have religious faith, we also have scientific hypothesis.

The chief principle of Prof. Warthin's creed is that the complete aim of life is evolutionary immortality. One assumes, therefore, that he believes in ontogenetic mortality but phylogenetic immortality; the latter being made possible by the continuity of the germ plasm. Such is his biological creed. What it is, and how one should behave in order to conform to its doctrines, are well worth reading. The book will meet with supporters and dissenters, and therein lies its value to intellectual thought.

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Anthropology and Archæology.

George Allen and Unwin, Ltd.—The Evolution of the Family, Dr. F. Müller-Lyer. Translated by F. W. Stella Browne. *Cambridge University Press.*—How it Happened, Rhoda Power; The Bronze Age, Prof. V. Gordon Childe. *G. G. Harrap and Co., Ltd.*—Folk-Tales of all Nations. Edited by F. H. Lee. *Methuen and Co., Ltd.*—A History of the Vikings, T. D. Kendrick; A Season's Work at Ur: Being an Account of the British Museum Archæological Mission to Babylonia, 1919, Dr. H. R. Hall. *Oxford University Press.*—Nuer Customs and Folklore, R. Huffman; Mesopotamian Origins, E. A. Speiser; Clay Figurines of Babylonia and Assyria, E. D. van Buren. *G. Routledge and Kegan Paul, Ltd.*—The History of World Civilization, from Prehistoric Times to the Middle Ages, Prof. H. Schneider.

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retired on Aug. 1, 1912, having in 1911 been raised to the knighthood.

Long a member of the Institution of Naval Architects, Sir William Smith became a member of Council in 1887 and a vice-president in 1906. He undertook the design of the well-known Antarctic expedition ship *Discovery*; became vice-chairman of the Board of Trade Committee on the Load Line for Merchant Ships; for eight years was chairman of the Board of Studies in Civil and Mechanical Engineering for the University of London, and was also chairman of the Advisory Committee of the William Froude Experimental Tank at the National Physical Laboratory. He was also a member of the Technical Committee responsible for the restoration of H.M.S. *Victory*.

WE regret to announce the following deaths:

Dr. Lewis Evans, founder of the Lewis Evans Collection of early scientific instruments at Oxford, on Sept. 25, aged seventy-seven years.

Mr. Daniel Guggenheim, an American financier and member of the mining firm of Guggenheim Brothers, who established in 1926 the Daniel Guggenheim Fund of £500,000 for the promotion of aviation, on Sept. 28, aged seventy-four years.

Sir Francis Watts, K.C.M.G., first principal of the Imperial College of Tropical Agriculture at Trinidad, on Sept. 26, aged seventy years.

News and Views.

THERE has recently been in progress at the Avonmouth Docks, Bristol, an experimental demonstration of the possibilities of a new system of hydro-electrical power development by means of the head due to the tides, which in the estuary of the Severn are of the order of 30-40 ft. Hitherto, the economical development of tidal power on commercial lines has been beset by the difficulty of obtaining uninterrupted functioning of the generating machine. The turbines, requiring a minimum head or pressure for working purposes in the neighbourhood of 10 ft., are necessarily inoperative during such times as the difference between the level of the impounded water and that in the outer channel is less than this. The periods are considerable and may absorb a third of the tidal time. The difficulty can be overcome by a complex system of auxiliary basins or reservoirs, but the cost of these is generally prohibitive. Under the new system, which is due to Mr. Paul Shishkoff and is being exploited by Hydro-Thermal Power Ltd., of Westminster, a portion of the power produced by the turbines under tidal action is converted into heat by means of a water friction brake, the heated water being stored under pressure in a steam accumulator. When the tidal head falls below the minimum required to drive the water turbine, power is generated by a turbo-alternator driven by steam from the accumulator. In this way the intermissions of tidal force are bridged over. The power system is, of course, of a dual nature, being partly by water and partly by steam, but it has the merit of being self-contained and is, indeed, quite simple in design. The experimental plant at Avonmouth is only of small calibre, with an ordinary continuous load of 16 kw. and a peak load of 32 kw., but its successful operation opens out a wide field of possible development for the Shishkoff system.

A VERY interesting and, it is hoped, a far-reaching development in the campaign against foot-and-mouth disease is indicated in an important new order issued by the Ministry of Agriculture under the Diseases of Animals Acts, making provision for the use of immune serum in the endeavour to check the spread of this most highly infectious and costly disease. The order provides that "The Minister may, for the purpose of preventing the spread of foot-and-mouth disease, treat with serum, as often as may be, in his opinion, necessary, any animals which may have been in contact with animals affected with foot-and-mouth disease or which have, in his opinion, been exposed to the danger of infection of that disease." This order marks a very big step forward, as it indicates strong reason to hope that one of the greatest difficulties hitherto met with in the spread of the disease and its control by serological methods has been overcome. That difficulty was due to the fact that there are several strains of the virus of foot-and-mouth disease, and hyper-immune serum found to be effective against one strain failed to produce any protection against the others. As the source of infection in Great Britain was varied, possibly European or even South American, serum proved to be effective in one case was quite useless in the next case. There are three known strains of virus, and the obvious aim has been to produce a serum effective against all three. It is believed that this has now been accomplished, and it is this trivalent serum that it is proposed to use. Fortunately it is being prepared on the Continent (Holland and Germany), so the establishment of an institute for its production, which would inevitably be a possible source of danger in Great Britain, will be unnecessary.

THE passive immunity to foot-and-mouth disease produced by the new serum is only of ten days' duration, so the inoculation will probably have to be repeated once or twice in an outbreak. The slaughter policy of *affected animals* is not to be varied, for the serum is preventive, not curative, and it is essential that the animal producing virus be stamped out. There must be no possible risk of producing carriers. The great value of this new procedure will be that when an outbreak occurs animals in the vicinity can be immediately mmunised, and it may be possible, if sufficient material is available, to establish an immune circle around the outbreak, and so enormously reduce the danger of its extension. Occasions have occurred in the past where most valuable animals have had to be destroyed, not because they were affected, but because they had been exposed to infection. It is to be hoped that, as the result of the new procedure, such animals may be saved.

Stockowners should be reassured that since the serum contains no living virus there can be no danger in its use. The order provides that the expenses incurred in its execution must be borne by the owner of the animals, and may be recovered summarily as a civil debt. The Ministry of Agriculture is to be congratulated on this forward step, and there is good reason to hope that it will be fully justified.

MR. WALTER GOODACRE, a past president of the British Astronomical Association and the director of its Lunar Section, recently gave the sum of £300 to the Association for the foundation of a medal and gift, to be awarded at intervals of a few years to a member of the Association, selected by the Council, in recognition of useful astronomical work carried out under the auspices of the Association. The first award has been made to the Rev. T. E. R. Phillips, a past president of the Association and the director of its Jupiter Section. Mr. Phillips has for a long time been a most active planetary observer and draughtsman ; he has brought out several memoirs on Jupiter, in which he has laid special stress on the rotation periods of different markings on the planet, and has detected several instances of abnormal motion. He wrote most of the descriptive articles on the planets in the new edition of the " Encyclopædia Britannica ".

MR. PHILLIPS was president of the Royal Astronomical Society 1927–29, and was awarded its Jackson-Gwilt medal a few years earlier. He has also given much time to the observation of variable stars and double stars. He applied harmonic analysis to the variable star observations, and his results suggested their division into two groups which were differentiated by the relations between the first and second harmonics. Mr. Phillips's observatory is at Headley, near Epsom, Surrey. His two chief instruments are an 18-inch reflector bequeathed by the late Mr. N. E. Green to the British Astronomical Association, and an 8-inch refractor lent by the Royal Astronomical Society ; the reflector has been remounted in an open lattice-work tube, which is found to give improved definition. The medal and gift will be presented by the president of the Association, Capt. Ainslie, at the annual general meeting on Oct. 29.

EARLY this month an expedition from the University of Cambridge will sail for Mombasa to carry out biological investigations of certain little-known lakes in Kenya and Uganda. The particular objectives will be Lakes Rudolf and Baringo in Northern Kenya and Lake Edward in Uganda. This follows upon interest in the ecological aspects of the great African lakes which was started by the Government fishing surveys of Lakes Victoria and Albert in 1927–28, and Miss P. M. Jenkin's recent work on the smaller lakes in the Kenya rift valley. The collections resulting will be deposited in the British Museum (Natural History), and since the lakes to be visited have never been examined thoroughly, it is anticipated that a number of new forms of life will be revealed. Work will be done on the chemistry and physiography of the lakes, and the ecology will be studied in as much detail as possible. Another side of the work will be the examination of high-level beaches around the rift valley lakes. This is expected to provide evidence concerning the previous land and water distribution during the African pluvial periods, additional to that already found by Mr. L. S. B. Leakey in Kenya and Mr. E. J. Wayland in Uganda. The expedition is being financed by the Royal Society, British Museum (Natural History), Royal Geographical Society, British Association, Percy Sladen Memorial Fund, Gloyne Fund, and the Cambridge Balfour Fund. It will be under the leadership of Dr. E. B. Worthington, and other members from Cambridge will be Mr. L. C. Beadle as zoologist and Mr. V. E. Fuchs as geologist and surveyor.

ON Sept. 25 the honorary freedom of the Borough of Kendal in Westmoreland was conferred on Sir Arthur Eddington, Plumian professor of astronomy and experimental philosophy in the University of Cambridge, in recognition of his high scientific attainments and contributions to knowledge. Sir Arthur was born on Dec. 28, 1882, in Kendal, where his father was headmaster of the Friends' School in Stramongate, a school in which John Dalton served for a time as assistant master. An appreciation which had been sent by Sir Oliver Lodge was read by Mr. H. C. Wilson, of Kendal, in presenting Sir Arthur to the Mayor. Sir Oliver referred to Eddington's mathematical work on the constitution of the stars and said that he is well known for his interpretation and extension of Einstein's work. Special tribute was paid to his gift of popular exposition. Sir J. J. Thomson, Master of Trinity College, Cambridge, also sent a tribute, in the course of which he said that " Sir Arthur is one of those rare cases where great literary is combined with great scientific ability ". Sir Arthur, in replying, said that he was glad that " Kendal has recognised scientific work as service of public importance, not in any material sense . . . but perhaps in some fuller sense ".

IN the course of its report, the Royal Commission on Agriculture in India dealt in detail with the possible scope and duties of the Imperial Agricultural Research Institute at Pusa, and recommended that a director possessing both administrative ability and experience in agricultural research should be obtained from Great Britain. The India Office has offered the appointment to Dr. B. A. Keen, of the Rothamsted Experimental Station, Harpenden, who will leave England on Oct. 7 on a year's leave of absence, which is being granted him by the Lawes Agricultural Trust with the concurrence of the Ministry of Agriculture. Dr. Keen joined the Rothamsted staff in 1913. At the outbreak of War he was commissioned to the Suffolk Regiment and served in Gallipoli and Palestine. On his return to Rothamsted in 1919, he became head of the Soil Physics Department, and in 1923 he was appointed to the new post of assistant director, which he still occupies. In 1924 he was elected a fellow of University College, London.

AT the Forestry Sub-Section of the British Association meeting at Bristol in September, Mr. Alexander

Howard, in a paper entitled "Our British-grown Hardwood Trees and Timbers", directed attention to the present heavy fellings and the almost total absence of replantings of the fine hardwood species of Britain—oak, ash, beech, elm, and so forth. Mr. Howard pointed out that the existing and often magnificent examples of these species in woods on private estates in Britain had resulted from the energetic and patriotic planting of the proprietors in the seventeenth and eighteenth centuries. Such plantings fell into abeyance during the nineteenth century, as the country and the nation's statesmen were no longer interested in hardwood timbers, owing to changed economic conditions. The latter-day imposition of heavy death duties has not only precluded the descendants of the former planters from carrying on the good work, but is resulting in the break-up of big estates, coupled with the felling, on an increasing scale, of large numbers of the magnificent trees and woods which have for so long made England famous as a beauty spot among the nations. Mr. Howard faces the fact that although the private proprietor may hope to make a profitable investment in planting coniferous woods, he can no longer hope to do so by planting hardwoods. The folly of the present system of taxation lies in the fact that timber represents so much capital which, on realisation, is being squandered by the recipients as soon as received.

REFERENCES are sometimes made in daily newspapers to the planting of trees by small-holders. Anyone conversant with this matter is aware that the mere planting of trees is but the first step: the results of such planting will depend on the technical supervision the trees receive during at least the first forty years of their lives; and the period in the case of hardwoods may well be longer. Mr. Howard points out that the Forestry Commission has limited its work mainly to softwoods and has as yet done little towards the replanting of hardwoods. His suggested remedy for the present position is to have a Government Forestry Department, which would have power to control all matters relating to forestry, to recommend expenditure, and to regulate all forests, without itself carrying on the trade of either planting, rearing, cultivating, felling, or selling. He considers that such a department might be in a very much better position. But under existing conditions in Great Britain, to which forestry practices in other countries have at present little application, a Government department, the sole work of which was to control all matters relating to forestry, recommend expenditure, and regulate all forests, would produce little of practical value. Mr. Howard states that: "Every man, woman, and child might be said to be a potential planter. All that is required is assistance and encouragement from the Government." If by this it is intended to imply that, given the money, the people will plant and look after trees, and that the results will be successful in the future, it is to be feared that Mr. Howard is unduly sanguine.

M. EM. TOUCHET, vice-president of the French Astronomical Society, makes a strong appeal in *La Nature* for Sept. 1 for the collaboration of amateur photographers in helping to get interesting and instructive photographs of lightning flashes and allied phenomena. The best methods of doing this were discussed by the French Society on Mar. 5 last and a résumé is given of the conclusions reached. Lightning is photographed in order to get a notable picture or for purely scientific purposes. In the latter case, the film should be changed after each flash. When a movable film is available, as when a cine camera is used, very instructive pictures can be obtained. Sometimes also the camera is rotated at a given rate about a vertical axis and excellent results obtained. Photographs are in existence showing successive flashes following exactly the same path. The size and kind of the camera used are not of great importance. M. Touchet says that a photograph taken with any kind of apparatus is better than no photograph at all. For example, it is most regrettable that although globular lightning has recently been seen hundreds of times, yet there is no authentic photograph of it in existence. With almost any portable cine camera an excellent photograph of it could be taken. Mathias has shown that at certain seasons and in certain mountainous regions these phenomena occur fairly often.

To obtain good stereoscopic photographs of lightning it is necessary to have two observers at stations about 200 metres apart. They can use electric torches for signalling to one another, or better, fix up telephone communication. Some good photographs have been taken in this way, the lightning standing out in relief. A table is given for the best length of base line to use for given focal lengths. Although with movable films it is possible to see roughly the true nature of the flash, we are still quite ignorant of its method of propagation. In general, the discharges are multiple; the first discharge blazes the way and the rest follow in the hot and ionised channel it has left. Traces of this channel are clearly shown by photographs. Between earth and cloud the discharges are nearly always multiple. In many cases the discharge is practically an 'electric arc' for an appreciable time and produces serious mechanical and calorific effects. Flashes between clouds, however, are generally simple. Lightning has often been observed curving towards the earth, and this has been attributed to the stratification of the atmospheric layers. There are many problems to be solved and the help of amateur photographers can be of the greatest assistance to meteorologists. The French Astronomical Society, Hôtel des Sociétés savantes, 28 rue Serpente, Paris, will gladly receive photographs of lightning, and those of scientific interest will be published in *La Nature*.

THE Bird Sanctuaries in the Royal Parks in and about London continue to do good work for the public as well as for the birds, and it is regrettable that a small minority of the people still abuses the privileges. The stealing of the eggs of Magellan geese in the Hyde Park and Kensington Gardens Sanctuary will be resented by none more than the public themselves. The Annual Report of the Sanctuaries Committee for 1929, now

again published in pamphlet form by H.M. Stationery Office (price 6*d.* net), gives many examples of improvements in the reserves. Undergrowth generally has been thinned to aid ground-feeding birds, clumps of brambles and nettles have been planted in Kensington Gardens, thickets in Greenwich Park, currant bushes, barberries, and teasels in Richmond Park, all to provide more food and cover to bird visitors. The lists of nesting birds and migrants show how great variety may be seen even in the heart of London. When the sun-bathers forsake the Serpentine, their places will be taken by immigrant ducks from the far north: there were 250 tufted ducks and more than 50 pochards last winter. Even a little auk from the open ocean visited the Round Pond. In these havens of peace, the struggle for existence goes merrily on: Magellan geese attacked all and sundry, herring gulls devoured the chicks of mallard, and mallard caught, drowned, and ate too venturesome sparrows. It is a lesson for those who would protect indiscriminately all the birds in a sanctuary or in a country.

IN a recent paragraph we referred to the work of the National Central Library (formerly the Central Library for Students), which endeavours to correlate in Britain the efforts of individual libraries to meet the needs of serious students. Readers may be reminded that this and several other British libraries take part in a much more extensive correlation scheme inaugurated by the International Institute of Intellectual Co-operation of the League of Nations. For several years this body has been endeavouring to collect information regarding the national and central libraries of different countries, with the view of creating a liaison between existing services. This was accomplished at the end of 1928, when a co-ordinating service of libraries was established by the International Institute. In order to increase the value of the co-ordination, at the request of an international congress of librarians held in 1929, there has just been issued a "Guide des services nationaux de renseignements du prêt et des échanges internationaux" (Paris: Institut International de Coopération Intellectuelle, 1930). In this appear concise notices of the centres of bibliographical information in every country where they exist or are in process of organisation, and in addition the addresses are given of all the bureaux for the international exchange of publications. Fifty-five nations or States are represented in the lists, an indication of the possibilities of this newly founded international service.

DURING the visit to Edinburgh of the French branch of the Franco-Scottish Society on Sept. 26, the French Ambassador unveiled, at the Royal Edinburgh Hospital for Mental Diseases, a bust of Dr. Phillippe Pinel, the Paris physician who gained undying fame by his reformation of the old barbarous methods of treating the insane. Pinel was born on April 20, 1745, studied at Toulouse and Montpellier, and then went to Paris to study botany, zoology, and anatomy. He became known as a translator and editor of medical works, was made physician-in-chief at Bicêtre in 1792, and later held a similar position at the hospital of Salpêtrière. The reforms he introduced in both institutions led to the award of the Legion of Honour, and he was admitted a member of the Institute of France. He died on Nov. 25, 1826.

THE Council of the Television Society has recently taken steps to co-ordinate the experimental work of the members in such a manner that certain well-defined lines of collective research or group experimenting can be undertaken. A Research Committee has been formed to direct and assist members who desire to take an active interest in the work of the Society and in the advancement of the study of television. A survey is to be made of the membership, with special reference to technical qualifications and facilities of members to assist in experimental work; and educational institutions, universities, and commercial firms are to be approached to give facilities for group research. The Committee has undertaken to formulate definite group experiments, to be divided amongst members in such a way that their work, when completed, will form a definite contribution to our knowledge of the subject. These results will be edited and published in the Society's *Proceedings*, to be issued three times a year. As a preliminary step, the Committee has decided to consider a joint demonstration to be given at the annual exhibition of the Society to be held in April of next year.

THE Ministry of Agriculture desires that full use should be made by mycologists and plant pathologists in Great Britain of the facilities offered by the Imperial Bureau of Mycology. This Bureau has been supported financially by contributions from the governments of the Dominions, India, the Sudan, Iraq, and most of the Colonial Dependencies. The British government has hitherto not made any financial contribution, its aid having taken the form of the provision of a government building for use rent-free by the Bureau. A new and more commodious building has been erected to house the Bureau, near the Herbarium at Kew (at Ferry Lane, Kew), and arrangements are being made by which substantial financial aid shall be given in future by the three home governments, which will enable the Bureau to extend the scope of its activities. The Bureau is directed by Dr. E. J. Butler. For the purpose of dissemination of information, it publishes the *Review of Applied Mycology*, which gives a monthly survey of all current literature dealing with phytopathology and economic mycology from every part of the world. Imperial mycological conferences are held, under the auspices of the Bureau, at intervals of five years. It undertakes the identification and study of fungus and bacterial plant pathogens; and it maintains a museum of tropical plant diseases and a lending library for the use of mycologists.

AS the result of a conference between the railway companies of France and the Minister of Public Works, a uniform system of electric signalling has been adopted and will be used on all the railways in France. The installation of the new electric visual system to replace the many mechanical systems in use will begin next year and will cost about £500,000. There are

important innovations made in the colour of the lights. The 'line free' signal, which is indicated at present by a white light, will in the future be signalled by a green light, thus bringing it into line with the colour used in all other countries. An orange-yellow colour indicates that the driver is to go slow. Violet will be used in shunting operations and to signify direction. The 'slacken speed' signal is given by two yellow lights placed horizontally followed by two yellow lights placed vertically. Red remains as the danger signal. The present use of mechanised systems which vary in different regions of France causes difficulty when engine-drivers are called upon to run trains over systems to which they are not accustomed. Trouble due to this cause was acute during the War. As the new signalling apparatus has been already tested on the Est, the État, and the Orleans lines, no difficulty is anticipated. An identical electrical system of luminous signals will be used in the day-time and at night.

AN instructive official table in connexion with international statistics of electric supply is published in the *Electrotechnische Zeitschrift* for June 12. It is compiled from the data collected by the international conference of high tension supply networks. The data show notable contrasts. In Switzerland, practically the whole population has electric supply available, whilst in Japan there is only about 20 per cent of the population similarly situated. England consumes 4·4 tons of coal per year per head of the population, which is the largest for any of the countries given. In Switzerland nearly 70 per cent of the available power is harnessed, whereas in Norway there is only about 15 per cent. The total maximum load per head of the population is credited to Norway, and Canada and Switzerland come next. The total capital cost of the generating and distributing systems in England is 222 million pounds, whilst in Canada it amounts to 157·5 million pounds. In the latter country, only about a third of the total is invested in distributing plant. The reason for this is that a very large fraction of the total energy is taken by large industrial consumers situated near to the generating stations. It is hoped that next year fuller international electrical statistics will be given. This is the first year of their publication and not many countries have sent in data.

THE principal international passenger traffic to and from Spain and Portugal, mainly for the capitals Madrid and Lisbon, passes through the frontier town of Irun near San Sebastian, where luggage is examined by the customs officers. From this town the main line follows the coast to San Sebastian and then turns off from the sea and gradually rises through the foothills of the Pyrenees to an altitude of 2000 feet, where the first ridge of the mountain is pierced by a tunnel which emerges at Alsasua. The section from Irun to Alsasua has been electrified by the North Spanish Railway; the Pajares mountain section and the suburban railways of Barcelona have also been electrified with direct current at 1500 volts. In the *Brown Boveri Review* for August there is an account of the express locomotives that have been built for the Irun-Alsasua section of the railway. Each locomotive is capable of developing 2700 h.p. at the tread of the wheels and is capable of hauling a passenger train weighing 400 tons (exclusive of the locomotive) at a speed of 40 miles an hour up an incline of 1·65 per cent. Special vacuum brakes are used and the braking force for the whole locomotive equals 177,000 lb. weight. There are six driving axles driven by six series wound motors which can be connected in various ways for altering the speed. Pantograph collectors with double bows are used to collect the current. Regenerative braking is also employed so that when going down hill electric power is generated by gravity. All the mechanical part of the locomotives was built by the Spanish Babcock and Wilcox Co. to the design of Swiss engineers.

MR. E. SHINWELL, M.P., the Secretary for Mines, has appointed Prof. Henry Louis to hold a local inquiry into the possibility of developing the production of gold and other minerals in Merionethshire.

DR. H. H. MANN, assistant director of the Woburn sub-station of the Rothamsted Experimental Station, is shortly leaving England for south Russia, to advise as to the possibility of the extension of the tea-growing industry. Before joining the Rothamsted staff, Dr. Mann was engaged in tea research in India, where he became recognised as one of the leading experts in the cultivation and management of the tea plant. He is expected to be away until December.

IN an article in NATURE of Sept. 20, p. 456, referring to the production of artificial pearls by Linnæus, the question was asked whether his experimental shells are still in existence. A correspondent has pointed out that the shells and also specimens of artificial pearls made by Linnæus are included in the Linnean Collection of Shells in the possession of the Linnean Society of London, and were among the exhibits from the Linnean Collections arranged in connexion with the Fifth International Botanical Congress held in August last.

PART I. (Medical Tables) of "The Registrar-General's Statistical Review", 1929, has been issued (London: H.M. Stationery Office, price 7*s*. 6*d*.). The birth-rate for 1929, 16·3 per 1000 persons living, was the lowest that has been recorded. The death-rate was 13·4 per 1000, against 11·7 for the previous year, the rise being accounted for by the high mortality occasioned by epidemic influenza and the severe weather in February and March. The same cause increased the infant mortality to a rate of 74 per 1000 live births, or 9 per 1000 above that for 1928. The death-rate from cancer was 1437 per million living, against 1425 for the previous year, being the highest crude rate recorded. The rate for suicide was 126 per million, the highest figure on record. Deaths from accidental injury by mechanical vehicles on roads increased from 4492 in 1927 to 5251 in 1928 and 5799 in 1929, of which 1162 were caused by motor cycles.

THE new catalogue of the Wild-Barfield Electric Furnaces Ltd., Holloway, N.7, describes electromagnetic steel-hardening furnaces which have an

efficiency of about 90 per cent. This high efficiency is obtained by means of a special form of fan incorporated in the oven. At 100° C. this fan increases the rate of heating thirteen times and at 250° C. four and a half times. This effects great saving in the running costs. In the old days, steel was tempered by reheating the hardened steel until it assumed a certain colour due to the gradual formation of a film of oxide on it; the thicker the film the deeper the tint. Modern methods of tempering consist in reheating the steel either in a bath of oil, lead or salt, or in an air tempering oven. The last method is the cleanest and safest in operation. There are no fumes and the running costs are lower owing to the absence of salt or oil replacements. The introduction of forced circulation by a paddle fan makes it not only possible to heat the charge very rapidly but also to secure almost uniform heating. It is claimed that these furnaces can operate within 1° C. to any required temperature without attention.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—An assistant in the Mechanical Engineering Department and two graduate assistants in the Mathematics Department of the Municipal Technical College, Coventry—The Director of Education, Education Department, Council House, Coventry (Oct. 6). An assistant analyst in the Health Department of the Municipality of Singapore—Peirce and Williams, 1 Victoria Street, S.W.1 (Oct. 6). A full-time lecturer in mining in the County Technical Institute, Worksop—The Principal, County Technical Institute, Worksop (Oct. 8). An assistant Government analyst, Hong Kong—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Oct. 8). A lecturer in experimental psychology in Otago University, Dunedin, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Oct. 10). A clinical assistant at the Radium Institute—The Secretary, Radium Institute, Riding House Street, W.1 (Oct. 10). An assistant radiologist at the Middlesex Hospital—The Secretary-Supt., Middlesex Hospital, W.1 (Oct. 11). A bacteriologist and a senior bacteriological assistant under the Devon County Council—The County Medical Officer, 4 Barnfield Crescent, Exeter (Oct. 11). Two temporary drainage inspectors under the Ministry of Agriculture and Fisheries for technical work in connexion with land drainage—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Oct. 13). A senior technical officer in the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (Oct. 15). A radiologist to the Royal Infirmary, Edinburgh—The Chairman, Royal Infirmary, Edinburgh (Oct. 20). A lecturer in the Department of Botany, King's College, London (special subject, plant physiology)—The Secretary, King's College, Strand, W.C.2 (Nov. 1). A Pilkington fellow in cancer research in the University of Manchester—The Registrar, University, Manchester (Nov. 15). A graduate for physics and mathematics in the County Technical and Secondary School, Workington—The Principal, County Technical and Secondary School, Workington.

Our Astronomical Column.

New Map of Mars.—*L'Astronomie* for September contains a new map of Mars, drawn by E. M. Antoniadi from his own studies of the planet, chiefly those made with the 33-inch refractor at Meudon. The map is a pictorial one, representing the telescopic aspect of each region, the gradations of light and shade being carefully reproduced. The map is in five portions; three of these have the equator in the centre, and extend to latitude 70° north and south, the projection being that of Mercator; each map covers 120° of longitude, the centres of the maps being at longitudes 310°, 70°, and 190°; the other two portions are circular, extending from latitudes 60° north and south to the poles. A large number of names are inserted, including those of many of the 'canals'.

M. Antoniadi rejects the view that the canals are arranged geometrically; he shows many of them as broad irregular stripes, others (notably Laestrygon and Antæus) as chains of lakes. Dotted lines indicate regions which have been observed to change either in shape or in tone during the period of his observations; these include five regions designated Nix (snow), but the so-called 'Dawes Ice Island' is not among them. The Solis Lacus is shown large and elongated, with some darker patches in it; five broad canals connect it with the surrounding dusky regions.

This is probably the most elaborate and detailed map of Mars that has been produced. There will doubtless be differences of opinion among observers as to some of the details, but few will dispute the artistic merit of the delineation. A new season of Martian observation will shortly commence, as the planet is in opposition next January in high north declination. This map may encourage new observers.

Galactic Rotation and the Spiral Nebulæ.—The researches of the Mt. Wilson observers and those of Prof. de Sitter have established a strong case for the conclusion that the large recessional velocities of the spiral nebulæ are approximately proportional to their distances. Dr. J. H. Oort, who was one of the foremost workers on the problem of galactic rotation, contributes a paper to *Bull.* No. 196 of the Astronomical Institute of the Netherlands, in which he obtains a solution for the solar motion relatively to the nebulæ, which he compares with the solar motion derived from his solution of galactic rotation; the two prove to be in close accord, which tends to confirm his elements for the rotation, and also to give some additional weight to the assumption regarding the recessional motion of the spirals.

There is evidence of the existence of several clusters of spirals; such cases have been used not individually but in combination, the mean of such a group being given a higher weight than a single nebula. Dr. Oort is in doubt whether to treat the Magellanic Clouds as extra-galactic objects or not. Including them, he finds 360 km./sec. for the solar motion relatively to the nebulæ, directed towards galactic longitude 57°, N. latitude 2° (longitudes reckoned from the ascending node of the galaxy on the equator of 1900). Excluding the Clouds, he finds 380 km./sec. towards longitude 58°, N. latitude 4°. The recession of the nebulæ is found to be 140 km./sec. at Prof. de Sitter's unit of distance, which is 1,060,000 light-years; de Sitter and Hubble found 153 km./sec. and 151 km./sec. at this distance respectively. The previously adopted motion of the sun due to galactic rotation was directed towards longitude 57°, latitude 0°.

Research Items.

Chinese Alchemy.—The September number of the *Scientific Monthly* contains an interesting paper by Dr. Tenney L. Davis and Mr. Lu-Ch'iang Wu, of the Massachusetts Institute of Technology, on the development of alchemy in China. This contains some quotations from a paper by Ch'i-Ch'ao Liang which appeared in Chinese in 1923, dealing with the five elements, yin and yang, etc. The change in the meanings attached to these conceptions which arose under Taoist influences is (as in previous writers) supposed to have been the beginning of alchemy in China, which occurred, according to the explicit statements of the very reliable Ssu-ma Ch'ien (first century B.C.), during the reigns of Huang Ti (259-210 B.C.) and Wu Ti (156-87 B.C.). The earliest purely alchemical treatise in Chinese is considered to be that by Wei Po-Yang, who flourished about A.D. 142, extracts from which are quoted from a text recently printed. "In many respects it bears a strong resemblance to the later alchemical writings of the Europeans." Mr. Lu-Ch'iang Wu promises an English translation of Wei Po-Yang's work, and it is to be hoped that this will appear in due course.

Corn Customs in Wales.—The distribution of corn customs in Wales is the subject of a study by Mr. Iorwerth C. Peate in *Man* for September. Many people still living can remember customs relating to reaping the last sheaf of the corn in harvest. Six, eight, or more reapers standing in a circle hurled their sickles at the last tufts of corn, which had previously been divided into three and plaited by the chief reaper. If it were not cut down by one of the sickles thrown at it, it was cut by the head reaper. It was then taken to the farm and hung on a beam, where it remained until the next harvest, when it was destroyed. It was necessary that it should reach the beam dry, a matter of difficulty, as the farm women threw water, beer, milk, or other liquid at the carrier, who kept the sheaf concealed. The carrier's companions endeavoured to protect him by each pretending themselves to be the carrier. If successful, the carrier took the place of honour at the harvest feast; if unsuccessful, he paid a fine to the women, or was the butt of the harvest supper. Alternatively, the carrier might take the sheaf to the field of a neighbour where the harvest was still in progress, and throw the sheaf down before the principal reaper's sickle, immediately running away. The reapers threw their sickles at him and pursued him. If he were caught, he was bound with straw ropes and left in the field or thrown into a stream or drenched with pig-wash. These customs were not found in the central moorland area of Wales but coincide in distribution with the chief wheat-growing areas of the country. In most districts the custom died out in the latter half of the nineteenth century, owing to the religious teaching which followed on the revival of the eighteenth century, receiving its last blow in the great revival of 1859.

Some Bird Changes in Canada.—In the extreme south-west corner of Saskatchewan, Lawrence E. Potter has been observing birds for close on thirty years, and has found in that relatively short space considerable change in the avifauna (*Canadian Field Naturalist*, Sept., p. 147). Of few birds can it be said that there is an increase in numbers. The house-sparrow first appeared in 1907; the shelter and waste grain due to the settlement of the country induce the western meadowlark and the red-winged blackbird occasionally to stay over the winter; and the mourning dove has increased during the past ten years. Sometimes the numbers rise and fall without any apparent reason: magpies were fairly common in 1901–4; for six years thereafter they vanished altogether, and since their reappearance in 1910 they have multiplied so as to become a pest. On the other hand, the coming of the black-billed cuckoo in 1912 and its disappearance in 1924 coincided with the coming and going of unusual numbers of the tent caterpillar. In general, conditions of settlement have been found to be unfavourable to wild duck, birds of prey, sharp-tailed and sage grouse, and wading birds; and unaccountably the barn swallow has become very scarce. An interesting link is revealed in the connexion between bitterns and beavers. From about 1908 to 1918 beavers became very common and the American bittern flourished, for it found the shallow water caused by the beaver dams good feeding-places. But the beavers were wiped out about the latter date and they have never regained their former numbers; and the bittern has correspondingly decreased and is now rather rare.

Aphis Harvest of the Red Wood Ant.—A few simple observations made by Fridthjof Ökland upon the use made by the red wood ant (*Formica rufa*) of the excreted juices of aphids, show clearly the importance of the relationship to this species of ant (*Biol. Zentralbl.* Bd. 50, p. 450, 1930). The author captured 200 ants on each of three species of trees, birch, pine, and fir, 100 as they marched up the tree trunk, and 100 as they marched down. The former were hungry ants on the way to their aphid pastures, the latter were fed ants returning. The difference in weight between the two groups represented the amount of aphis juices imbibed by 100 ants at one visit—the dry weight of this difference averaged about 100 mgm. Observation showed that an ant paid about five visits a day, so that the amount of 'aphis-sugar' collected by an ant per diem would be 5 mgm., or during the summer months 500 mgm. Now the number of the inhabitants in a nest of the red wood ant have been reckoned at 150,000-200,000 individuals; suppose, on the safe side, we take the number to be 100,000, and that of these one-fifth are 'milk-gatherers'. Then the quantity of 'aphis-sugar' collected by a colony would amount to 10 kgm. a season, and the daily amount from one tree would be about 60 gm.—by no means an insignificant loss to the tree. Moreover, comparison with hive bees indicates that the aphis-sugar crop of an ant colony of several nests would be not less than the honey crop of a colony of hive bees.

Polar Limits of Tree Growth.—The Polish plant geographer, Dezydery Szymkiewicz, in his travels in high northern latitudes, has paid particular attention to this point, to which he devotes a paper in the *Acta Societatis Botanicorum Poloniae*, vol. 7, No. 1, 1930. His general conclusion is that trees are no more susceptible to low temperatures than other plants and that, as a result, there is no thermal limit to the northward spread of the tree habit. On the other hand, the desiccating effect of the cold dry winds prevalent in northern latitudes increases with the elevation of the foliage of the plant above ground level, and it is these arctic winds which are responsible for the absence of trees in the regions of frequent frost. The polar limit of tree growth, he therefore concludes, is really a maritime limit, and if the land masses were differently arranged, trees would be found nearer the poles.

The Movement of Continents.—The forces which, according to Wegener's theory, move the continents have been taken to be those due to the combination of the gravitational and centrifugal forces on the

continents and on the denser viscous magma on which they float. These give a resultant directed towards the nearer pole for a continent the centre of gravity of which lies above that of the displaced magma, and towards the equator if it is below. Dr. U. P. Lely, of The Hague, describes, in the issue of the *Physikalische Zeitschrift* for Aug. 1, experiments on the behaviour of a small piece of wood placed on the surface of water in a cylinder rotating about its axis, which was vertical. His results have led him to conclude that in the case of an elongated continent there is also a couple which may tend to set the long axis either parallel or at right angles to the meridian. In the case of Europe-Asia the couple is zero, of South America and Africa it is small, but in the case of North America it is large, and the American continent is bending at the equator. Dr. Lely considers that an examination of the directions in which the axes of elongated sunspots set should lead to important conclusions as to the distribution of density in such spots.

Meteorites in the Philippines.—The Director of the Weather Bureau of the Philippines, the Rev. M. Selga, has collected together in *Publications of the Manila Observatory*, vol. 1, No. 9, 1930, all the available information regarding meteorites in the Philippines. Seventeen cases are discussed, including twelve falls, two actual findings, and three sets of spurious examples. The earliest fall dates from 1618 and the latest from 1928. It is shown that the Mexico meteorite, which has been recorded as falling in Mexico in 1859, fell near the town of that name in the province of Pampanga; specimens are preserved in Paris, London, and Chicago. The Calivo meteorite fell in 1916 and analyses are now presented for the first time. The meteorite is a brecciated siderolite with 19 per cent of nickel-iron. The stony material is said to be mainly enstatite, but is clearly variable. One analysis gives 27·92 per cent of magnesium oxide, whereas another shows only 1·20 per cent, alumina and lime being high in this sample. A detailed petrographic examination appears to be called for, to complete the investigation. Reference is also made to the tektites found by Beyer in the province of Rizal since 1926. These occur in neolithic deposits and their composition places them between the australites and billitonites; the name *rizolites* is proposed for them. Their composition, form, lack of crystallites, and distribution all favour a cosmic rather than a terrestrial origin.

Sound Test Gramophone Records.—An addition to the number of gramophone records of scientific interest mentioned in NATURE of Nov. 9, 1929, Vol. 124, p. 741, has been made by the Parlophone Company's recent issue of two further sound test records. Each of these gives under normal conditions any one of a series of eight pure tones, covering in intervals of an octave a range of seven octaves, the lowest tones being respectively 32 and 50 vibrations per second. The playing duration of each tone is 40 seconds.

Rotatory Dispersion.—The issue of the *Physikalische Zeitschrift* for July 15 contains a summary by Dr. G. Kortüm, of the Chemical Institute of the University of Würzburg, of present-day knowledge of the optical activity of substances, and of the empirical and half empirical theories which have been advanced to connect the observations with the chemical properties of the substances. The general character of the optical rotation on the two sides of an absorption band is in keeping with the classical theory of Drude, but the constants calculated from the observations of rotation are not identical with those given by refraction and absorption measurements. The newer theories seek to connect the rotation either with the relation between the oscillations of the electrons or with the asymmetrical arrangement of the atoms within the molecule. They have, in the different forms in which they have been presented, met with a qualified success, and the recent observations of optical rotation in the ultra-violet are likely to provide means of testing them more severely. A list of more than 130 references is given.

Spectra of the Rare Earths.—The July issue of the *Journal of Research* of the U.S. Bureau of Standards contains a partial analysis of the spectra of lutecium, by W. F. Meggers and F. B. Scribner. This element is the heaviest of the rare earths, the spectra of which have been little studied, and has atomic number 71. As with hafnium, which was also under investigation recently in the same laboratory, auxiliary information, such as that provided by the Zeeman effect, was practically absent, and the classification of lines had to be carried out by their different behaviour under arc and spark excitation, and by the numerical relations between their wave-numbers. The normal states of neutral, singly ionised, and doubly ionised lutecium atoms have been found to be represented by ^2D, ^1S, and ^2S spectral terms, respectively, and there is evidence for the completion of the inner shell of *f*-type electrons, which is only partially filled in lighter rare earths, from the absence of certain terms from the first spark spectrum (Lu II). The closely allied problem of the correlation of the spectroscopic and magnetic properties of the rare earths has also been discussed recently by Prof. A. Sommerfeld in a paper in the *Sitzungsberichte* of the Vienna Academy of Sciences (vol. 139, p. 11).

Determination of Blood Cholesterol.—The determination of the blood cholesterol in clinical investigations is assuming growing importance and a simplified method has been described by Emily M. Day and A. Bolliger (*Australian Jour. Exper. Biol. and Med. Sci.*, vol. 7, pts. 1 and 2, 1930, p. 41). One cubic centimetre of blood or plasma is spread on two filter papers, No. 40 Whatman, 7 cm. diameter, and is dried in the air or in an incubator or paraffin oven. When dry, the filter paper is folded and placed in a dry, clean test tube 6 in. × ¾ in.; chloroform (B.P. suffices) is added, sufficient to keep the filter paper well covered. The test tube (or tubes if several determinations are being made) is then put in a beaker or tin containing carbon tetrachloride up to about the same level as chloroform in the test tubes. This carbon tetrachloride bath is put into a water bath which is heated until the chloroform boils gently. Should the carbon tetrachloride start to boil, the heating is reduced; in this way the boiling of the chloroform is perfectly controlled. The chloroform is allowed to boil for 15 minutes; should it evaporate to the paper level, more is added. The chloroform extract is then poured into a graduated or volumetric flask and is made up to a known volume, conveniently 15 c.c., with several chloroform washings of the filter paper in the test tube. The cholesterol is estimated in an aliquot part of the extract, preferably 5 c.c., by adding 2 c.c. acetic anhydride and 0·1 c.c. concentrated sulphuric acid, and comparing the colour developed with that of a standard, similarly treated, in a colorimeter. The standard solution consists of 1 c.c. of a stock solution containing 0·1 per cent cholesterol made up to 15 c.c. with chloroform. The mixtures are allowed to stand in the dark for 10 minutes before being placed in the colorimeter. Calculation: $x = \frac{\text{Standard}}{\text{Reading}} \times 100$ mgm. per cent cholesterol. Comparison with other methods shows that the errors are within ± 5 per cent, even if only 0·2 c.c. of blood is extracted.

New Building for Mining Department of the University of Leeds.

THE new mining building which was officially opened by Viscount Chelmsford on Sept. 30 marks the first stage in the reconstruction scheme rendered necessary by the growth of the University of Leeds. Its erection has been made possible by the generosity of the Yorkshire Coal Owners' Association, which contributed £25,000 to the general building fund of the University, and of the Miners' Welfare Committee, which gave £10,000.

The main building is of three stories, and while the accommodation it provides is considered adequate for the immediate future, there exists considerable scope for extension should the need arise. The front of the building consists of Portland stone, and has been built to conform with the general architectural plans for the new University building scheme. The roof of the building is flat and is intended for use in the testing of surveying instruments and for latitude and azimuth observations.

On the top floor is a large well-lighted drawing office, a spacious room meantime used as a museum, a students' common room and departmental library, a research laboratory, and a large lecture theatre. In the museum numerous mining exhibits, historical and modern, are to be found. The wide corridors in both the top and middle floors are also utilised for the convenient display of geological specimens from many parts of the Empire and other exhibits of considerable importance to the successful teaching of mining practice.

Fig. 1.—Mining Department, University of Leeds.

The first or middle floor is apportioned into laboratories for wet and dry assaying, a gas-analysis laboratory, a dark room for photometric and safety-lamp work, a balance room, two research laboratories, and the departmental offices. The balance room is conveniently situated between the assaying and the research laboratories. One of the latter, and the research laboratory on the top floor, are to be occupied by a section of the Fuel Research Board for the physical and chemical survey of the West Yorkshire Coalfield. The other, and larger, research laboratory is fitted with all services necessary for the investigation of any physical or chemical problem associated with modern mining practice. It has so far been used by that branch of the Safety in Mines Research Board dealing with improvements in self-contained breathing appliances for use in mines. Entrance to any one of the laboratories on the first floor can be made only from the main corridor, a feature especially desirable in research work.

The ground floor comprises the main laboratory, crushing laboratory, sampling room, machinery room, ore bins, workshop, and stores. There are four independent means of access to this floor, two being at the front and two at the rear of the building. The main laboratory largely occupies the ground floor and is entirely given up to work on the preparation of coal and ores for the market. Working models of the principal appliances used in coal-cleaning and ore-dressing operations are installed. Adjacent to, but entirely separate from, the main laboratory is the crushing laboratory. Here an ore is treated, progressively if need be, by jaw crushers, rolls, stamps, and ball mills. The sampling room is completely isolated from the remainder of the building so as to reduce the risk of contamination during the grinding and subsequent treatment of coal or ore samples.

The principal units housed in the machinery room are: (1) a 25 h.p. vertical 2-stage air-compressor complete with all accessories required for testing purposes; (2) 32 h.p. motor-generator set with auto-transformer starter and six Reyrolles distribution panels; (3) full-size air-driven turbine chain coal-cutter kindly presented by Messrs. Anderson Boyes and Co.; and (4) two air-driven jigging-conveyor engines with lengths of troughs and accessories kindly presented by the British Jeffrey-Diamond Company.

In the basement, two 20-in. diameter Sirocco fans are installed together with about a hundred feet of fan gallery for experimental ventilation work. The fans are so arranged that they can be operated either singly, in series combination, or in parallel combination. A series of compressed-air pipe lines of various diameters is fitted along one of the walls of the basement, the arrangement incorporating different forms of metering devices, the whole being laid out for experimental work in compressed-air power service.

A special feature of the building is the ready accessibility of all services. In all there are twelve services, namely, a.c. two-phase, a.c. single-phase, d.c. power, electric lighting, water at mains pressure, water at constant head low pressure from the large capacity tank on the roof, domestic hot water, waste water, gas, compressed air, heating, and steam. Each service conduit system is painted a different colour, and the diagram giving the key to this colour scheme hangs in the main laboratory. In the laboratories the main services required are carried openly, along the top of, but are quite independent of, the benches. Tappings are arranged at intervals commensurate with the particular requirements. The cupboards below benches are all small standard-sized units and are readily removable or interchangeable. The general arrangement of the services is

thus one which facilitates their efficient maintenance and permits of ready extension whenever necessary.

All the electrical apparatus is earthed and adequately protected. Transformers for the supply of two-phase and single-phase a.c. are situated outside the main building, the distribution panels only being housed in the crushing laboratory. Reyrolle B.E.S.A. plugs (15 amp. and 5 amp.) are fitted throughout the laboratories for a.c. power and Reyrolle standard are used for d.c. The building is heated chiefly by the modern panel system, the panels being fitted on the walls or ceilings. Coke-fired boilers, separately housed in the basement, provide the hot water for heating and other purposes both in the Mining and the Fuel Departments.

Conference on Soil Science Problems.

THE Imperial Bureau of Soil Science, formed in May 1929 to assist workers on soil science throughout the Empire by providing technical information and promoting personal contacts between them, held its first Conference on Soil Science Problems on Sept. 16–18, at Rothamsted Experimental Station, Harpenden, with which it is in close association. The first day was made the occasion of the annual visit of Empire agricultural officers to the Station. The visitors, who included representatives from Australia, Canada, Ceylon, Gold Coast, India, New Zealand, Nigeria, Sierra Leone, South Africa, Straits Settlements, Federated Malay States, Sudan, Trinidad, Uganda, and Great Britain, were entertained to lunch, following a tour of the farm in which the classical and modern experiment plots were demonstrated. During the luncheon, the Conference was formally opened by the Right Hon. W. G. A. Ormsby-Gore; and later, an inspection of the laboratories was made and the work of the various departments demonstrated in groups, according to the individual interests of the specialist workers present.

The work of the Conference began on the following day, Sir A. D. Hall presiding, and a discussion on the mechanical analysis of soils was opened by Prof. G. W. Robinson (Bangor), who gave an account of the results of his work in comparing methods proposed by the International Society of Soil Science. He showed that similar figures were obtained by different methods with the majority of the soils examined. The main points of the discussion that followed were: The application of the proposed methods to tropical soils and the advisability of choosing a method suited to each particular class of soil; modifications in technique affecting the degree of dispersion of the soil by the omission, with some soils, of acid and peroxide treatment; and the proposed use of sodium hypobromite or chlorine peroxide for the oxidation of organic matter prior to analysis.

Mr. A. W. R. Joachim (Ceylon), who opened the discussion on available phosphorus and potash, spoke with particular reference to the reliability of laboratory tests for availability, such as the Dyer citric acid test and the physiological methods of Mitscherlich and Neubauer, suggesting that more use might be made of data for exchangeable potassium as an index of potash availability. During the discussion, reference was made to the desirability of eliminating errors due to seasonal effects and faulty sampling of the soil, and to the need of trustworthy, rapid, chemical methods to replace the tedious physiological tests. The suggestion was also made that the undoubted popularity of the latter methods on the Continent, and particularly in Germany, could be partly attributed, first, to a lower state of soil fertility than is prevalent in Great Britain; secondly, to unbalanced fertiliser additions, in the past, to soils in the same area, due in some cases to War shortage of one or other of the fertiliser components; thirdly, to legal difficulties involved in the sale of mixed fertilisers; and lastly, to conditions of land tenure.

A discussion on soil reaction and lime requirement was then opened by Mr. P. E. Turner (Trinidad) with an account of his work on the correlation of *p*H measurements of the soil with its degree of saturation with lime. This led to a discussion, principally on the correlation of *p*H values with other factors and the significance of soil reaction, especially in relation to the tolerance of specific plants.

At the afternoon meeting, the chairman, Dr. A. C. D. Rivett (Australia), opened a discussion on the work of the Imperial Bureau of Soil Science. Sir David Chadwick, secretary of the Executive Council of the Imperial Agricultural Bureaux, referring to the need of unity among research workers of the Empire which presaged the inauguration of the Bureau at the Imperial Agricultural Research Conference of 1927, said that the financing of the Bureau from a common fund derived from contributing governments marked a new departure in the constitution of the Empire. The work of the Soil Bureau for the year was then outlined by the Director, Sir John Russell. In the general discussion that followed, recommendations were made, many by overseas representatives, with the view of increasing further the usefulness and efficiency of the Bureau's activities. Finally, a proposal that the Bureau should hold annually a one-day informal conference was adopted.

The morning of Sept. 18, devoted to a discussion of soil survey, with Sir Thomas Middleton as chairman, began with an address on the soil resources of the Empire, by Sir John Russell, in which he said that no basis sufficiently broad to allow the comparative study of regions so widely scattered as those of the Empire has existed until recent years. The grouping of soils is determined, first, by climatic factors, and secondly, by geological factors. Topographical features also play an important part; but as first approximate generalisation, similar climatic conditions may be said to produce similar soil types and a tendency to form similar agricultural conditions. This is well seen in comparing the great regions of the British Empire and should serve as a basis for a valuable survey of the soil's resources. In concluding, he said that there is among manufacturers of the Empire a general working towards mutual agreements to reduce unnecessary competition and over-production; the agricultural scientific workers of the Empire are now organised through the Agricultural Bureaux to pool their information and ensure the maximum result for their efforts: it remains to bring about an organised agriculture for the Empire, based on sound soil and agricultural surveys, to ensure the best use of Imperial resources. A discussion on the position of soil survey in the Empire was then opened by Dr. F. J. Martin (Sierra Leone) with a description of a survey undertaken by him which resulted in an extension of rice-growing areas in Sierra Leone. Examples of similar extensions were brought forward during the general discussion. Sugar cane crops have been considerably extended in India through irrigation, by carrying out survey work which distinguishes between areas that would or would not respond to irrigation. The need for further work of that kind, especially in north-west India, and for

the examination and correlation of official data already available, was stressed.

Among other recommendations put forward in the next discussion, on the classification, mapping, and profile examination of soils, opened by Dr. W. G. Ogg (Edinburgh), were: That uniformity in the classification of soils could be furthered by discussions between surveyors of a large area at a central station; the more extended use of aerial photography in survey work; the use of single value factors and the data derived from examination of the clay fraction of the soil as aids in classifying soils; and the advisability of co-operation between soil surveyors and geologists.

The last discussion, on methods of field experimentation, presided over by Dr. P. J. du Toit (South Africa), began with an account by Dr. J. Wishart (Rothamsted) of plot layout in manurial experiments based on the statistical methods in use at Rothamsted. In further discussion he was able to put forward the advantages of the randomised block and Latin square methods over the older systematic arrangements. Errors in the analysis of yield data in fertiliser experiments on cacao or coconut trees due to lack of uniformity of seed or size of roots were instanced, and this led to a discussion on the most suitable size of plot to be adopted for tree crops, and to the further question of eliminating errors in pasture fertilisation experiments with grazing animals.

The first evening of the Conference was spent at a social gathering at Rothamsted, the second at a joint meeting of the British Empire Section of the International Society of Soil Science and the Soils Sub-Committee of the Agricultural Education Association. Prof. J. Hendrick (Aberdeen) deputised for Prof. N. M. Comber (Leeds) at this meeting, when the Russian Soils Congress and the organisation of the British Empire Section were dealt with in a partly informal discussion.

International Bibliography.

THE Institut International de Bibliographie was founded in 1895 by an international conference held in Brussels in response to the need to index the growing volume of recorded information. As the result of a thorough investigation of the problem, the logical principles of classification were developed, and it became possible to devise a classification, known as the Universal Decimal Classification, which is sufficiently extensive and flexible to index the literature of the world.

The Institute commenced to issue various bibliographies, of which the most important was a classified index to the literature of applied science with the title "Index technique". This publication is still being continued as the "Meddeelingen of the Nederlandsch Instituut voor Documentatie en Registratuur", and, though little known in Great Britain, is perhaps the most useful index of its kind.

The ninth annual conference of the Institute, held at Zurich on Aug. 21-25, was attended by delegates and members from all parts of the world. The British delegates were Sir Charles Sherrington, Sir Frederic Nathan, Dr. J. G. Priestley, and Dr. S. C. Bradford. In the absence of the president, Prof. A. F. C. Pollard, through illness, the chair was taken by M. W. Janički, the president of the newly formed Swiss section of the Institute. In a message to the conference, Prof. Pollard recommended that each national section of the Institute should prepare a list of the current periodical literature of its country, showing which literature has been indexed by the Decimal Classification and which awaits indexing, with the view of gradually building up complete classified national bibliographies.

A number of interesting papers were communicated. M. Paul Otlet recommended the establishment of a new scientific publication called "The Bibliographical Year", which should give an account of the advancement in bibliographical science. Sir Frederic Nathan read a paper in which he showed that the Association of Special Libraries and Information Bureaux arose spontaneously as the result of the pressing need for the supply of information to research workers, and gave an interesting account of the Association's activities; its Directory of Information Bureaux and Sources of Information, its Inquiry Bureau, the setting up of its Panel of Expert Translators, and culminating in its recent decision to recommend the general adoption of the Decimal Classification as a means of co-ordinating bibliographical undertakings.

M. B. Bourrel, director of the bibliographical information department of the Société des Transports en Commun de la Région Parisienne, gave an account of the application of the Decimal Classification to transport undertakings. In a succeeding communication M. Léon Walters, assistant director of the International Municipal Union, Brussels, considered the problem of classification from the point of view of municipal and local administration archives. Next, Dr. Walther, librarian to the Technical High School at Aix-la-Chapelle, dealt with the application of the Decimal Classification as a standard system from the point of view of scientific libraries, and traced the important developments in the use of the classification now taking place in Germany. The unequivocalness and completeness of the classification, as well as a possible simplification of the system by the deletion of certain auxiliary signs, was discussed by Dr. Hanauer, librarian to the Allgemeine Elektrizitätsgesellschaft.

Dr. Predeek, director of the library of the Technical High School, Charlottenburg, illustrated the usefulness of addressograph machines as means for printing catalogue titles and providing the subsequent reprints needed for a bibliographical service. M. W. Janički gave an interesting account of the historical development of bibliographical service in Switzerland. His compatriot, M. E. Mathys, librarian to the General Management of the Swiss Federal Railways, read a paper on the collection, cataloguing, and subject-matter indexing of professional literature, in which he discussed the establishment and running of information bureaux and inquiry offices, and showed the necessity both for national and international co-operation. Dr. Koch-Hesse, of Berlin, then illustrated the application of small-film photography to bibliographical purposes.

In a paper on the development of scientific bibliography in Great Britain, Dr. S. C. Bradford, Keeper of the Science Library at South Kensington, indicated the remarkable growth of institutions using the Universal Decimal Classification in Great Britain, from one to twenty-eight in four years. He showed that a complete bibliographical service comprises: (1) the survey of the literature being published, (2) its collection in the library, (3) the cataloguing and subject-indexing of the collected material, (4) the supply of bibliographies to research workers, (5) arrangements for the service of the books, either by reference, loan, or the issue of photo-copies — none of which departments had been organised satisfactorily up to the present. Dr. Bradford suggested that the material for a complete survey of the world's published literature would be provided if the principal library in each country should issue a weekly catalogue of all the publications of its country classified decimally. Such a catalogue would correspond to the list of accessions of the library, but would

need to be complete, up-to-date, and not necessarily to contain more than the publications of its own country. These weekly classified catalogues could then be used by the special librarian, both for book selection and as the actual author and subject catalogue-titles for his catalogues. The lists could also be amalgamated into a union catalogue of the world's literature. For the latter purposes, standard cataloguing-rules are needed as much as a standard classification. The divergencies in the cataloguing rules of different libraries were illustrated by the single example of the *Comptes rendus* of the French Academy, which was found to be catalogued under a different heading in each of the eight catalogues of large libraries consulted.

The Subject-Matter Index in the Science Library, to which are added all scientific references that are classified by the standard classification, has now grown in three years to more than one and a half million cards. This considerable repertory has been supplemented by gathering together as complete as possible a collection of miscellaneous scientific bibliographies, so that the Library is in a position to supply, so far as other work permits, really extensive bibliographies on scientific subjects in answer to inquiries.

As the result of the conference, the Commission of the Decimal Classification, which has control of the tables of the classification, has now been strengthened by including a delegate from each of the national sections of the Institute and from four of the principal State libraries, by the appointment of sub-commissions which will have charge of the improvement and extension of the different sections of the tables, and by the creation of a small executive committee with power to make small extensions that may be urgently required. Any modifications of the classification, which experience may show to be needed, will now be forthcoming without delay.

One of the most important decisions of the conference was that from next year the *Meddeelingen* of the Nederlandsch Instituut should be extended to include pure science and printed in a new form, bimonthly, under the title *Repertorium Technicum*. Each entry will bear the number which indicates its subject in the Decimal Classification, but, so that the bibliography may be useful to those who do not wish to employ the decimal classification, a small subject-index will be added to each part, and at the end of the year these indexes will be combined in an alphabetical index in three languages. An index of authors will be issued every year, or every two years. The bibliography will also be printed on loose leaves, so that, when it is not desirable to mount the titles on cards, the pages can be filed under the first decimal number on each page, in order to bring together entries on cognate subjects. In addition to references to articles, the *Repertorium* will be also a world-list of the more important technical books, so that it should be indispensable to librarians and research institutions of all kinds. The annual subscription will be £3.

In view of the simplicity and power of the methods of the Institut International de Bibliographie, it is astonishing that during the last thirty years or more so little use has been made of the bibliographical facilities provided by the Institute, the only explanation of which can be the almost complete lack of propaganda. Now that at last the methods of the Institute are beginning to be known, progress has already become rapid. As Sir Charles Sherrington remarked at the conference, scientific men are becoming aware of the need for guidance in the indexing of their publications, and the Institut International de Bibliographie is showing them the way.

S. C. BRADFORD.

University and Educational Intelligence.

BIRMINGHAM.—Under the will of the late treasurer of the University (Mr. Hugh Morton), the University will receive the sum of £20,000, to be applied at the discretion of the Council, in addition to £5000 for the foundation of two scholarships, one in English and the other in law. Of the ultimate residue of the estate, one half will accrue to the University, the other half being divided between the General Hospital and Queen's Hospital.

CAMBRIDGE.—The Vice-Chancellor announces that the late Miss R. M. Clark left to the University Observatory a legacy of £100.

Mr. H. W. Florey, of Gonville and Caius College, has been reappointed Huddersfield lecturer in special pathology.

ST. ANDREWS.—Payment has been received of a sum of £3000 bequeathed to the University by the late Dr. William J. Matheson, of Florida, U.S.A., for the institution of additional bursaries or scholarships in chemistry in the United College. It is proposed that a residential entrance scholarship in chemistry be instituted and that the existing Matheson Bursary should be made tenable for one year.

The new hall of residence for men students, St. Salvator's Hall, came into use on Oct. 2. Chattan House, hitherto occupied as a residence for men students, has been redecorated and furnished to receive women students who could not be accommodated in University Hall and its adjoining overflow houses. At the beginning of this session there will be about 220 students (including men and women) housed in residences under the management of the University.

THE next series of lectures and demonstrations on tropical hygiene, which are intended for men and women outside the medical profession proceeding to the tropics, will be given by Lieut.-Col. G. E. F. Stammers, on Oct. 8-10, 13-17, from 11 A.M. to 12.30 P.M. Syllabuses and full particulars can be obtained on application to the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.

PROSPECTUSES for the coming session have now been issued by technical colleges in London. The Imperial College of Science and Technology has a department of aeronautics which offers complete courses of lectures and laboratory work for graduate students and facilities and personal supervision for researches in every branch of the subject. The Battersea Polytechnic provides full day and evening courses in preparation for the University of London degrees in science and engineering and includes a Domestic Science Department and Training College, and a Department of Hygiene and Public Health. In six years its students are known to have obtained posts as follows: 189 as engineers, 167 as chemists or scientific assistants, 246 as health visitors or sanitary inspectors, etc., 504 as domestic science inspectors or teachers, 48 as art and handicraft teachers and designers. The Chelsea Polytechnic includes day schools and colleges of science and technology, pharmacy, metallurgy, housecraft, and chiropody, and evening classes in science, technology, and domestic subjects. The school of chiropody has a staff of 15 teachers and offers a two-year full-time course as well as a one year course (for older students) and a post-certificate one-year course. The Sir John Cass Technical Institute has departments of pure science, applied chemistry (including brewing and malting, gas manufacture, and petroleum technology), metallurgy, and navigation.

Historic Natural Events.

Oct. 5, 1091. **Thunderstorm in England.**—The "Anglo-Saxon Chronicle" records that "a marvellous sore tempest fell in sundry parts of England but especially in the town of Winchcombe, where (by force of the thunder and lightning) a part of the steeple of the church was thrown down, and the crucifix with the image of Mary standing under the rood-loft was likewise overthrown and shattered in pieces; then followed a foul, a noisome and a most horrible stink in the church". Five hundred houses were blown down in London, and Bow Church was unroofed. In Old Sarum the steeple and many houses were thrown down.

Oct. 5, 1570 (or 1571). **Storms on English Coast.**—There was a great storm of wind and rain in which many ships were lost and much damage was done on land. About midnight the Thames rose so high that it invaded the houses and a woman was drowned as well as many houses and cattle. The sea broke in between Wisbech and Walsoken and drowned a number of villages over a space of ten miles. At Yarmouth a great part of the bridge was carried away and the 'haven house' was carried six miles into the marshes and set down upright with the haven man and his wife. A ship was driven on a house, and some of the sailors climbed out on the roof. Bourne was overflowed to the midway of the height of the church, and boats were rowed over St. Neot's church walls. The water broke into the Wash and permanently flooded a great deal of low ground, destroying the dykes. The Stratford Avon ran so violently that it drove back the waters of the Severn, causing great floods and loss of cattle. A great part of the bridge by Magdalen College, Cambridge, was broken down and in all parts of the country many trees were uprooted.

Oct. 5, 1858. **Donati's Comet.**—On this date Donati's Comet was in conjunction with the bright star, Arcturus. The curved tail of the great comet, not unlike a gigantic quill pen, was then about 35° in length, and the head or nucleus was a brilliant object. The comet, discovered at Florence by Donati on June 2, was a striking naked-eye object seen from the northern hemisphere during September and October. It was last seen from the Cape of Good Hope Observatory on Mar. 4, 1859. The period is of the order of 2000 years.

Oct. 5, 1864. **Storm Wave at Calcutta.**—During a cyclone which swept over Calcutta the sea, rising ten feet above the highest spring tides, covered the whole of the level country at the mouth of the Ganges, causing a death roll of 45,000.

Oct. 5, 1881. **The Tongking Typhoon.**—The most frightful storm on the coast of Annam on record struck Tongking during the morning. The wind caused an abnormally high tide and heavy sea in the river; during the afternoon the waves broke through and washed away the banks, flooding the whole countryside. During the night the storm increased in intensity until there was 6 feet of water in houses three or four miles from the shore. Two thousand houses, 200 churches, and nearly 100 junks were destroyed; there was great loss of life and the whole district was ruined. The s.s. *Quinta* went ashore on the coast of Hainan and was a total loss.

Oct. 8, 1530. **Floods in Italy.**—Following three days of bad weather, with thunderstorms and heavy downpours of rain, a great flood of the Tiber invaded Rome, destroying 600 houses and causing the loss of 12,000 lives. At about the same time there was a great inundation of the sea in Venice.

Oct. 8, 1726. **Aurora.**—Descriptions of this notable aurora are given in *Phil. Trans.*, 1726. As seen from the south of England, the display began about 6 P.M., spread from the northern horizon to all parts of the sky, and, after culminating in activity about 8 P.M. (when a short-lived corona appeared near the zenith), died away after 2 A.M. on Oct. 9. The formation of the corona was preceded by pulsating streamers and cones of light which shot up towards the zenith, first, from an arch in the northern sky and, later, from all parts of the horizon. The display seems to have been similar and but little inferior to that of Mar. 6, 1716, which aroused great interest. It was surmised by one observer that the origin of the phenomenon was "a thin Cloud composed of a Sulphureous Exhalation, hanging over us in the Air, at a considerable Height" that took fire; further, that "they are, doubtless, of great use to the Peace and Safety of the Earth, by venting some of that pernicious Vapour and Ferment that is the Cause of those terrible Convulsions, which Earthquakes are accompanied with". According to Wolf, a sunspot maximum fell during 1727.

Oct. 8, 1871. **Great Fire of Chicago.**—In 1871 the greater part of Chicago was built of wood, which was very dry after an almost rainless summer. On Oct. 8 a fire broke out near the lumber district west of the city, and spread rapidly under the influence of a strong wind. Except for the San Francisco fire of 1906, this was the greatest fire of modern times; in 27 hours 17,450 buildings were destroyed and 100,000 people rendered homeless, while 250 lost their lives. The destruction would have been even more complete but for opportune rain on Oct. 10.

Oct. 10, 1780. **Hurricane in Barbados.**—Barbados was devastated by a hurricane which began on the morning of Oct. 10 and continued for 48 hours. In the afternoon of the first day all the ships were driven from their anchors to sea. In the night Bridgetown was laid nearly level with the earth, and by daylight not one building on the island was undamaged. Most of the livestock and 4326 persons perished, and the loss was estimated at more than a million sterling. It was officially reported that a 12-pound gun was carried by the wind and waves from the south to the north battery, a distance of 140 yards. Other islands in the Lesser Antilles suffered equally; in Martinique 9000 lives were lost and in St. Lucia 6000, and the British and French warships, of which there were many in those waters, were badly damaged. The course of this storm was afterwards worked out in detail by Reid from the logs of these ships.

Oct. 11, 1737. **Destructive Indian Earthquake.**—A violent earthquake and hurricane visited Calcutta and the surrounding district. It is said that the lofty steeple of the English Church sank into the ground without breaking. The water of the Ganges rose 40 feet above its usual level. About 20,000 ships were lost, while 300,000 persons, it is estimated, were killed.

Oct. 11, 1918. **Earthquake in Porto Rico.**—The epicentre of this earthquake lay in the north-eastern portion of Mona Passage, a deep submarine valley, the slopes of which are so steep that they appear to be fault-formed. A few minutes after the earthquake a sea-wave about 16 feet high swept over the north-west coast of the island. During the half-century before, this coast had been subsiding, and the earthquake and sea-waves may have been caused by a displacement along one side of the submarine valley.

Oct. 11–12, 1737. **Cyclone in Bengal.**—A great cyclone crossed the Bay of Bengal and entered the mouth of the Ganges, where a cyclonic wave rose 40 feet above the usual level of the river. It is stated that this wave drowned 300,000 men.

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting at Southampton), Sept. 11.—J. C. Hudson: The effects of two years' atmospheric exposure on the breaking load of hard-drawn non-ferrous wires. The losses in strength after two years' exposure are very small; the majority of non-ferrous materials are very resistant to atmospheric corrosion. Brass is an exception, as its strength is adversely affected by the copper redeposition that accompanies atmospheric corrosion.—W. H. J. Vernon and L. Whitby: The open-air corrosion of copper. (2) The mineralogical relationships of corrosion products. Complete agreement with the formula of the corresponding mineral has been realised in products after seventy years' exposure and upwards. Basic copper sulphate (under most conditions the major constituent) then coincides in composition with brochantite, $CuSO_4.3Cu(OH)_2$; basic copper chloride (in products near the sea-board) with atacamite, $CuCl_3.3Cu(OH)_2$; basic copper carbonate (usually present but in minor proportion) with malachite, $CuCO_3.Cu(OH)_2$. After shorter periods of exposure the basicity of the product is lower than that of the corresponding mineral.—E. Voce: Silicon-copper alloys and silicon-manganese copper alloys. A survey of these alloys, studying their mechanical and physical properties in the cast, drawn, and rolled conditions, with the view of developing and extending their uses.—E. Vaders: A new silicon-zinc-copper alloy. The range of the α-solid solution phase at the copper end of the diagram has been determined; the 90 per cent copper alloy can take up 4·5 per cent silicon into solid solution. Alloys with 2-5 per cent silicon and 70-90 per cent copper have valuable properties. The best alloys within this range are those with 80-82 per cent of copper; these can be forged hot, rolled, and extruded, and give good castings, which have a dense uniform structure free from shrinkage cavities even in the thickest parts.—H. C. Dews: The effect of phosphorus on the strength of Admiralty gun-metal. Phosphorus up to approximately 0·05 per cent has little effect on the mechanical properties or structure. Above 0·05 per cent phosphorus causes the appearance of free Cu_3P and at the same time a reduction in the mechanical properties.—F. Hargreaves: Heat-treatment, ball-hardness, and allotropy of lead. From quenching and ball-hardness tests on lead of high purity, it is suggested that lead is allotropic, the suggested critical points being 187° C. and 228° C., approximately. The hardness varies greatly with the heat-treatment. Very marked changes take place in the hardness immediately after quenching. The presence of 0·005 per cent tin inhibits these marked changes, and they do not take place in commercially pure lead.

PARIS.

Academy of Sciences, Aug. 25.—Georges Urbain: Notice on Achille Le Bel.—Louis Blaringhem: An autofertile hybrid of *Ægilops ovata* and *Triticum dicoccum*.—A. Yersin: Some observations on atmospheric electricity in Indo-China.—Cl. Chevalley: A theorem of Hasse.—Georges Durand: The application of the ideas of convexity and of contingent to obtaining certain criteria of enumeration.—Nikola Obrechkoff: Series of functions.—A. P. Rollet and L. Andrès: The cæsium borates. Evidence has been obtained of the existence of three cæsium borates, possessing 5, 3, and 1 molecule of boric anhydride to 1 molecule of Cs_2O.—L. Bert and P. Ch. Dorier: A new method of synthesis of cinnamic alcohol and its homologues.—R. Weil: New observations on quartz.—M. Blumenthal, P. Fallot, and A. Marin: Geological observations on the limestone of the Spanish Rif of Djebel Musa at Xauen.—Th. Biéler-Chatelan: The quaternary polysynthetic glacier of Monti Simbruini (Central Apennines). The limits of its extension.—H. Hérissey and J. Cheymol: Vicioside. This substance has been isolated from the vetch by methods similar to those described by Ritthausen, but the presence of galactose, found by this author after hydrolysis, could not be confirmed: the only sugar produced was *d*-glucose.—Louis Emberger: A climatic formula applicable in botanical geography.

Sept. 1.—L. Filippoff: The astronomical determination of the period of the disappearance of Atlantis. Atlantis existed during the Quaternary period and disappeared about 7256 B.C.—S. Carrus: The determination, without the square sign, of various expressions relating to skew curves by means of two arbitrary functions capable of defining the radii of curvature and of torsion of the curve.—Serge Tchounikhin: Simplicity of the finite group and the orders of its classes of conjugated elements.—L. S. da Rios: The theory of vortices.—H. Pélabon: New copper oxide rectifiers. In a preceding communication the author has suggested the existence in the active layer of an unsymmetrical condenser consisting of a copper armature, a semiconductor (cupric oxide) separated by an insulating layer of cuprous oxide. To test this view, a condenser has been formed of a metal, a semiconductor of pure copper oxide moulded into pastilles, separated by a semi-insulating layer of gold powder in suspension in varnish, the whole being placed under pressure. This arrangement possessed unilateral conductivity and acted as a rectifier for alternating currents.—E. Rinck: The equilibrium in the fused state between calcium, sodium, and their chlorides.—J. Barbaudy and A. Lalande: Some properties of absolute alcohol.—Albert Portevin and Pierre Chevenard: The change of composition of the cementite constituent in the course of reheating special steels.—A. Nowakowski: The study of certain cellulose and glucose esters by means of the X-rays. The results obtained are in good agreement with the conclusions which may be drawn from the cellulose model suggested by Sponsler and Dore and by Meyer and Mark.—Paul Remy-Genneté: The action of hydrogen and of hydrocarbons on barium. Barium slowly combines with hydrogen at the ordinary temperature, but methane and acetylene after a month in contact show no trace of absorption, and it is suggested that this fact might form the basis of a method of analysis. Carbon monoxide does not react with barium.—M. Prettre, P. Dumanois, and P. Laffitte: The inflammation and combustion of mixtures of pentane and air. In a previous paper it has been shown that there are two visible stages of combustion of pentane in air, one at 270°-300° C. and the other at 660° C. The effect of antidetonant substances on the lower temperature phase of the combustion has now been studied. The antidetonants included benzene, tin tetrethyl, and lead tetrethyl: the effect of adding these substances to the pentane was to reduce and finally to suppress the luminosity of the low temperature stage of combustion.—Ch. Courtot and V. Ouperoff: Study of the action of aluminium chloride on the aryl-alkyl, alkyl, and hydro-aromatic ketones in the presence of tertiary aromatic amines.—Louis Emberger: The stage of vegetation.

Official Publications Received.

BRITISH.

Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. Syllabus of Classes, Session 1930–31. Pp. 132. (London.)

Battersea Polytechnic, Battersea Park Road, London, S.W.11. Calendar of Evening and Afternoon Classes for Session 1930–1931. Pp. 31+14 plates. Free. Technical College for Day Students, and Day School of Arts and Crafts: Calendar, Session 1930–1931. Pp. 48+16 plates. 3*d*. Domestic Science Department and Training College: Full Time Day Instruction, Afternoon and Evening Classes, Session 1930–1931. Pp. 34+9 plates. 3*d*. Department of Hygiene and Public Health, Session 1930–1931. Pp. 24+6 plates. 3*d*. (London.)

Transactions of the Institution of Chemical Engineers. Vol. 7, 1929. Pp. 218. (London.)

Geological Survey Department, Tanganyika Territory. Short Paper No. 5: Water Supplies for Cattle along the Kondoa Irangi–Handeni Stock Route. By F. B. Wade. Pp. 24+6 plates. (Dodoma.)

The Proceedings of the Physical Society. Vol. 42, Part 5, No. 235, August 15. Pp. iv+355-606. (London.) 7*s*. net.

Chelsea Polytechnic, Manresa Road, Chelsea, S.W.3. Prospectus of Day and Evening Classes for Men and Women, Session 1930–31. Pp. 69. Chelsea School of Art. Prospectus, Session 1930–31. Pp. 8. Chelsea College of Physical Education. Prospectus, Session 1930–31. Pp. 11. Chelsea Polytechnic: Chelsea School of Pharmacy. Prospectus, Session 1930–31. Pp. 18. Chelsea Polytechnic: Chelsea School of Metallurgy. Prospectus, Session 1930–31. Pp. 15. Chelsea School of Cookery, Housecraft and Dressmaking. Prospectus, Session 1930–31. Pp. 8. Chelsea School of Chiropody. Prospectus of Day and Evening Courses, Session 1930–31. Pp. 8. (London.)

Department of Tsetse Research, Tanganyika Territory. Annual Report on Experimental Reclamation for the Year ended March 31st, 1930. Pp. 24+4 plates. (London: The Crown Agents for the Colonies.) 1*s*. 6*d*.

Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1929. By Dr. Joseph Pearson. Pp. F16+4 plates. (Colombo: Government Record Office.) 50 cents.

Madras Agricultural Department. Year Book 1929. Pp. 47. (Madras: Government Press.) 12 annas.

Tenth Annual Report of the Scientific and Industrial Research Council of Alberta, 1929. (Report No. 25.) Pp. 65. (Edmonton, Alba.: W. D. McLean.) 35 cents.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 60, January to June 1930. Pp. 268. (London.) 15*s*. net.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1319 (Ae. 455): Moments and Forces on a Yawed Model Aeroplane. By W. G. A. Perring and C. Callen. (T. 2930.) Pp. 3+2 plates. 4*d*. net. No. 1321 (Ae. 458): Maximum Lift Coefficient of R.A.F. 30 All-moving Rudder. By F. B. Bradfield. (T. 2941.) Pp. 4+3 plates. 4*d*. net. No. 1327 (Ae. 460): Wind Tunnel Tests of Seven Struts. By A. S. Hartshorn. (T. 2935 and A.) Pp. 12+6 plates. 9*d*. net. No. 1311 (Ae. 450): Wind Tunnel Tests on Gloster and Supermarine Wing Radiators. By Dr. R. G. Harris, L. E. Caygill and R. A. Fairthorne. (T. 2624.) Pp. 14+5 plates. 9*d*. net. (London: H.M. Stationery Office.)

Transactions of the Leicester Literary and Philosophical Society, together with the Council's Report and the Reports of the Sections 1929–30. Vol. 31. Pp. 62. (Leicester.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. Edited for the College by Dr. S. Graham Brade-Birks. No. 27, 1930. Pp. 256. (Wye.) 8*s*. 6*d*.; to Residents in Kent and Surrey, 4*s*. 6*d*.

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1930–31. Pp. 337. (Manchester.)

World Agricultural Tractor Trials, 1930, under the Auspices of the Royal Agricultural Society of England in conjunction with the Institute of Agricultural Engineering, University of Oxford. Official Report on Tests and Catalogue of Machines taking part in the Public Demonstration at Ardington, near Wantage, Sept. 16th-19th, 1930. Pp. 109. (Oxford: Institute of Agricultural Engineering). 1*s*.

Proceedings of the Royal Society. Series A, Vol. 129, No. A809, September 3. Pp. 234. (London: Harrison and Sons, Ltd.) 12*s*.

Tanganyika Territory. Tsetse Research Annual Report for the Year ended December 31st, 1929. Pp. 20. (London: The Crown Agents for the Colonies.) 1*s*.

The Royal Technical College, Glasgow. Calendar for the One Hundred and Thirty-fifth Session, 1930–1931. Pp. 440+xxx. (Glasgow.)

Ceylon Journal of Science. Section G: Archaeology, Ethnology, etc. Vol. 2, Part 2, August 15th. Edited by A. M. Hocart. Pp. 73-147+plates 37-77. (Ceylon: The Archaeological Commissioner; London: Dulau and Co., Ltd.) 3 rupees.

FOREIGN.

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 5, No. 2. Rédigé par E. S. Russell. Pp. 139-284. (Copenhague: Andr. Fred. Høst et fils.) 4.50 kr.

U.S. Department of Agriculture. Technical Bulletin No. 190: A Study of the Lesser Migratory Grasshopper. By R. L. Shotwell. Pp. 35. 10 cents. Circular No. 123: A Comparative Study of Dusting by means of Airplane and Ground Machine for the Control of the Blueberry Maggot. By F. H. Lathrop and C. B. Nickels. Pp. 15. 5 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the American Museum of Natural History. Vol. 61, Art. 4: The Whale Shark, *Rhineodon typus*—Description of the Skeletal Parts and Classification based on the Marathon Specimen captured in 1923. By E. Grace White. Pp. 129-160+plates 4-12. (New York City.)

Instituts scientifiques de Buitenzorg: "'s Lands Plantentuin". Treubia: recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Suppl., Livraison 6, Juillet. Pp. 305-347. (Buitenzorg: Archipel Drukkerij.) 2.50 f.

Transactions of the American Institute of Mining and Metallurgical Engineers (Incorporated). Coal Division, 1930: containing Papers and Discussions presented at Meetings held in New York, February 1928, February 1929, and February 1930. Pp. 724. (New York City.) 5 dollars net.

U.S. Department of Commerce: Coast and Geodetic Survey. Special Publication No. 164: First-Order Triangulation in Southeast Alaska. By Walter F. Reynolds. Pp. vi+157. (Washington, D.C.: Government Printing Office.) 40 cents.

Smithsonian Miscellaneous Collections. Vol. 83: The Skeletal Remains of Early Man. By Aleš Hrdlička. (Publication 3033.) Pp. x+379+93 plates. (Washington, D.C.: Smithsonian Institution.)

Smithsonian Institution: United States National Museum. Bulletin 150: Revision of the Fishes of the Family Liparidae. By Victor Burke. Pp. xii+204. (Washington, D.C.: Government Printing Office.) 45 cents.

Smithsonian Institution: Bureau of American Ethnology. Bulletin 95: Contributions to Fox Ethnology, II. By Truman Michelson. Pp. vii+183. 75 cents. Bulletin 96: Early Pueblo Ruins in the Piedra District, Southwestern Colorado. By Frank H. H. Roberts, Jr. Pp. ix+190+55 plates. 75 cents. (Washington, D.C.: Government Printing Office.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104a: Supplement, Oceanographische en Meteorologische Waarnemingen in dem Indischen Oceaan, September, October, November (1856–1914). Tabellen, Waarnemingen Noord van 0° (1856–1923). Pp. iii+36. (Amsterdam: Seyffardt's Boekhandel.) 1.25 fl.

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 134: Wood-boring Insects which attack Furniture and Buildings. By E. I. McDaniel. Pp. 12. Special Bulletin No. 196: Cantaloupe Production in Michigan. By J. B. Edmond, A. B. Strand and F. J. McNall. Pp. 51. Special Bulletin No. 198: Combine Harvester Threshers in Michigan. By E. C. Sauve. Pp. 19. Special Bulletin No. 199: Studies in Swine Feeding, Parts 1, 2, 3. By W. E. J. Edwards. Pp. 36. Special Bulletin No. 200: Hogging off Corn. By W. E. J. Edwards. Pp. 17. Special Bulletin No. 201: The Influence of Sugar and Butterfat on Quality of Ice Cream. By P. S. Lucas, Toshihide Matsui and D. E. Mook. Pp. 22. Special Bulletin No. 202: The Propagation of the Highbush Blueberry. By Stanley Johnston. Pp. 22. Special Bulletin No. 203: Spraying Materials and the Control of Apple Scab. By W. C. Dutton. Pp. 32. Technical Bulletin No. 106: The Fruiting Habits and Pruning of the Campbell Early Grape. By N. L. Partridge. Pp. 48. (East Lansing, Mich.)

Cornell University: Agricultural Experiment Station. Bulletin 502: An Economic Study of Food consumed by Farm and Village Families in Central New York. By Faith M. Williams and Julia E. Lockwood. Pp. 52. Bulletin 503: The Molting Factor in judging Fowls for Egg Production. By Dean R. Marble. Pp. 42. Bulletin 504: A Partial Sociological Study of Dryden, New York, with Special Emphasis on its Historical Development. By Gladys M. Kensler and Bruce L. Melvin. Pp. 65. Bulletin 508: Lead-Arsenate Experiments on the Germination of Weed Seeds. By W. C. Muenscher. Pp. 10. Bulletin 509: Results of Sweet-Corn Suckering Experiments on Long Island. By H. C. Thompson, H. S. Milles and P. H. Wessels. Pp. 11. Memoir 128: Studies on Fungicides. 1: Concepts and Terminology, by H. H. Whetzel and S. E. A. McCallan; 2: Testing Protective Fungicides in the Laboratory, by S. E. A. McCallan; 3: The Solvent Action of Spore Excretions and other Agencies on Protective Copper Fungicides, by S. E. A. McCallan. Pp. 79. (Ithaca, N.Y.)

Transactions of the San Diego Society of Natural History. Vol. 6, No. 7: Notes on some Species of *Epitonium*, Subgenus *Nitidiscala*, from the West Coast of North America. By A. M. Strong. Pp. 183-196+plate 20. Vol. 6, No. 8: Two new Subspecies of Birds from Sonora. By A. J. van Rossem. Pp. 197-198. Vol. 6, No. 9: The Races of *Auriparus flaviceps* (Sundevall). By A. J. van Rossem. Pp. 199-202. Vol. 6, No. 10: Comment on the Marsh Sparrows of Southern and Lower California, with the Description of a new Race. By Laurence M. Huey. Pp. 203-206. (San Diego, Cal.)

Det Kgl. Danske Videnskabernes Selskab. Biologiske Meddelelser, Bind 9, Nr. 2: The Species of the Genus Larix and their Geographical Distribution. By C. H. Ostenfeld and C. Syrach Larsen. Pp. 107. (København: Andr. Fred. Høst et fils.) 5.00 kr.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 10. Pp. 399-418+plates 77-80. 0.80 yen. Section 3: Botany. Vol. 2, Part 4. Pp. 345-380. 0.60 yen. Vol. 2, Part 5. Pp. 381-412+plates 18-21. 0.80 yen. (Tokyo: Maruzen Co., Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 260: Notes on Helium Spectrum in the Presence of the Electric Field. By Yoshio Ishida. Pp. 49-61+plates 1-11. 45 sen. No. 261: On Tea Tannin isolated from Green Tea. By Michiyo Tsujimuro. Pp. 63-69+plate 12. 15 sen. Nos. 262-263: Experimental Studies on Adsorption by Means of X-Rays, by Morisô Hirata; High Voltage Phenomena in Insulating Oil, Part 2 (Abridgment), by Takeshi Nishi, Kiyoki Ohtsuka and Yasuo Arakawa. Pp. 71-103+plates 13-18. 60 sen. No. 264: Fine Structures in the Band Spectra of Hydrogen and Helium examined under High Resolution. By Sunao Imanishi. Pp. 105-115+plates 19-20. 20 sen. (Tôkyô: Iwanami Shoten.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 19, No. 3, July. Pp. 265-364. (Tokyo and Sendai: Maruzen Co., Ltd.)

CATALOGUES.

A Catalogue of General Literature, including a selection from the Library of the late Charles Whibley. (No. 452.) Pp. 40. (Cambridge: Bowes and Bowes.)

Apparatus for Testing Petroleum and its Products. Pp. 52. (London: A. Gallenkamp and Co., Ltd.)

The Nickel Bulletin. Vol. 3, No. 9, September. Pp. 281-312. (London: The Mond Nickel Co., Ltd.)

Diary of Societies.

FRIDAY, OCTOBER 3.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at "The Manchester" Limited, Royal Exchange, Manchester), at 7.—B. D. Porritt: Some Aspects of Standardisation.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. J. Crispin: The Development of the Bridge.

TEXTILE INSTITUTE (at Manchester), at 7.30.—J. Smeaton: Textile Specifications and their Preparation.

SATURDAY, OCTOBER 4.

ROYAL SANITARY INSTITUTE (in the Assembly Room, Town Hall, Hereford), at 10.—Councillor Mrs. Luard: The Place of Women in Local Government.—G. H. Jack: The Preservation of the Countryside.—Councillor J. R. Barker: The Health Authority and the Milk Supply.

BIOCHEMICAL SOCIETY (in Biochemical Laboratory, Cambridge), at 3.—E. L. Smith and V. Hazley: (*a*) Action of Antimony Trichloride with Cod-liver Oil and its Unsaponifiable Fraction; (*b*) A New Technique for the Antimony Trichloride Colour Test.—B. C. Guha: Observations on the Newer Factors Necessary for the Normal Growth of the Rat.—K. H. Coward, F. J. Dyer, K. M. Key, and B. J. E. Morgan: A Quantitative Method for the Biological Estimation of Vitamin A.—B. Woolf: The Addition Compound Theory of Enzyme Action.—Dr. M. Nierenstein, J. C. Pool, and N. V. Price: Pyrogallase, a New Enzyme.—T. Moore: The Distribution of Vitamin A and Carotene in the Body of the Rat.—B. H. E. Cadness and C. G. L. Wolf: Urinary Proteases.—A. N. Drury and L. J. Harris: Vitamin B Deficiency in the Rat, Bradycardia as a Distinctive Feature.—W. Ramsden: Denaturation of Proteins by Urea.—R. P. Cook, Prof. J. B. S. Haldane, and L. W. Mapson: The Action of Carbon Monoxide on the Oxidation of Certain Substances by *B. coli communis*.—M. Stephenson and L. H. Stickland: Bacterial Reductions of Molecular Hydrogen.—A. Patey and B. E. Holmes: Preliminary Observations of a Biochemical Nature on the Tumour-Producing Filtrates from the Rous Sarcoma.—D. R. P. Murray: The Inhibition of Esterases by Excess Substrate.—Demonstration by R. P. Cook, Prof. J. B. S. Haldane, and L. W. Mapson: The Use of the Barcroft Manometer in Determining the Respiration of Tissues in the Presence of Mixtures of CO and O_2.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch) (at the College of Technology, Manchester), at 4.—R. W. Stubbs: Presidential Address.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District) (at Beach House Park Pavilion, Worthing), at 4.45.—P. E. Harvey: Notes on Recent Works at Worthing.—B. V. Bradforth: The Storm-Water Problem at Worthing.

MONDAY, OCTOBER 6.

SOCIETY OF ENGINEERS (at Burlington House, Piccadilly), at 6.—Lieut.-Col. H. C. Hawkins: Some Impressions of America.

IRON AND STEEL INSTITUTE (Joint Meeting with the Cleveland Institute of Engineers) (at the Cleveland Technical Institution, Middlesbrough), at 7.30.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—J. Sárek: What Reasons compelled the Prague Ironworks to Introduce Thin-walled Blast-furnaces.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—L. W. Schuster: The Effect of Contamination by Nitrogen on the Structure of Electric Welds.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

HALIFAX TEXTILE SOCIETY (at Friends' Meeting House, Halifax), at 7.30.—B. S. Rowntree: Unemployment.

INSTITUTE OF METALS (Scottish Local Section) (at Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow), at 7.30.—Aluminium Review and Visit of the President.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (jointly with Chemical Engineering Group) (at Institution of Civil Engineers), at 8.—Dr. E. Hauser: Recent Results in Structure Research of Colloids in Science and Industry.

TUESDAY, OCTOBER 7.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.—G. L. Copping: Power Plant Chimney Pollution.

INSTITUTE OF METALS (Birmingham Local Section) (in Chamber of Commerce, Birmingham), at 7.—T. G. Bamford: Chairman's Address.

IRON AND STEEL INSTITUTE (Joint Meeting with the Lincolnshire Iron and Steel Institute) (at the Secondary Schools, Doncaster Road, Scunthorpe), at 7.—F. Bainbridge: Developments in Fuel Economy at Skinningrove.—J. A. Jones: Chromium-Copper Structural Steels.

IRON AND STEEL INSTITUTE (Joint Meeting with the Sheffield Metallurgical Association) (at 198 West Street, Sheffield), at 7.30.—D. F. Campbell: High-Frequency Steel Furnaces.—W. H. Hatfield: Permanence of Dimensions under Stress at Elevated Temperatures.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 8.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

WEDNESDAY, OCTOBER 8.

ILLUMINATING ENGINEERING SOCIETY (at 15 Savoy Street, W.C.2), at 6.30.—Report on Progress in Illuminating Engineering, and Display of Exhibits illustrating Recent Developments in Illumination.

TELEVISION SOCIETY (at University College), at 7.—J. H. O. Harries: Some Developments in Television based on Quantitative Analysis (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—Sir Herbert Austin: The Future Trend of Automobile Design (Presidential Address).

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 8.—Dr. S. J. Kohli: The Effect of Surface Conditions on Heat Transmission.

EUGENICS SOCIETY (at Linnean Society), at 8.30.—Dr. E. B. Turner and others: Quinquennial Health Assessments—(*a*) Unemployables; (*b*) National Health Insurance.

THURSDAY, OCTOBER 9.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (British Section) (at Royal Agricultural Hall), at 10 A.M.—H. Bradley: Some Physical Properties of Leather.—R. H. Marriott: The Origin of Ammonia in Lime Liquors.—G. E. Knowles: Study of Dyes Suitable for Dyeing Synthetic Tanned Leather.—W. R. Atkin: Effect of Heat on Chrome Alum Solutions.—E. C. Line: Some Applications of the Microscope in Leather Manufacture.

ROYAL AERONAUTICAL SOCIETY (in the Lecture Hall of the Royal Society of Arts), at 6.30.—C. R. Fairey: The Growth of Aviation.

INSTITUTE OF METALS (London Local Section) (at Society of Motor Manufacturers and Traders, Ltd., 83 Pall Mall), at 7.30.—W. T. Griffiths: Chairman's Address.

INSTITUTION OF WELDING ENGINEERS (at the Engineers' Club, Albert Square, Manchester), at 7.45.—J. Ryder: The Training of Operators in the Welding and Cutting Industries.

FRIDAY, OCTOBER 10.

ROYAL SANITARY INSTITUTE (in the Guildhall, Nottingham), at 4.30.—Alderman A. R. Atkey: River Pollution.—Dr. L. P. Lockhart: Industrial Medicine in Relation to Public Health.

IRON AND STEEL INSTITUTE (Joint Meeting with the Local Branch of the South Wales Institute of Engineers) (at the Royal Metal Exchange, Swansea), at 7.—A. Kříž: The Heterogeneity of an Ingot made by the Harmet Process.—H. C. Wood: Open-hearth Furnace Steelworks: a Comparison of British and Continental Installations and Practice.—O. Quadrat: A Contribution on the Problem of the Analysis of Basic Slags and the Representation of their Composition in a Triangular Diagram.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. Dunlop: The Refining of Cane Sugar.

INSTITUTE OF METALS (Sheffield Local Section) (in Mappin Hall, Applied Science Department, University, Sheffield), at 7.30.—Prof. F. C. Thompson: Some Observations on the Wire Drawing Process (Sorby Lecture).

SATURDAY, OCTOBER 11.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at the Technical College, Burnley).—F. Griffiths: Belgian Moulding Sands in the Iron Foundry.

PUBLIC LECTURES.

SATURDAY, OCTOBER 4.

MATHEMATICAL ASSOCIATION (at Bedford College), at 3.—W. C. Fletcher: Napier's Method of Constructing Logarithms and its Advantages for School Use.

MONDAY, OCTOBER 6.

UNIVERSITY COLLEGE, LONDON, at 2.30.—Sir Flinders Petrie: Egyptian History before the 18th Dynasty.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Types of Pneumococci in Adults and Children and their Significance (Harben Lecture 1).

TUESDAY, OCTOBER 7.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Epidemiology; the Refining of Antipneumococcus Serum (Harben Lecture 2).

KING'S COLLEGE, LONDON, at 5.—Dr. J. W. Pickering: Blood Plasma and Platelets. (Succeeding Lectures on Oct. 14, 21, and 28.)

WEDNESDAY, OCTOBER 8.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. W. H. Park: Pneumonia: The Therapeutic Use of Vaccines and Antibacterial Sera (Harben Lecture 3).

THURSDAY, OCTOBER 9.

BEDFORD COLLEGE, at 2.—Prof. Wilson: General Physics.—At 5.—Dr. P. Hopkins: A Psycho-Analytic Study of Jeremy Bentham as a Type of Social Reformer.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Rev. Dr. A. H. Gray: Christian Civilisation and Contraception.

UNIVERSITY COLLEGE, LONDON, at 5.30.—R. Engelbach: Recent Discoveries in Egypt.—Prof. H. Spemann: Introduction to the Theory and Practice of Experimental Embryology (in English). (Succeeding Lecture on Oct. 10.)

SATURDAY, OCTOBER 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: Native Life in the Solomon Islands.

CONGRESS.

OCTOBER 15 TO 23.

INTERNATIONAL CONGRESS OF HYDROLOGY, CLIMATOLOGY, AND MEDICAL GEOLOGY (at Lisbon).