NATURE

SATURDAY, MARCH 10, 1928.

CONTENTS.

Popular Science.

POPULAR science is a phrase which almost inevitably conjures visions of Pepper's ghost, unpleasant smells, a loud bang, and a disapproving mother. Not only in chemistry and physics, but also in psychology, sociology, and economics, the term suggests a superficial acquaintance with the more amusing manifestations of natural phenomena or with some arguable thesis concerning political affairs rather than any widespread understanding of the relation between cause and effect. Nevertheless, there is a general lay interest in the march of science, and very laudable attempts have been made, and continue to be made, to keep the populace informed of the trend of its progress, its rate, its direction, its practical effects, and something of the spirit permeating its body of serving men and women. Such a presentation demands painstaking and prolonged effort. The material must not be inaccurate, yet it must necessarily be indefinite, it must be attractive but not sensational, dignified but not high-brow. It must not be presented in its native language, but in that of everyday speech; it must indicate some practical advantage or it must positively refrain from suggesting any such mundane possibility, according as it is intended to be read before or after dinner.

We need not debate the desirability of recording the progress of scientific investigation and of discussing cognate matters in such a way as appeals to the 'average' man. Obviously, if the task is not undertaken there can be little public appreciation of or sympathy with the objects to which the workers have devoted their labours, neither can there be full support in the provision of conditions necessary for the fruition of their efforts. Could one, for example, imagine an unenlightened community establishing a Ministry of Health, or a Department of Scientific and Industrial Research, or even a Broadcasting Corporation? It does not necessarily follow, of course, that progress is any the more rapid on account of public interest, especially when the problem happens to be one which may admit of confusion by the articulate assistance of partially informed critics, but it is indisputable that encouragement and provision are much more likely to be the outcome of knowledge than of ignorance. Apart from such a consideration, most readers of the general press seek to know more of the world around them, whether physical, moral, ethnological, or industrial, provided that the effort accompanying the stimulation of their interest is not too noticeable. If science is displayed for their benefit, it is not intended that they should be

creative investigators ; if poetry, that they should rush into verse. Besides, ignorance of natural laws, as of other laws, is no insurance against the regrettable consequences which may arise from their neglect.

The translation of scientific news—nowadays so enormous in its bulk—into suitable language, and its condensation to comparatively minute dimensions, are undertaken in a systematic manner in the United States of America by an organisation known as Science Service, Inc., directed by Dr. E. E. Slosson, and functioning under the auspices of the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science. This organisation publishes daily science news bulletins, and a weekly summary of current science entitled the *Science News-Letter*, in which current events, scientific discoveries, and résumés of progress, together with broadly-drawn reports of the proceedings of scientific conventions, are recorded in simple terms. In addition, there is compiled a weekly digest, intended to present the cream of the week's scientific news, which is regularly used by more than twenty broadcasting stations in the United States.

Fortunately, in Great Britain there is little fear that discoveries might be announced to the listening public in a manner savouring of sensationalism, or that accounts of scientific affairs might be so rendered as to appear ludicrous to the initiated, for the policy in this respect of the British Broadcasting Corporation and of its predecessor company has been exemplary. We are, however, familiar with the result of excursions by otherwise competent journalists into spheres with which they are not familiar ; indeed, the distaste for publicity which is usually ascribed to undue modesty might, if the truth were known, quite possibly often be traced simply to a fear of misrepresentation. The American press is now able, however, to rely on telegraphic news 'stories,' prepared by the managing editor of Science Service, Mr. Watson Davis, and the members of his specialist staff, so that their reports of the proceedings of conferences and conventions shall be well-balanced and accurate, without losing their attractiveness as items of news.

In Great Britain there is, of course, fairly adequate publication and survey of the results of research, such publication being intended for the use of the scientific population itself, and being normally directed by members of that fraternity, but we seem to lack a widespread sense of the importance of an appeal to the non-specialist members of the community as part of their ordinary daily culture, an appeal which must, to be worth while, be sponsored by the most notable members of the professions, and to be effective by the more journalistically-minded among them. There is, after all, no valid reason why the dissemination of knowledge beyond the confines of schools and colleges, provided it is carried out with scrupulous honesty, dignity, and restraint, should not be acknowledged to be as valuable a social service as the collection and arrangement of the knowledge itself. True, this view has been given practical effect in certain influential sections of the British lay press by acknowledged authorities in a number of the sciences, but apart from one or two publications of admitted standing, there is little organised continuous effort in this direction. An attempt was made a couple of years ago to secure the interest of scientific societies and institutions in Great Britain in the establishment of a science publicity service, but the response was so disappointing that the scheme was abandoned.

Dr. E. E. Slosson, in a recent address before the American Association for Adult Education, made the somewhat surprising statement that archæology and astronomy—essentially remote and unpractical—head the list of the sciences in order of popular interest, and that the essentially practical sciences are low in the list. He ascribes this, probably correctly, to the same cause as that operating in the selection of, say, 'Futuristic Art' as a subject of study in a women's club rather than 'Domestic Economy.' He declares that scientific workers have been too humble and too modest in claiming credit for what they have done and what they can do in the control of human affairs, but have allowed statesmen, writers, and financiers to take all the praise for the advance in civilisation and the amelioration of living conditions that were really due to scientific research. If we look at the matter from the point of view of the wealth of nations, as Dr. G. E. Hale, the honorary chairman of the National Research Council, has recently done in *Harper's Magazine*, it is clear enough that the business of men of science is to help to guide mankind as well as to serve it. That is to say, if a scientific orientation can more universally be associated with moral and religious convictions in the equipment of the human mind, there will be less danger of the wicked and unscrupulous misuse of scientific power, less point in arguing the prohibition of poison gas, and an extension of that wider fraternal patriotism which distinguishes scientific international relations.

Letters to the Editor.

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

Magnetic Properties of Single Crystals of Zinc and Cadmium.

RECENT investigators have studied the thermal expansion, the electrical resistance, the elastic constant, the thermoelectric and the photoelectric effects of single crystals of metals, but up to the present few accurate results have been obtained for the fundamental para- or diamagnetic properties of such metals.

Last year the susceptibilities of the alkali metals were studied, and it was thought of interest to extend this investigation to a study of the elements of the second column of the periodic system. When these elements were studied previously (Honda and Owen), metals in the form of an isotropic aggregate of crystals were used. As zinc and cadmium form crystals of the hexagonal system, the value of the magnetic susceptibility parallel to the crystallographic axis would be expected to differ from its value in a perpendicular direction.

In making crystals for these experiments, the method described by Bridgman was used. He found that for cadmium and zinc the preferred manner of growth was with the basal plane parallel or perpendicular to the axis of the cylinder. Under a rough optical examination, the crystals used in the experiment referred to appeared to be orientated with the basal plane parallel to the axis of the cylinder.

To study the susceptibility, the crystals were suspended vertically from one arm of a balance so that the lower end hung between the poles of an electromagnet, and weighings were taken in the presence and absence of a known magnetic field. The crystal was rotated through 360° about a vertical axis, readings being taken every 15°. The results obtained are shown in the accompanying diagram (Fig. 1). At the position of maximum and minimum effect, readings were taken for a range of field from 5000 to 12,000 gauss, and corrections for iron impurities were made according to the method given by Owen. By this method, the amount of free iron contained in the metal was found to be of the order of $0{\cdot}5 \times 10^{-6}$ gm. of iron per gram of metal. The specific susceptibilities obtained in this manner were, for zinc, $-0{\cdot}183 \times 10^{-6}$ in a direction parallel to the principal axis of the crystal, and $-0{\cdot}147 \times 10^{-6}$ in a direction perpendicular to this. For cadmium, these values were $-0{\cdot}276 \times 10^{-6}$ and $-0{\cdot}169 \times 10^{-6}$. The values given by Owen, obtained from coarse-grained crystals, were, zinc $-0{\cdot}155 \times 10^{-6}$ and cadmium $-0{\cdot}18 \times 10^{-6}$.

It is intended to study a still larger number of crystals and to investigate the influence of low temperatures upon their magnetic susceptibility.

One of us, Elizabeth Cohen, has been enabled to co-operate in this investigation through the award to her of a studentship by the National Research Council of Canada.

J. C. MCLENNAN.
RICHARD RUEDY.
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University of Toronto,
Jan. 21.

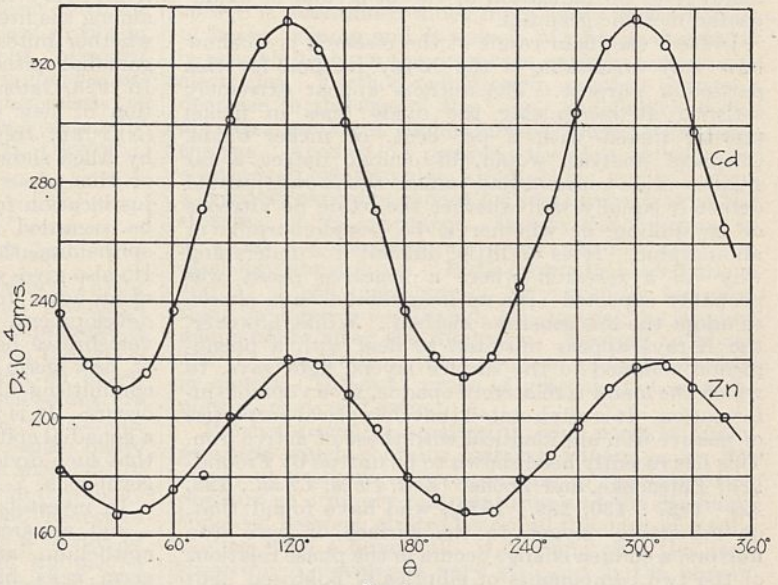

FIG. 1.

Passivity and Protective Oxide Films.

IN NATURE of Feb. 11 (p. 222) it is stated that "An X-ray examination of finely divided iron, nickel, and chromium, conducted by F. Krüger and E. Nähring at Greifswald, has shown conclusively that films of oxide thicker than 10^{-7} cm. are not present on the surface of a passive metal." Lest a wrong impression be gained from this statement, I would venture to add a few remarks on the factors which determine the thickness of protective films.

The film produced by oxidising agencies on metals necessarily ceases to thicken as soon as it becomes sufficiently protective to exclude the oxidising agent. Recent work (*Jour. Chem. Soc.*, 1020; 1927) has pointed to the fact that, on freshly abraded iron, the considerable thickening of the film experienced proceeds through the production of cracks due to the internal stresses left by the abrasion; only when this cracking of the film has ceased will the thickening come to an end. Since a cracked film produces no passivity, coarsely ground metal requires a longer time to become passive than finely ground metal, and develops a thicker film, especially if substances be present in the solution which are capable of penetrating the smallest cracks (*e.g.* chlorine ions). The films obtained from abraded specimens attain thicknesses of the order 10^{-6} cm., and can be isolated from their basis and studied. In the presence of a regulated amount of penetrating anions, the thickness may come to exceed 4×10^{-6} cm., and the films will then give rise to interference tints. Great thickening is only to be obtained under conditions which render the material less perfectly protective, and there is naturally some danger that the film will break down altogether. Under suitable conditions, however, considerable thicknesses may be reached; the writer has quite recently prepared

some specimens showing the complete sequence of interference tints right up to the late second-order colours; although produced at room temperature, the sequence of colours is the same as that of the 'temper colours' obtained at high temperatures, and the tints are, on the whole, brighter.

The tiny particles of metal used by Krüger and Nähring were presumably almost free from internal stresses. On stress-free metal there will be practically no cracking of the film, and the film will stifle its own growth as soon as it is continuous over the whole surface. There is no reason to think that the thickness will come to exceed 10^{-7} cm. In any event, it is not probable that these very thin films would cause oxide-lines. The work of Kohlschütter and Krähenbühl (*Zeit. Elektrochem.*, **29**, 570; 1923) on films of silver halides suggests that such films only assume their proper crystalline structure when they reach a much greater thickness; a 'pseudomorphic' stage precedes the 'idiomorphic' stage. Krüger and Nähring's attempt to check their method by studying mixtures of granular oxide with granular metal gives no indication of the behaviour of oxide-coated metallic granules.

Indeed, the main result of the research is to show how very unsuitable is the X-ray method for this particular purpose. The authors appear extremely satisfied at recognising the oxide lines in nickel powder mixed with 2 per cent. of nickel oxide. Chemical analysis would, of course, detect a far smaller oxide-content, and (unlike the X-rays) would detect it equally well whether the oxide be vitreous or crystalline, or whether it be pseudomorphic or idiomorphic. It is a little difficult to understand why—in a research where a negative result was probably expected—the authors should have chosen to adopt the less sensitive method. While, however, the X-rays appear unsuited to deal with a phenomenon confined to the surface layers, light rays, to which the metal is relatively opaque, give valuable information. It is often stated that the optical properties of passive iron are identical with those of active iron. This has recently been shown to be untrue by Freundlich, Patscheke, and Zocher (*Zeit. Phys. Chem.*, **128**, 321; 1927: **130**, 289; 1927), who have found that, on admitting oxygen to the surface of pure iron mirrors, a sudden change occurs in the phase relations of the two components of elliptically polarised light reflected from the metal; this change they attribute to an oxide film. At the same time—and, no doubt, owing to the same cause—the chemical activity suddenly falls off, the iron becoming unaffected by nitric acid of concentrations which have a marked action upon the iron mirrors if introduced *before* the admission of oxygen.

'Air-passivity' (*i.e.* marked change in chemical properties of iron, brought about simply by exposure to air or oxygen) appears to be a property of the pure metal. It is not shown well by the commercial varieties of iron (other than chromium steels), probably because the oxide-film produced by gaseous oxygen has discontinuities at the junctions of the different phases present. The phenomenon is, however, displayed both by Freundlich's iron mirrors, produced by the decomposition of the carbonyl, and also by the electrolytic iron used in the writer's own work. It has been somewhat satisfactory to find that the quite independent study of the two materials —obtained by two totally different methods and in forms quite dissimilar externally—has led to concordant results and identical conclusions.

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The Trail of the Germ-plasm.

IN his brilliant analysis of the phenomena of growth, T. B. Robertson ("Chemical Basis of Growth and Senescence," 1923) starts with the assumption that growth phenomena can be likened to certain chemical reactions which are subject first to an acceleration due to catalysis and in a later phase diminished by the products formed in the course of the reactions (autocatalysis). Growth phenomena so closely resemble such reactions in so many cases cited, that Robertson gradually assumes that his premise is correct, and finally ends in accepting the proof accumulated. Let the thesis be accepted as a working hypothesis. The two most awkward phenomena to bring in line with the hypothesis were found to be the carrying on of the germ-plasm intact in the course of development to the adult gonad, and cancer-like growths. In connexion with this hypothesis the following observations on germ-plasm may be helpful.

With regard to the trail of the gonadial germ-plasm in ontogeny a great deal has been written, but relatively very little determined. In a recent search among the literature of the subject, I tried to find out whether mitoses had *ever* been recorded in an adult gonadial epithelium, and found very little information. In 1923, Gatenby discussed the question of the formation of new egg-cells in the ovary of vertebrates (NATURE, July 7, vol. 112), and quotes recent work by Allen showing mitoses in the germinal epithelium of Mus (*Amer. Jour. of Anat.*, vol. 31, 5; 1923) as justification for a particular case in which ova may be regarded as being derived from the gonadial epithelium, the so-called somatic part of the ovary. He also gives a photomicrograph of a section of ovary of an adult frog, showing germ-cells in all stages of development, and states "it is indisputable that in vertebrates below the mammals seasonal accessions of new germ-cells take place," without, however, committing himself to views on how this accession occurs. It is admitted that even if mitoses occur in a gonadial epithelium, the interpretation may be made that such dividing cells may be immigrated primitive germ-cells.

In invertebrates germ-cells are found attached to —and apparently proliferating from—the germinal epithelium, and it is generally assumed that such germ-cells have arisen from the underlying epithelium. But the interpretation that mitoses in a germinal epithelium may be due to an immigration of primary germ-cells applies with greater force in the case of invertebrates. It is thus permissible to raise again in a different form the old problem, namely: Which and where are the germ-cells during adolescent and inter-spawning periods? In this inquiry it may not be enough to know the complete ontogeny of a germinal epithelium, unless it be proved at the same time that that germinal epithelium does produce from its own elements—gametes; for it is not impossible that a so-called gonad may be merely the locus in which gametes develop but do not necessarily originate.

On this problem the following observation, which is probably not an isolated case, is of interest. After *O. edulis* has spawned as a female and afterwards as a male (in one and the same summer) the gonoducts fill with leucocytes. My first interpretation of this phenomenon was naturally that the leucocytes were all phagocytes, and employed in cleaning up the gonadial passages ready for next year. No doubt the removal of unused and waste genital products is an important function of these leucocytes, but their abundance has frequently arrested attention and provoked the suggestion that other functions may be

being performed. In many cases there would appear to be no necessity for such large numbers merely for phagocytic purposes, although a purely physical explanation may be possible. Is it possible, therefore, that certain leucocytes may be potential germ-cells and only develop such potentialities in a suitable locus, the gonad, at a suitable time? Critical work which aimed at providing definite information on this problem would have great value whatever the result might be. Germ-cells, disguised as leucocytes—and not a few cases of such (as amœbocytes) are indeed known—could be pre-formed in the very earliest stages of development, and be subjected, while in the blood stream, to the maximum net and accumulative effect of the environment on the individual.

That this interpretation is not outside the region of probability may be deduced from Woodger's observations on the origin of the germ-cells of the fowl (*Q. J. M. Sc.*, **69**, p. 460; 1925), and Simkins on Trionyx (*Am. J. Anat.*, **6**, 36; 1925). The former states (italics are mine), "I feel no doubt about the continuity of the *primitive germ-cells* of the genital ridge with those of the splanchnic mesoderm of earlier stages, and with the *large cells of the blood-stream* in still earlier ones"; the latter finds that "*Isolated blood-cells* before the origin of the germ-gland rudiment more nearly answer to the requirements of *primordial germ-cells* than any other cells encountered."

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High Frequency Discharges in Gases.

IN the issue of NATURE for Feb. 4, Messrs. Taylor describe a 'new form' of high frequency discharge in gases at low pressures. This type of discharge is one of those which may be obtained when the gas is acted upon by an oscillatory force, derived either from a Tesla transformer where the oscillations are damped or from a generator performing continuous oscillations, and they occur in various forms, many of which are quite well known. The methods of maintaining continuous oscillations at high frequency by means of valves have added additional interest to electrodeless discharges as they provide a means of attaining a steady state of ionisation in the gas so that the currents and the potentials at the electrodes corresponding to the various forms of the discharge may be accurately measured. For this reason they have been included in the experimental courses in Oxford, and doubtless at other universities, and it may be of interest to describe a few of the more striking features which can be made the subject of simple experiments. Luminous discharges in gases may be maintained with long wave oscillations or with oscillations of a few metres wave-length. The resulting phenomena are much the same whether the potentials be applied between external or internal electrodes.

The distribution of the luminosity depends on several factors: the shape of the discharge vessel and the position of the electrodes, which may be internal or external; the nature and pressure of the gas; the applied potential and its frequency. Taking the very general case of a cylindrical tube 1 metre long and 3 cm. in diameter, with two external electrodes wrapped round in the middle of the tube about 10 cm. apart, the following are the main features of the discharge which may be observed as the pressure is reduced. Neon may be taken as an example of a gas which gives brilliant discharges over a large range of pressures from 50 mm. to 10^{-2} mm. of mercury, using a generator kept in oscillation by a 30-watt valve.

At comparatively high pressures the discharge takes place only in the gas nearest the two electrodes. As the pressure is reduced the luminosity extends along the tube until it fills the whole space between the electrodes. With further decrease in pressure the luminous column increases beyond the electrodes, and will finally fill the whole length of a very long tube. Still further decrease in pressure brings a contraction of the length of the luminous column together with a decrease in its intensity. When the pressure of the gas is of the order of 10^{-4} mm. a quite different phenomenon appears. The luminosity breaks up into sharply defined balls of light, sometimes perfect spheres, but in cylindrical tubes usually egg-shaped. Argon shows this phenomenon best, and gives an 'egg formation' with an exceedingly sharp boundary. In general, three balls of luminosity appear; one in the middle between the electrodes and one in each of the spaces beyond the electrodes, but by varying the applied potential it is possible to have one, two, or three 'eggs' existing together or separately.

At pressures of this order it is found that the discharge is maintained much more easily in the vessels of larger volume and in vessels of certain shapes, it is possible to have the discharge entirely outside the electrodes. Further reduction in pressure brings a decrease in the size of the 'egg,' and finally it disappears, leaving a slight diffused illumination from the gas. At very low pressures the glass between the electrodes begins to glow a red colour, and will show a greenish phosphorescence for some seconds after the stopping of the discharge. Quartz will continue to give out a green glow for many minutes after the discharge has stopped. If the quartz be heated above 150° C. it will phosphoresce very brightly for more than an hour, even though the heating be applied many hours after the discharge. Heating to about 600° C. will destroy this power of phosphorescence in quartz. Different types of glass do not seem to phosphoresce on heating.

When a discharge is passed through neon, at 5 mm. pressure, which contains mercury vapour as an impurity at a pressure corresponding to the saturation pressure at ordinary temperatures, and the discharge is passed between electrodes round the neck of a tube leading from a large bulb, it is found that the neon spectrum is developed very strongly in the narrow tube with very faint mercury lines, but in the bulb the spectrum is almost exclusively that of mercury. The neon spectrum appears in the strong, the mercury in the weak, part of the field. In general it may be noted that in monatomic gases impurities show themselves in the spectrum to a greater extent in the vessels of large volume where the field is relatively weak and at the higher gas pressures.

Various experimenters have measured the potentials to maintain these discharges under different conditions. One need only mention the researches of Gutton, Kirchner, Gill and Donaldson, and Townsend.

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Origin of the Semi-diurnal Pressure Wave in the Earth's Atmosphere.

THE small semi-diurnal wave of atmospheric pressure has long been recognised as a world-wide phenomenon. Simpson (*Q. J. Roy. Met. Soc.*, **44**, pp. 1-18; 1918) showed ten years ago how closely its value at individual places corresponds with the resultant of two twelve-hour vibrations, one parallel to the circles of latitude and one parallel to the meridians, as suggested originally by Schmidt (*Meteorologische Zeitschrift*, **7**, p. 182; 1890). The

mathematical investigations of Laplace, Kelvin, Margules, and Lamb have led to the conclusion that the atmosphere has a natural period of vibration of about twelve hours. The general opinion during recent years has in consequence been that the semi-diurnal wave of pressure is a forced oscillation of thermal origin, with the reservation that a considerable degree of mystery attaches to the precise way in which such a resonance effect can take place in an atmosphere complicated and changeable as that of the earth. Some meteorologists apparently go even further, and reject this theory completely. Goldie, for example (*Proc. Royal Soc. Edinburgh*, **47**, part 4, No. 25), has been led by a critical examination of many autographic records of meteorological elements, to take up a point of view the essence of which, to quote his own summary, is as follows :

"A semi-diurnal variation appears to some extent in many meteorological phenomena, in particular in barometric pressure, rainfall, visibility, atmospheric electric potential gradient, and atmospheric pollution, even though the variation of temperature, at least in the lower levels of the atmosphere, is very approximately a purely diurnal variation.

"The data examined in this paper suggest that, in the forenoon, insolation affecting the ground and the lower layers, and, in the evening, outgoing radiation affecting clouds and the upper part of the troposphere, each lead to a disturbance of the stability of arrangement of the atmosphere in the vertical direction and to a consequent increased mixing of layers. On the other hand, in the late afternoon and in the later part of the night, as the turbulences arising from the above two effects respectively die down, there is an improvement above normal in the laminarity of flow of atmosphere over the earth. The resultant effect is therefore, on the average, a semi-diurnal variation in the vertical structure and horizontal movement of the atmosphere, which variation is reflected in the meteorological phenomena mentioned above. It is shown in the paper that the various individual effects may be greatly exaggerated, or almost eliminated, or accelerated or retarded, at least in temperate latitudes where a suitable variety of types of upper air structure, from which to select, is available."

It is impossible to deal in detail in a short space with the evidence put forward in support of this view. All this evidence is indirect, and some of it decidedly ambiguous ; it rests mainly upon differences in the character of the diurnal changes of pressure and temperature with different types of weather, and, above all, with different vertical gradients of temperature such as are found on the average in 'polar' and 'equatorial' air that reaches temperate latitudes. No direct observational evidence of a second maximum of convective movement in the troposphere in the late evening is brought forward. Since the diurnal pressure wave is present in clear weather, as well as on days when there are cumulus clouds in the sky to provide foci of radiation, it is evident that the theory relies upon the existence of strong outward radiation from relatively dry air at great heights in accordance with the conclusions arrived at by A. Angstrom (*Q. J. Roy. Met. Soc.*, **50**, pp. 121-125 ; 1924), to which Goldie makes reference. This is a pity, for there are ways of studying upward and downward currents at high levels directly : for example, by observations of the rate of ascent of pilot balloons, or observations of 'bumpiness' made by aeroplane. One would like to know the experience of aeroplane pilots on this point. Simple observation of the collapse of convectional day clouds in the late evening has never suggested to me anything but a gradually increasing tendency to stratification : the last remains of such clouds not infrequently take the form of flattened strato-cumulus, and have never been observed to change into mammato clouds, as might be expected to happen if each cloudlet were descending rapidly towards the earth.

It would appear that, although attempts at the interpretation on dynamical and thermodynamical lines of thermograms and barograms, for selected types of atmospheric structure, may well bring interesting new matter to light, the general conception of a forced oscillation of the atmosphere corresponding with its natural period of twelve hours, as the cause of the twelve-hour pressure wave, will probably continue to hold the field for some time to come.

E. V. NEWNHAM.

Rainfall Interception by Plants.

IN NATURE of Dec. 11, 1926, p. 837, I outlined the results of some observations upon the interception of rainfall by plants. *Inter alia*, it was shown that where an ordinary gauge registered a catch of 1, an adjacent gauge bearing a 12-in. high cylindrical frame of wire-mesh carrying branchlets of *Podocarpus Thunbergii* Hook. registered 1·81 during the period June 1, 1925–May 31, 1926.

Lieut.-Col. Gold, in NATURE of Dec. 25, 1926, p. 915, pointed out that the major portion of this interception gain was no doubt due to the frame catching rain which would otherwise have fallen on the lee side of the gauge. He further stated that this would become negligible were a large area to be covered by a comparatively close network of screens.

I accordingly endeavoured to test Col. Gold's statement by means of placing a gauge—screened exactly as described in the note of 1926—at the centre of a close network of concentric circles bearing the laced-in branchlets of Podocarpus. The heights of the circular screens decreased as the centre was approached, and the distances separating the circles were in all instances less than the heights of the latter. A control gauge was placed some yards distant. The catches recorded during the period of observation were :

Month.	Gauge in Centre of Screen Net-Work.	Control.
1927.	Inches.	Inches.
April	1·90	1·54
May	12·12	6·77
June	3·37	2·02
July	3·24	2·00
August	6·68	4·16
September	4·01	2·63
October	4·40	2·96
November	3·06	2·44
Total	38·78	24·52
Percentage	158	100

From observations during periods of rainfall it is obvious to me that, were a closer and more extensive network provided, the seeming interception gain would be reduced still further. I am indebted to Col. Gold for his criticism of the experiment.

The data given in the 1926 note require to be interpreted in light of the information yielded by this second experiment, but at the same time it is certain that the general truth of the argument they purported to support cannot be denied. The following observations at Deepwalls substantiate this claim :

(1) A gauge placed under several 15 ft.-20 ft. high *Virgilia capensis* Lamk., growing on the research station

hill at 1725 ft., registered 0·0025-0·05 in. in six hours during which periods dense *Nebelreissen* cloaked the hilltop, *no actual rainfall occurring the while*. A control gauge placed well away from tall vegetation during these self-same periods registered not the slightest precipitation.

(2) The taller the vegetation the greater the precipitation induced: occasional observations at the base of a row of 100 ft.-115 ft. high *Eucalyptus globulus* growing on the north side of the research station hill indicate that the catch in six hours of dense *Nebelreissen*—without any actual rainfall—may range from 0·0025 to 0·15 in. The writer, while working at the base of these in misty weather, has had to wear a rainproof, so heavy has been the fall of water from the foliage, whereas, when the wind is of low velocity, he has been able to leave papers lying 20-30 yards away from the trees without the records becoming wet. During wind of high velocity it has been noted that an interrupted fall of moisture occurs to a distance of about 40 yards in the direction of the wind.

A continuous series of observations during misty weather has not been possible, but it seems clear that an increased fall of from 10 in. to 15 in. per annum occurs under the Eucalpyts as the result of condensation of the hydrometeors. In mountain macchia and mountain forest on the south-west, south, and south-east slopes of the Outeniqua range and of its highest foothills—sites mist-clad on the aggregate a quarter to a half of the year—the increased fall as the result of condensation of the mists must be very much greater.

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Dec. 5, 1927.

Active Nitrogen.

IN the current issue of the *Journal of the American Chemical Society*, Dr. Bernard Lewis criticises certain aspects of the work upon active nitrogen which has recently been published from the Laboratory of Physical Chemistry, Cambridge. He states, *inter alia*, that "the authors (Willey and Rideal) neglect to consider many reactions initiated by active nitrogen which require more energy than two volts"; in spite of this somewhat sweeping statement which, if upheld, would stultify a good deal of the work under discussion, he does not quote or even hint at a single reaction which can be held to justify his contention. His next sentence, "The varied phenomena caused by active nitrogen make it evident that 2-volt level nitrogen molecules do not issue from the discharge," is equally illustrative of its author's tendency to state opinions as facts.

It is difficult to understand our being at variance over the obtaining of ammonia from active hydrogen and inert nitrogen. In the experiments at Cambridge, condenser discharges (identical with those employed in obtaining active nitrogen) were employed and careful precautions were taken against mixing of the gases in the discharges. Three concordant experiments showed that ammonia equivalent to about 0·2 per cent. active hydrogen (calculated as H_3) could be obtained if the gases after mixing were further treated with a little water vapour, admitted from another side tube, and drawn to exhaust through a condensing trap cooled by liquid air. In two runs, also, it was found that when the nitrogen was activated no ammonia was obtained, and the glow appeared to diminish slightly, a result which at the time was interpreted as being due to the decomposition by the active nitrogen of ammonia first formed from the inert nitrogen and active hydrogen; the quantity of active nitrogen present (1 per cent.) rendered this quite probable. The experiments were carried out only to test Wendt and Landauer's claims as to the properties of active hydrogen, and were part of the attempts to activate this gas by second-type collisions with active nitrogen as described in the second paper.

It is a pity that Lewis did not make a quantitative study, however short, of his ammonia synthesis from active nitrogen and active hydrogen. Lord Rayleigh has shown (*Proc. Roy. Soc.*, **85**, 219; 1911), and Dr. Rideal and the author have confirmed his observation, that ammonia extinguishes the glow of active nitrogen and chemical reaction appears to be traceable. This fact would appear to constitute a grave objection to Lewis's theory of the formation of ammonia from atomic nitrogen and atomic hydrogen, namely:

$$N + H \longrightarrow NH \quad . \quad . \quad . \quad (1)$$
$$NH + H_2 \longrightarrow NH_3 \quad . \quad . \quad . \quad (2)$$

Spectroscopic evidence, taken in conjunction with the decay of the afterglow being bimolecular with respect to the glow-producing system, leads to the view that the first step at any rate in the development of the luminosity is the recombination of nitrogen atoms, which are the primary reacting system according to his scheme. If, then, they are to take part in the ammonia synthesis, considerable changes—probably extinction—of the glow might be anticipated; conversely, if ammonia were produced in any quantity by any other mechanism, it should also affect the glow, but no mention of such a phenomenon occurs in his paper. The matter will later be discussed more fully in another place.

Recent studies of the decay of the after-glow have, it is believed, led to important clues as to the origin and nature of active nitrogen. It appears that between 1 mm. and 10 mm. pressure the decay process is very complex, although bimolecular with respect to the active nitrogen. Moreover, it appears very likely that the luminosity and the chemical activity are steps in an involved deactivation process; the first of these stages appears to consist of a ternary collision between two atoms and a molecule, as would be expected from the negative temperature coefficient of the decay process as observed long ago by Lord Rayleigh (*Proc. Roy. Soc.*, A, **86**, 262; 1912).

A full account of these investigations will shortly be published.

E. J. B. WILLEY.

Laboratory of Physical Chemistry,
Cambridge, Feb. 13.

Units of Energy.

DR. RUSSELL'S suggestion (NATURE, Feb. 4, p. 170) that the kilowatt-hour is the best unit of energy for practical purposes, ought to be popular with the gas companies. At present, by Act of Parliament, we have to purchase our energy from the public supply companies by two different measures, and the cheaper purveyor does not get full credit for his cheapness. The unit for electricity is of course the kilowatt-hour, $3{\cdot}6 \times 10^6$ joules; the unit for gas energy is the therm—the energy required to heat 1000 lb. of water through 100° F., and this is 105×10^6 joules. Thus the therm is approximately 29 kilowatt-hours. In other words, when the price of gas per therm is the same as the price of electricity per kilowatt-hour, electrical energy is 29 times as dear as gas energy.

As to the scientific aspect of the question of units, it would be useful if someone with missionary zeal could provide handy reference tables bringing in all

the different forms of energy. The subjoined list gives some indication of what is wanted, and suggests to my mind the reflection that it would not be beneficial to adopt one unit of energy to the exclusion of the others.

For the benefit of meteorologists who are interested in the measurement of geopotential, I have included in the table the unit introduced by Prof. V. Bjerknes, the dynamic metre or, as I prefer to call it, the metre-leo. This is the gain in potential when a body is raised through 1 metre in a hypothetical place where $g = 1000$ cm./sec.^{2}. The metre-leo is 10^5 ergs per gramme. The specification of the upper levels of the

SPECIFIC ENERGY IN VARIOUS UNITS.

		Metre-gravity, Lat. 45°.	Metre-leo or Dynamic Metre.	Joule / gm.	kw. hr./tonne or mw. hr./gm.	Water-degree C. or cal./gm.
Potential energy	Metre in London	1·0006	0·9812	$9{\cdot}812 \times 10^{-3}$	$2{\cdot}726 \times 10^{-3}$	$2{\cdot}347 \times 10^{-3}$
	Metre in lat. 45°	1	0·9806	$9{\cdot}806 \times 10^{-3}$	$2{\cdot}724 \times 10^{-3}$	$2{\cdot}346 \times 10^{-3}$
	Dynamic metre	1·0198	1	10×10^{-3}	$2{\cdot}778 \times 10^{-3}$	$2{\cdot}392 \times 10^{-3}$
Kinetic energy .	10 metres per sec.	5·10	5	0·0500	0·0139	0·0120
	100 km. per hour	39·3	38·6	0·386	0·107	0·092
Heat . . .	Water 1° C. at 20° C.	426	418	4·18	1·16	1
	Air at const. pressure 1° C.	103	101	1·01	0·280	0·242
	Air at const. vol. 1° C.	73	71·5	0·715	0·199	0·171
Latent heat .	Water–ice at 0° C.	$34{\cdot}1 \times 10^3$	$33{\cdot}4 \times 10^3$	334	93	80
	Steam–water at 100° C.	230×10^3	226×10^3	2260	627	540
Calorific value .	Hydrogen (to H_2O)	$12{\cdot}4 \times 10^6$	$12{\cdot}1 \times 10^6$	121×10^3	34×10^3	29×10^3
	Carbon (to CO_2)	$3{\cdot}4 \times 10^6$	$3{\cdot}3 \times 10^6$	33×10^3	$9{\cdot}3 \times 10^3$	8×10^3
Electrical energy	Kilowatt hours per tonne	367·1	360	3·6	1	0·861

atmosphere by geopotential rather than by height has certain theoretical advantages, the principal one being that points with the same geopotential are on the same level surface. Whether it is desirable to use the metre-leo in recording observations is a question on which opinion is at present sharply divided. The question has been answered in the affirmative by more than one international conference, but some of the most influential meteorologists hold strongly the contrary view. My little table, in which the simple relation between the second and third columns will be noted, may serve to show why the proposal has some attractions for students of dynamical meteorology.

F. J. W. WHIPPLE.

Kew Observatory,
Richmond, Surrey.

Density of a Luminous Gas and the Emission of Light by Atoms in Metastable States.

MR. I. S. BOWEN points out in an interesting letter to NATURE (Oct. 1, 1927, p. 473) that the low density prevailing in nebulæ favours the emission of light by atoms in metastable states, and thus he accounts for a number of hitherto unexplained nebular lines as the result of transitions from initial metastable states of ionised atoms of oxygen and nitrogen. There is no doubt, as Prof. Fowler, who has adduced further spectroscopic evidence in support of the suggestion, puts it, that "a satisfactory explanation of some of the most important nebular lines has at last been reached." The suggestion, however, implies that we have to give up the position that the transition of an atom from a metastable state to one of other conditions of excitation remaining unaltered (*Roy. Soc. Proc.*, A, vol. 117, p. 20, communicated July 7, 1927). Quoting from the paper, "these considerations would appear to indicate that the metastable state 2^3P_2 is not one in which, left to itself, the excited atom remains for ever in that state, but one whose average free life is large compared with the average life of other excited atoms . . . the (free) life of an excited atom in the metastable state is so long that in an arc under a pressure of the order of a couple of millimetres of Hg the probability of such an atom suffering during its life an inelastic impact resulting in a radiationless transition approaches certainty." It appears to me that the behaviour of the mercury line λ2270 described in the paper referred to above is of the nature of a crucial experimental confirmation of Bowen's brilliant suggestion.

B. VENKATESACHAR.

Physics Department,
Central College,
Bangalore, India, Jan. 26.

The Constituents of Low Temperature Tar.

IN NATURE of Dec. 4, 1926, p. 805, which has only recently come to my knowledge, I find a notice by Messrs. G. T. Morgan and D. D. Pratt which interests me greatly, because it contains a confirmation of an observation which I made and published some years ago (*Berichte der Deutschen Chemischen Gesellschaft*, **39**, 1238; 1906). It concerns the occurrence of β-methylanthracene in low temperature tars from certain coals. I have already demonstrated this for

three poor (' magere ') coals, that is, geologically old Westphalian coals, with a coke content of 82 per cent.—at the same time the yellow hydrocarbon, crackene, was isolated—and it may well be supposed that the coal employed by Messrs. Morgan and Pratt displays a similar character. That β-methylanthracene is indeed concerned, I have already proved in a similar manner to Morgan and Pratt by the oxidation product of the hydrocarbon. More recently I have arrived at this proof by another way (*Berichte der Deutschen Chemischen Gesellschaft*, **59**, 2812; 1926),[1] which, however, leads to the same result, namely, the preparation of a double compound of the hydrocarbon with β-dinitroanthraquinone (Fritzsche's Reagent).

E. BÖRNSTEIN.

Berlin-Charlottenburg.

BY the courtesy of the Editor of NATURE we have seen the foregoing letter from Prof. Börnstein, in which he states that our letter to NATURE of Dec. 4, 1926, confirms an earlier observation of his as to the presence of β-methylanthracene in low temperature tars from certain Westphalian coals (*Berichte der Deutschen Chemischen Gesellshaft*, **39**, 1238; 1906). In a later communication (*ibid.*, **59**, 2812; 1926) Börnstein, Schliewiensky, and Szczesny-Heyl had expressed a contrary opinion, but Prof. Börnstein's footnote now indicates that this discrepancy was due to a typographical error. With this correction his two observations are now in agreement with ours.

We would take this opportunity of stating that investigations on the aromatic hydrocarbons of low temperature tar are still in progress in this laboratory. Other anthracene derivatives have been isolated in considerable quantities, together with complex hydrocarbons including the so-called 'crackene.' Further details of these researches will be published in the near future.

G. T. MORGAN.
D. D. PRATT.

Chemical Research Laboratory,
Teddington, Middlesex.

Activation of Hydrogen by Electric Discharge.

IN Dr. Elliott's absence, en route to Australia, I venture to indicate certain difficulties inherent in the hypothesis proposed by Mr. G. Glockler in NATURE of Jan. 21 for the mechanism of the formation of hydrogen sulphide in experiments on active hydrogen produced in an ozoniser discharge. At a constant alternating potential applied to the ozoniser electrodes, and at a constant gas pressure, it is clear that, as the velocity of gas flow is increased, the number of electrons per litre of hydrogen available for adsorption on the sulphur is increased since the interval in which recombination can take place is diminished. Dr. Elliott's experiments show that under such conditions the amount of hydrogen sulphide formed per litre of hydrogen decreases as the velocity of gas flow is increased.

It is to be anticipated that the passage of the gas through glass wool would greatly diminish any residual ionisation, due to surface adsorption and recombination. The rate of formation of hydrogen sulphide remains, however, unchanged when the glass wool is removed. ("Action of the Corona Discharge on Gases", G. A. Elliott, Thesis, University of London, 1927.) If a stray field capable of sustaining ionisation had existed in the neighbourhood of the sulphur, any reaction due to electrons adsorbed on the sulphur would also increase with increasing gas flow, since a greater mass of ionised gas would then come in contact with the sulphur in unit time.

At the lowest pressures investigated the luminous discharge did extend to the sulphur; the intensity of this stray glow could be greatly increased by attaching an earthed wire to the tubing below the sulphur. No change in the amount of hydrogen sulphide formed was obtained by this procedure: it appears that the hydrogen capable of reacting with sulphur is produced in the principal discharge in the ozoniser only. The suggestion that the formation of hydrogen sulphide results from encounters between simple positive hydrogen ions (H_2^+, H^+) and negatively charged sulphur cannot, therefore, be accepted.

R. WINSTANLEY LUNT.

University College,
London, W.C.1,
Feb. 10.

[1] In this communication to the *Berichte* the symbols α and β should be interchanged.

Movements of the Lower Jaw of Cattle during Mastication.

STIMULATED by the interesting communication of Dr. Jordan and Mr. Kronig (NATURE, Dec. 3, 1927) concerning the direction of rotation of the jaws of cows in North Sjælland during mastication, we have ourselves carried out similar investigations. We have made the interesting observation that the direction of rotation is the same whether the cow be taking in food through the mouth or ruminating. If according to the convention of the above-mentioned authors we choose as the positive direction that of the food, it follows that one and the same cow must be classed sometimes as right-handed and at others as left-handed. If we may assume that the processes of taking in food by the mouth and of rumination alternate, then it follows that the cases of right-handed and left-handed mastication must of necessity be equal in number. The fact that the former investigators did not find a ratio of exactly one to one is then presumably due to their not having made equal numbers of observations on the two different phenomena.

HANS RIEHM.
E. A. GUGGENHEIM.

The Royal Veterinary and
Agricultural College,
Copenhagen, Feb. 7.

The Spark Spectrum of Neon.

BY the use of a vacuum spectrograph, in which the spectrum was excited by electron impacts at controlled voltages between a Wehnelt cathode and a wire grid anode, we have discovered a new series of lines of considerably shorter wave-length than any hitherto reported for neon. There are 15 of these lines between wave-lengths 462·38 and 353·01. They show the wave number difference 782 expected of the neon spark spectrum, and have in fact led to an almost complete analysis of the spark spectrum, in which 203 lines have been classified in 59 multiplets. From this analysis the ionisation potential of the neon ion is found to be $40{\cdot}9 \pm 0{\cdot}05$ volts.

H. N. RUSSELL.
K. T. COMPTON.
J. C. BOYCE.

Palmer Physical Laboratory,
Princeton University,
Feb. 9.

Marcello Malpighi.

(1628–1694.)

THE three-hundredth anniversary of the birth of Marcello Malpighi, the Italian whom Sir Michael Foster designated "anatomist, physiologist, botanist, pathologist, biologist, and above all natural philosopher," occurs on Mar. 10.

Born at Crevalcore, a village near Bologna, Malpighi was one of the sons of a small farmer. Proceeding to the University of Bologna, he engaged in medical studies, graduating there in 1653, after four years' work, with a doctor's degree. Three years later he transferred to the University of Pisa, taking up the professorship of medicine; here he formed a friendship with Borelli, the mathematician, who encouraged him to pursue researches in anatomy. In 1662, Malpighi removed to Messina to occupy the chair of medicine, remaining there four years. Always subject to insecure health, a request to return to Bologna was willingly obeyed, and there Malpighi spent twenty-five years, fruitful in results. Summoned to Rome in 1691 as first physician to Pope Innocent XII., he died in that city three years later whilst holding office. Such is the summary of his ordinary life avocations.

In reality, however, we must extend these boundaries and regard Malpighi as a philosophic naturalist, a pioneer investigator, and a founder of microscopic anatomy. He had constant resort to the microscope, observing with its aid the passage of blood cells from arteries to veins. He made discoveries relating to the structure of the kidneys and spleen. He also investigated vegetable structure. If not endowed with a subtle instinct—it has been said that his physiology was necessarily of the unspecialised kind—he was yet competent to make general conclusions, fully endorsed afterwards.

We may appropriately allude here to Malpighi's connexion with the Royal Society of London in its earliest days, and with contemporaries such as Boyle, Hooke, Oldenburg, and Grew. Oldenburg, ever anxious to foster relations with foreign investigators, was doubtless first in the field to invite correspondence from Bologna. It seems to have begun in 1667. In the following year Malpighi wrote to Gresham College, sending a book, and expressing readiness to communicate "philosophical matters." A bond was henceforth established with the Society which almost obliterated nationality, actuated as it was by a true spirit of fraternity.

At this time, moreover, there was much Italian sympathy for science, of the kind, that is, that existed. It is recorded that at the very next meeting after Malpighi's letter was received, two Italian gentlemen were present, introduced by Count Ubaldino. They acquainted the Society of the singular respect which the Cardinal Leopold de Medicis had for them, and that he desired to have his excuse made for not having himself returned his acknowledgments for the History of the Society sent to him, which he had been hindered from doing by his lately acquired dignity of Cardinal; but that since that time he had desired and already obtained the Pope's permission to correspond with the Society, of which he now intended to make use to let them see the esteem which he had of them and their institution. Whereupon the president thanked these gentlemen for acquainting the Society with so favourable an inclination of his Eminence to them, and that they would study to entertain so noble and promising a correspondence with all reciprocal services that might be acceptable to his Eminence.

At a meeting of the Society held on Feb. 18, 1668/9, "Mr. Oldenburg brought in a packet sent to him by Signor Malpighi containing a manuscript history of the silk-worm, its whole life, and the anatomy of all the parts thereof, consisting of twelve folio sheets with as many microscopic draughts in folio. It was ordered that the hearty thanks of the Society be returned to the author by a letter to be drawn up by Mr. Oldenburg; and that he and Mr. Hooke be desired to peruse those papers, and to make a report thereof . . . and that the consideration of publishing them be referred to the council." As is well known, the decision was taken to print the treatise, "De Bombyce," and Lord Brouncker, the president, communicated the order to Malpighi. Hooke had found it "very curious and elaborate, *well worth printing*."

On Mar. 4, 1668/9, Marcello Malpighi was proposed by Oldenburg as an honorary member, and elected *nemine contradicente*. Oldenburg was directed to draw up a special diploma. It is scarcely necessary to say—the fact is generally known—that Malpighi never attended any meeting at Gresham College, and hence the Charter Book does not bear his signature.

A letter to Oldenburg, presented on Mar. 23, 1670/1, contained "several curious remarks on the communication between the bronchiæ and lungs in frogs, lizards, and tortoises." On Dec. 7, 1671, a manuscript was produced, sent by Malpighi, containing an abstract of his observations and considerations of the structure of plants. It was ordered that he be solemnly thanked "for his singular regard for the Society and his great care of improving natural knowledge: as also that it be signified to him that Dr. Grew had made the like attempt in his 'Anatomy of Vegetables,' lately published in English; and that the Society would be very glad to see Signor Malpighi's labours on that subject brought to that perfection which was intended by him." In the spring of 1680 the Society sent to Bologna some small microscope glasses (by Mellin) as a present. Later on, Hooke announced the welcome gift from Malpighi of his portrait "very well painted, as big as the life." A letter full of tribulation was received from him in 1684 mentioning the burning of his house, whereby he had lost all his *adversaria* and microscopes.

Malpighi's autobiography, and collections of many important contributions to the anatomy of plants and discoveries in physiology, were published in London in 1696, under the auspices of the Royal Society. In 1897, Malpighi's native town, Crevalcore, marked the bicentenary of his death (1894) by a festival of homage, when a bronze statue of the philosopher, erected in the market place, was unveiled. A memorial volume was issued afterwards, containing appreciations by Virchow, Weiss, Haeckel, Kölliker, and others.

This brief notice, written for remembrance' sake, may fitly close, as it began, with words written long ago in this journal by Sir Michael Foster—"To look across two centuries at a great man, struggling with the beginnings of problems which have since come down to us, some in part solved, but others with their solutions put still further off by the very increase of knowledge, is a useful lesson to every one of us. In any case the great men who in the past opened up for us paths of inquiry . . . ought not to remain mere names known to us chiefly through being attached to some structure or to some piece of apparatus. We ought all of us to be able to form some idea of what they were and what they thought." T. E. JAMES.

Geophysical Prospecting.

By Prof. A. S. EVE, F.R.S., McGill University, Montreal.

"Here we are on Tom Tiddler's ground
Picking up gold and silver."
—*Song of an Old Game.*

AN eminent geologist has said that "the best way to find out what is under the ground is to bore a hole in it." Truly the diamond drill is the miner's best friend in exploration, presenting samples of successive layers for him to worry over with the geologist; but drilling is an expensive game and the world is wide, so that some guidance is necessary as to where to bore the next hole.

Until quite recently the chief aids to exploration were (1) the divining rod, known in the U.S.A. as the 'doodle bug,' not now used by any mining engineer of repute; (2) magnetic surveys, whereby can be found magnetic ores, such as magnetite or pyrrhotite, but ineffective for non-magnetic ores such as pyrites; and (3) the intelligent applications of geological principles.

To-day, however, there is much more assistance available, new in type, and varied in character. Just as invisible and submerged submarine boats may be detected from the surface of the sea by some physical dissimilarity between the boat and its surrounding medium of sea water, so also ore bodies of fair magnitude can be detected by the wise appreciation of some inherent property different in the ore from the surrounding medium of rocks. Oil has not yet been detected by direct methods; the search has been rather for folds below the ground or for salt domes, where the oil tends to collect in paying quantities.

Now the chief methods of ore hunting, which is a good sport, are these: (1) Electrochemical detection; (2) electrical, tracing the equipotential lines between earthed conductors using direct or alternating current; (3) magnetic methods, as heretofore; (4) electromagnetic detection with direction-finding coils, not unlike direction-finding by ships at sea, only here the ore body must be stimulated by alternating currents flowing in horizontal or vertical loops, using audio or radio frequency. This is the hunt for an electrical echo.

In the search for oil the procedure is usually quite different, and this fact is evidence of the great flexibility of geophysical operations in the field. The chief methods for oil hunting are: (1) Seismic, using an artificial explosion and a seismograph a few miles away to detect the first swift message of the uproar, travelling by a route far down below the earth's surface; (2) gravitational, using that most exquisite and sensitive apparatus, an Eötvös torsion balance; (3) magnetic, where disseminated magnetite makes such search possible; (4) electrical, just as for ore bodies, but on a larger scale. So far, no certain information as to the success of this last method over oil fields is available.

Many of these methods have been already well tested over 'proving grounds' above known ore bodies, so that to some extent their rival merits are known to the initiated, while on the other hand many mine managers and engineers are puzzled to distinguish between those schemes which rest on a sound scientific basis, and other plans which may be termed psychological, fraudulent or subconscious methods, based on the mystical or unknown, sometimes worthy of study, but with a balanced scepticism.

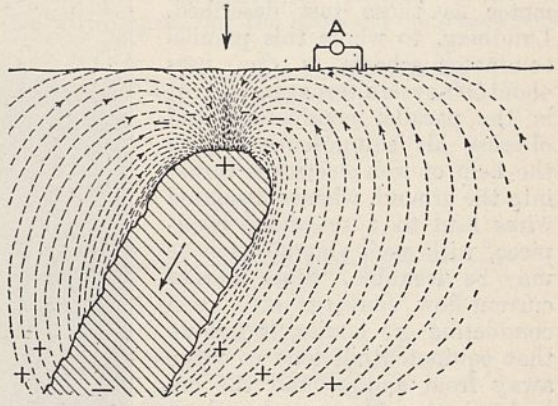

FIG. 1.—Diagram illustrating a sulphide ore body acting as a battery while being oxidised above by rain and surface water. Current lines are dotted and the galvanometer and two detecting electrodes are shown at *A*.

Sulphide ore bodies are slowly oxidised by surface and rain water, so that the mass acts as a large battery with the negative electrode the higher, so that currents flow towards this upper region from below (Fig. 1). The current can be

readily detected by non-polarisable electrodes placed on the ground and connected by insulated wires to a sensitive galvanometer or portable microammeter. This method was first due to Barus, and it has been extended by Schlumberger, using porous pots containing a saturated solution of copper sulphate and a copper rod as electrode. All sulphide bodies which oxidise, and also

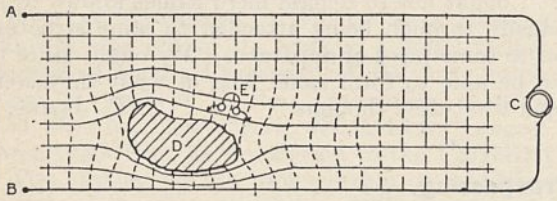

FIG. 2.—Diagram of an alternating current sent from generator *C* to two long bare copper conductors well connected to the earth. The lines of current flow are normally perpendicular to the conductors, but tend to crowd toward the good-conducting ore body *D*. *E* is the telephone (with amplifier) for getting silence points on the equipotentials which spread away from the ore body.

magnetite, may be detected by this simple and direct process. The depth of detection must naturally depend upon the size of the ore, the rate of oxidation, and the conductivity of the ground around and above it.

As to direct electric methods, it is safe to commend the long parallel bare copper wires pegged to the ground to which the current from a dynamo or a few 'B' batteries is led. Detection may be made, with due allowance for the natural or electrochemical currents, by the same electrodes and microammeter as those just described. Lundberg, to whom this parallel conductor scheme is due, uses about 500-cycle alternating current in the parallel conductors, and obtains his equipotentials with the help of iron electrodes thrust into the ground, whence insulated wires lead to a telephone headpiece, with such amplification as may be desirable. Since lines of current-flow converge into good conducting ore bodies, it follows that equipotentials tend to curve away from and around the ore body, both underground and on the earth's surface (Fig. 2). It is naturally impossible to detect by such methods those ores like zinc blende, the conductivity of which is almost identical with that of the surrounding rock. Nor is it possible to declare whether the indication is due to a worthless or to a paying vein.

Instead of two parallel wires, a large loop of well-insulated wire may be laid upon the surface of the earth and an alternating current from a 500-cycle generator passed around the loop. This current will cause an electromotive force and resulting current around the ore body. A coil near the surface of the earth will be stimulated by induction, and again detection can be made by head telephones and amplifier (Fig. 3). Direction, magnitude, and phase of this induced current can all be investigated, and the scientific problem is one of some complexity and great interest. Lundberg and Bieler, for example, use detection methods which are quite different in actuality though apparently the same to a superficial observer. One compares magnitude, the other, balancing phase difference, compares horizontal components with the vertical.

The Radiore Company uses a vertical loop of many turns to which is led alternating current of high or radio frequency (10,000 metres wave-length). The ore body is stimulated by induction rather than by radiation, and the effect is again detected by a loop, tuned to resonance, with amplifier and head telephones. The penetration to some depth into the earth and the emergence from that depth of the excited radiation presents some interesting and important physical problems awaiting further investigation. Dr. Appleton suggested to the writer the possibility of producing repeated maxima and minima in the coil by gradual change of wave-length in the loop, so that a vein or sheet of conducting ore body might have its depth determined by a method quite analogous to that by which he has found the height of the Heaviside layer far over our heads, which renders radio telegraphy or telephony effective by reflection and refraction. The difficulty arises, however, that in ore-prospecting short radio waves must then be used, and such waves do not travel far into the earth.

FIG. 3.—Transit tripod with coil, turning in azimuth or dip, and the telephones. Large horizontal loop with 500-cycle alternating current. Near Caribou Mine, Colorado.

Investigations of these and allied problems over a known ore body or 'proving ground' may well fall within the scope of government-assisted research. Thus, last summer the United States Bureau of Mines had a party working near the Caribou Mine, 10,000 feet up in the Central Rockies in Colorado. This party consisted of Dr. C. A. Heiland, of the School of Mines, Boulder, Colorado; Dr. D. A. Keys, of McGill University; and the present writer. Satisfactory and concordant results

were obtained with magnetic and diverse electrical methods, and a new scheme was also evolved which was quite effective in the dry region of the Rockies, but disappointing amid swampy districts when tested in Northern Quebec. Indeed methods must be varied to suit local conditions, and all eggs in one basket is a poor policy. The reports of this expedition will be published this year by the Bureau of Mines, Washington, following a

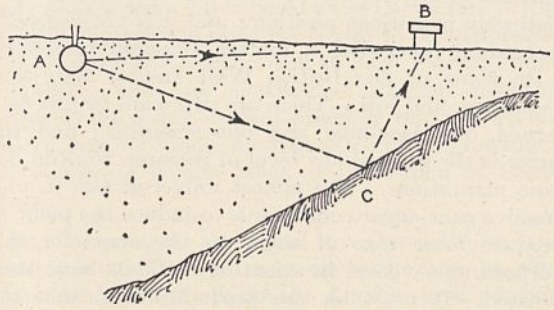

FIG. 4.—Diagram showing small charge at *A* sending out waves which are reflected upward from a fault or discontinuity at *C* and pass to *B*, so that the route by way of the fault (*ACB*) may be quicker than direct route *AB*, because speed increases with elasticity and therefore with depth. All the lines should be drawn slightly curved, concave upward.

brief summary, already published, of the elementary principles involved (Technical Paper 420).

Extensive experiments both in the laboratory and in the field have been made during the last four years by Dr. Max Mason, president of the University of Chicago. His interesting address to the Mining and Metallurgical Engineers of America has been printed, and can be obtained from the Physical Exploration Corporation, 111 Broadway, New York City. This is a valuable report which indicates the scope and possibilities of geophysical methods.

Let us revert to oil hunting. The sound work done in south-west Persia with the Eötvös torsion balance has been set forth clearly in Appendix 12 of the "Summary of Progress of the Geological Survey of Great Britain for 1926" (London: H.M. Stationery Office). In Texas and Mexico, although abundant work has been carried out by the great oil companies of America, yet all this information, whether obtained by gravitational or seismic methods, at great cost to these companies, is retained as confidential, and they do not publish the methods employed or the results obtained.

The Eötvös balance consists of two small heavy gold balls at the ends of a light aluminium bar suspended by a platino-iridium wire. If the balls were at the same level and if the earth were a uniform sphere at rest, the arrangement would be astatic. Actually, however, such a torsion balance, truly of the Henry Cavendish type, tends to set itself along the direction of maximum or minimum curvature of the irregular level or equipotential surface at the place under investigation, and we can find $g(1/R_1 - 1/R_2)$, the horizontal direction tendency (H.D.T.) in magnitude and direction. R_1 and R_2 are the minimum and maximum radii of curvature of the 'level' surface. The torque tends to set the beam along the ridge of an anticline and across the valley of a syncline. Eötvös, however, hung one ball about sixty centimetres below the other and thus determined also the direction and magnitude of the gradient of gravitation, which is the change of numerical value of g per horizontal unit distance. The vertical gradient of gravity does not here concern us at all. The theory of the torsion balance is often obscured by double partial differentials which alarm the unaccustomed reader, whereas the problem is one of ordinary statics with a slight admixture of dynamics and three-dimensional analytical geometry. The truly alarming feature of the work is the correction for altitude and latitude and for terrain and topographical features. In many cases, however, comparative values of the H.D.T. and of the horizontal gradient of gravity are all that are required for the determination of some local problems in geology or mining.

In seismic work, small charges of high explosives are used to obtain reflection of the shock from faults or discontinuous strata. In these cases the time to the seismograph by the direct route is comparable to the time by the reflected route, and the record is therefore hard to interpret (Fig. 4). It will be noted that this plan resembles quite closely the methods now available of determining the depth of the ocean by echo methods. Much larger scale work is used in the Gulf region. There large charges of 150 lb. of T.N.T. are exploded and timed by radio signal. The velocity of the shock is governed by the elasticity and by the density of the medium. Density varies but little with depth, but the elasticity increases with

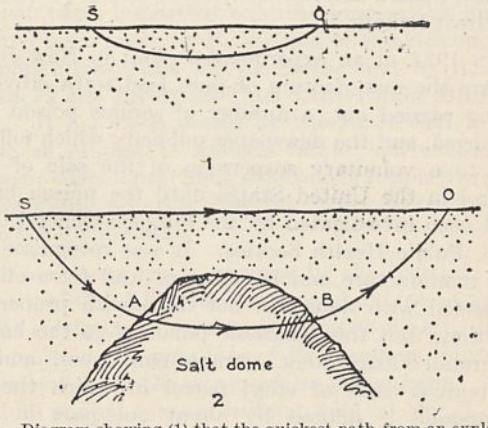

FIG. 5.—Diagram showing (1) that the quickest path from an explosion at *S* to an observer at *O* is a curved one, *SO* (diagram 1), through the earth, because elasticity increases with depth; and (2) that *S* and *O* are farthest apart and the quickest route *SABO* (diagram 2) is by way of the salt dome beneath, which can be thus detected because of the high velocity of the waves in the salt dome.

the pressure, and the pressure with the depth, perhaps in a linear relation. Hence the first shock signal which travels a few miles and reaches the recording seismograph is that compressional wave which has passed deep down a few thousand feet into the earth and emerged after its curved and concave path (Fig. 5). If a salt dome intervenes, there is yet higher speed, and by numerous shocks and measurements the size and shape of the salt dome may be determined, the site purchased,

and the hunt for oil, now aided by torsion balance work, pursued. If success follows, there is avoided that scramble for the oil field which has so often in the past involved loss due to hasty and wasteful boring and pumping, and violent fluctuations in supply and cost.

To sum up: geophysical methods wisely used can be helpful and profitable. If the possibilities are over-stated or improper claims made, there will be a lack of confidence retarding that advancement which careful development should achieve.

News and Views.

THE discovery in the United States in 1922 by T. Midgley that lead tetra ethyl has a remarkable action in delaying detonation or 'knocking' in the internal combustion engine when added to petrol in minute amounts, has brought this organo-metallic derivative from the obscurity in which it had remained since it was first prepared and described in Great Britain by Buckton nearly seventy years ago (*Phil. Trans.*, **149**, 431) to be an important article of commerce. It is an oily colourless liquid, density 1·66; of boiling point above 200° C., with decomposition. It possesses toxic properties which are specific in character and differ from ordinary lead poisoning in that the first symptoms are insomnia and fall in blood pressure. The oil is slightly volatile and can be absorbed through the skin. Attention has been directed recently by eminent chemists to these poison dangers which might occur with the indiscriminate use of petrol containing small amounts of lead tetra ethyl, and on Feb. 29 in the House of Lords it was announced that an Interdepartmental Committee is to be appointed forthwith consisting of representatives of the Ministry of Health, the Home Office, and the Medical Research Council, to investigate the poison hazard associated with the sale of ethyl petrol in Great Britain.

IN 1924, at an experimental plant in New Jersey, where the manufacture of pure lead tetra ethyl was being carried out, a number of serious poison cases occurred, and the newspaper publicity which followed led to a voluntary suspension of the sale of ethyl petrol in the United States until the poison hazard had been investigated by the Surgeon-General of the U.S. Public Health Service. It was recognised that the manufacture and handling of lead tetra ethyl is attended with danger if not done with proper precautions, but the debatable points were the hazards to retail distributers, garage employees, and the individual users of ethyl petrol in which the lead compound is diluted by about one part in 1300. After elaborate and careful investigations, it was concluded by the Surgeon-General that no poison hazard could be traced to the use of ethyl petrol, and the manufacture of lead tetra ethyl was resumed on June 1, 1926. Researches in the direction of finding other substances of a non-poisonous character and equally as efficacious as lead tetra ethyl, have up to the present been without success, although iron carbonyl is used to some extent in Germany, so that unless a grave and well-established hazard exists, the abandonment of the use of lead tetra ethyl does not appear to be justified.

IT is, perhaps, little appreciated in Great Britain that the present low price of sugar has placed British Colonies which supply us with this commodity in a distinctly precarious position; and it is not generally recognised how vital a matter Imperial preference is to some of the British West Indies, Mauritius, Demerara, and Fiji. There are two main factors concerned, one economic and one scientific; and the latter is the general low level of research work in our cane plantations. The almost universal aim in progressive cane-sugar countries is to induce the plant to produce more tons of sugar to the acre; for this purpose men versed in scientific methods have been enlisted. It must be confessed, however, that the British Colonies are very much behindhand in this respect. A short article in the current issue of the *International Sugar Journal*, under the heading "Scientific Work in the Plantations," deals with this matter, using as a text the action of the Oahu Plantation Company in the Hawaiian Islands, when faced with the serious situation caused by the trade slump following the boom year of 1920. In January 1921 this company founded a "Department of Agricultural Research and Control," and the results thus far obtained by its scientific officers on one single programme of work, namely, the proper feeding of the cane with artificials, are briefly summarised. Astonishing success has attended the application of scientific research to the fields for this purpose; and it is claimed that if in the factory a piece of machinery were invented giving equal financial results, it could be capitalised at one million dollars. So it would seem that such an investment in research is a paying proposition.

THE quarterly report of the Empire Cotton Growing Corporation, issued on Feb. 9, clearly indicates the extent to which this body is involved in the present serious crisis in the Lancashire cotton industry. The purpose of the Corporation was described and discussed in our issue of Nov. 5, p. 645. Briefly, its income is, in the main, obtained from a levy of 6*d.* per bale of cotton entering England; and its aim is to enable British buyers to control this raw material, by increasing the amount grown within the Empire. The Act legalising the levy expires in July next, and representative bodies have been sounded as to the attitude likely to be taken up by the trade when the question comes before Parliament during the present session. The result of this inquiry appears to be that, while fully appreciating the work that the Corporation has been able to accomplish, it is unlikely that the spinners will agree to the continuance of the levy, at any rate at the present figure.

THE position of the cotton industry has, indeed, become so precarious that drastic retrenchment in every possible direction has become a vital necessity,

and, as is so often the case, the reduction of research is considered a possible economy. The only hope is that the industry will consent to a reduced levy. If this is denied, the Corporation may have to close down—a contingency not only adverse to Lancashire, but also to most of the cotton growing dependencies of Great Britain. Lord Derby, in presenting the report of the executive committee, directed attention to some of the progress which has recently been made, and issued a powerful appeal to the Lancashire cotton trade to support the fresh Bill about to be introduced. The work of the Corporation is both economic and scientific; and one instance of marked scientific success is the result of plant-breeding work, which has cleared away the main hindrance to cotton growing in the important cotton tract of the Union of South Africa.

THE committee appointed on Jan. 16 by the conference of Thames riverside authorities in connexion with the floods in the London area of Jan. 6–7, presented on Feb 29 a unanimous and authoritative report. A technical sub-committee, which examined the hydrographic, meteorological, and hydraulic questions involved, reported that on the information at present available, more could not be said in explanation of the tide of Jan. 6–7 than that it was due to a combination of a spring tide, not in itself exceptionable, the raising of the water in the estuary by the meteorological conditions of the North Sea, and by flood waters from the upper Thames. On the question of future probabilities, it was reported that the whole subject of tides in the Thames requires further expert investigation, and it is recommended that this investigation should be undertaken by the Tidal Institute of the University of Liverpool, in co-operation with the Hydrographic Department of the Admiralty and the Meteorological Office. A scheme of warnings of the possibility of storm-floods was drawn up and recommended by the committee, subject to any improvements which the report of the special investigation on tides may suggest. The main points of this scheme are the following: (1) Public announcement to be made by the Meteorological Office, after consultation with the Port of London Authority, should climatic and tidal conditions be such that exceptionally high tides may be expected. This is an initial precaution. (2) Special watch to be kept at Southend, and, should the tide reach a specified high point, warning to be given to the appropriate authorities. (3) Watch then to be kept at selected points, and public warning to be given in the locality if the water reaches danger level, the London County Council to specify the danger level at each point and the locality to be warned.

MUCH interesting historical information on exceptional high waters in the Thames is set out in the Committee's report, and it is concluded that on the basis of records alone, there was no reason to expect a tide of the magnitude of that of Jan. 6–7. So exceptional was this recent storm-flood that its high water was eleven inches above the highest previously recorded, namely, that of Jan. 18, 1881. The Committee shows that whereas during the last thirty years the yearly average height of high waters at Crossness, on the seawards border of London, has remained steady, the corresponding average at Hammersmith has shown a small but continuous upward trend. The phenomenon at Hammersmith is probably to be attributed to the dredging and other changes which have been made in the bed and sides of the river, but the Committee quite properly points out that what is important for flood-works is not average high-water levels, but what may be expected in the way of exceptionally high tides.

LITTLE progress appears to have been made as yet in the discovery of principles which will enable storm-floods to be forecast from a knowledge of meteorological conditions. From noon until midnight on Jan. 6, there was a north-westerly gale over the North Sea and a westerly gale over the English Channel. On the other hand, the flood of Jan. 18, 1881, was preceded by a south-easterly gale which changed to easterly and then to north-easterly. The floods which occurred on the eastern shores of the North Sea in January 1916 have been studied by L. Grossmann, of the Deutsche Seewarte, and by D. la Cour, of the Danske Meteorologiske Institut. Those which occurred on the coast of Flanders during the German occupancy have been studied by Bruno Schulz, of the Deutsche Seewarte. More progress has been made in correlating with meteorological conditions those much smaller but fairly steady changes in sea-level which are almost invariably present in addition to the regular tides. In recent years important contributions to this subject have been made by R. Witting of the Helsinfors Havsforskningsinstitut for the Baltic and by A. T. Doodson of the Liverpool Tidal Institute for British waters. It has been shown by the latter that it is possible at present to forecast about half of these non-storm effects, providing that one is supplied with a substantially accurate forecast of the distribution of atmospheric pressure.

HALF a century has been spent by the Institute of Chemistry of Great Britain and Ireland in increasingly effective service to the community as well as to the profession, and the intention of its members to continue vigorously in the same service is apparent. At the fiftieth annual general meeting, held on Mar. 1, in the unavoidable absence of the president, Prof. A. Smithells, Mr. E. R. Bolton, vice-president, read the presidential address, in which the importance of the continued loyal co-operation of all the members in this direction was emphasised. The membership has increased during the past year by 202, the roll of fellows and associates now totalling 5388. The associateship is a recognition not only of competence but also of personal acceptability; adherence to the code of professional ethics, moreover, is a sign of a definite orientation towards the highest ideals of the professional man. The determination to keep Great Britain in a leading position in chemical industry, evident in recent developments among our greatest

manufacturing concerns, has created an unprecedented stir in centres of chemical education; the address referred to the desirability of convening a conference to consider generally the education of the chemist. It has been a function of the Institute to make representations to public authorities whenever it has appeared that there was inadequate understanding of the aims of, or of the responsibility involved in, the work carried out by professional chemists, and to protest when mean conditions of service have been offered. The existence of local sections of the Institute in the principal centres throughout the country has enriched the corporate life of the profession. Prof. A. Smithells was re-elected president for the new session.

BENJAMIN LEIGH SMITH, Arctic explorer, was born on Mar. 12, 1828, and the centenary of his birth deserves recognition for his disinterested and courageous efforts to add to Arctic geography. He graduated at Jesus College, Cambridge, attaining a high place in the Mathematical Tripos. Proceeding to the bar, he was 'called' at the Inner Temple in 1856. He lived a long span, dying in 1913, aged eighty-five years. Leigh Smith made in all five voyages to the Arctic regions. The first, carried through in 1871, in the *Samson*, was directed to exploration north-east of Spitsbergen. Two further voyages were similarly devoted to the Spitsbergen zone. In these he combined the attainments of a scientific observer with the skill of an experienced navigator, whilst both were coupled with that sense of enthusiasm which is indispensable to the pioneer. In the winter of 1880, Leigh Smith built a steam vessel at Peterhead—the *Eira*—of 360 tons burden, and 123 feet long by 25 feet beam. She had a complement of twenty-five, and was intended for a summer cruise in the vicinity of Franz-Josef Land. Much was accomplished before disaster overtook the expedition. The *Eira* was crushed in the ice on Aug. 31, 1881, and sank. The crew built a hut of turf and stones and wintered, along with their leader, living for the most part on walrus and bears. In June following they left in boats, reaching Novaya Zemlya, where relief was available. At the anniversary meeting of the Royal Geographical Society in 1881, the Patron's Gold Medal was awarded to Leigh Smith on the grounds (announced by Mr. C. R. Markham) that he had made important discoveries along the south coast of Franz-Josef Land, establishing new starting points for polar research; and for previous geographical work in the Arctic regions, all of which had been carried out entirely at his own expense and were personally directed. There is a portrait of Smith in the National Portrait Gallery, by Stephen Pearce.

AN interesting glimpse of primitive Europe still surviving is afforded by the story of the career and death of Samuele Stocchino, quoted from the *Corriere della Sera* by the *Times* on Feb. 27. Stocchino was the terror of Nuoro, the wildest province of Sardinia, and is known to have killed eleven men in vendetta besides having committed many minor outrages. He was thirty-two years of age, and the son of a brigand who was sentenced to twenty years' penal servitude. Stocchino behaved with conspicuous bravery during the War, but at its termination took to the mountains to carry on his vendettas. He has now been shot by the carabinieri after a hunt lasting for eight years. He was finally caught in an ambush, and for some time his body lay where it fell beneath a tree. His relations, belonging to eleven families, all dressed in black, filed past it in procession, each touching the left foot of the body in passing, it being the popular belief that by so doing the doom overhanging the family was averted. Pieces of the brigand's clothes were distributed to serve as amulets. Finally, the population of Nuoro sprinkled salt and dry olives on the threshold of the 'cursed' house where the brigand was born as a propitiatory rite. The use of salt as a protection against evil influences is interesting. It will perhaps be remembered that in a matrimonial case heard a year or so ago in Devonshire, one of the grounds of complaint by the husband was that his wife, believing him to have bewitched their child, always sprinkled salt around his chair.

MR. A. J. B. WACE communicates to the *Times* of Feb. 27 an account by Prof. Persson of the excavations of the Swedish Expedition in Greece at Dendra, at the foot of the Mycenæan citadel of Midea, in Argolis. A cemetery of important rock-cut chamber tombs has been excavated, two of them being found to contain funerary offerings such as are usual in better-class tombs of this type and dating from the latter end of the fourteenth century B.C. A third tomb was of unusual size and was immediately apparent to be out of the common. The entrance passage, hewn out of the rock, is 60 ft. long and 6 ft. wide. On its floor, which lies 17 ft. below the surface, was a mass of stones from the wall barring access to the door, and under this lay a female skeleton, accompanied by a long bronze pin, spindle whorl, and ornaments in glass paste once masked with gold leaf, which had been left by plunderers of Mycenæan times. In the chamber under two great stone slabs was found a collection of thirty-three bronzes packed one within the other, and brilliantly patinated in green, blue, and brown. These included six large jugs, seven bowls, four tripods, five lamps, a six-pronged fish-spear, a sword, two knives, and two razors. Several are decorated with delicately engraved flowers or shell-fish, others with geometrical patterns. Many of the objects retain their wooden handles.

THIS find is one of the richest of early bronzes yet made in Greece. It has been possible to fit together some of the many fragments of limestone on the floor. They have proved to be a sacrificial stone, and further apparatus of sacrifice, of which other evidence appears in traces of smoke on the walls and a quantity of charcoal. On the floor was a bronze sword with a hilt ornamented with glass beads in hundreds, boars' tusks cut and pierced to sew on a leather helmet, an iron stud from a sword hilt, and hundreds of small

(*Continued on p.* 393.)

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Reviews.

Science and History.

Classics of Modern Science (*Copernicus to Pasteur*). Edited by Prof. William S. Knickerbocker. Pp. xiv + 384. (New York and London: Alfred A. Knopf, 1927.) 18*s*. net.

THERE is a great problem facing the study and the teaching of history throughout the civilised world. On one hand, it is more and more of a commonplace that we must study history, and that the historical way of looking at things is essential to right action. On the other, there remains the greatest divergence as to what sort of history should be studied. Nay, more; on the subject suggested by this book there is not so much divergence as an almost complete severance and ignoring of one side by the other in the discussion. The editor begins by quoting Du Bois Reymond to the effect that "the history of science is the real history of mankind." He cordially accepts that statement, and adds that the sooner we realise it on a grand scale, the more we shall hasten the happiness of mankind. Now, what Du Bois Reymond held was that the real history of mankind is simply ignored by all those who are generally recognised as 'historians.' It is not that they criticise or oppose it 'in its place,' but they say that it is not their business; it is not what they mean by history.

This is the extraordinary position, and as it is impossible to believe that such a misunderstanding or divorce between two connected aspects of human thought can be permanent, one welcomes any modest and practicable attempt to make a bridge. This book is distinctly of the bridge-building kind. It is compiled by a professor of English in the University of the South, U.S.A. It consists of typical extracts chosen from the writings of thirty-six men of science from Copernicus onwards, and the preface ends by commending science as one of other efforts towards "bettering man's estate." The author holds that for English courses, where emphasis is laid on ideas as inspiration in writing, men of science, being necessarily clear thinkers, have provided excellent illustrations of straightforward and coherent writing.

From this point of view, the book, so far as we know, is unique in English, and deserves special attention as a fresh approach to the problem from which we started. There are two other methods now in progress for bridging the gulf, and it may be interesting to put them side by side with this. One is that going on within the ranks of men of science themselves, which found expression a few years back in a resolution, and a committee appointed by the British Association, aiming at including some teaching of the history of science in the last two years of the science course at school. The book, compiled by Mr. Whetham and his daughter, called "Cambridge Readings in the Literature of Science," and published by the Cambridge University Press, would be useful material for students of that kind rather than for the English courses which Prof. Knickerbocker has in mind. The Cambridge book traces the development of definite subjects; the structure of the universe, the nature of matter, and the development of life are the topics chosen as being of transcending importance. This plan involves much more detailed and technical matter than would be suitable for general reading, and the book thus becomes clearly one for those pupils who make natural science their principal study. It does not help us directly to solve the problem of the bifurcation in history.

A third method remains, which is happily gaining ground among the writers of history text-books. This is to introduce, at the most telling points in the ordinary political narrative, some account of the contemporary development of thought, especially in the sphere of scientific discovery. It was, in fact, an anomaly too flagrant to be defended, to teach Greek history without Pythagoras or Archimedes, the Renaissance without Leonardo or Galileo, the modern world without Newton or Darwin. If once a few such *points de repère* can be secured, the battle is more than half won. Interest once aroused, and the right of place granted, it is inevitable that inquiry spreads and teachers and taught alike begin to ask what led up to the achievements of these great men, and how has their

work affected later thought, and, more especially, the evolution of society.

The last point is capital, and the orthodox historians are perfectly right in asserting that social structure is the proper subject of history. They are wrong in ignoring the part which science has played in forming it. We, on the side of science, shall fail if we do not make clear the growingly preponderant rôle which science has played in that direction. Specialism on both sides has proved the most serious obstacle to a better mutual understanding. The political historian is more and more absorbed in the overwhelming mass of his documents, and is apt to think that the attempt to set up such connexions as we have here in mind is illegitimate or at the best premature. . . . It is all so complicated and obscure; we do not know enough to 'generalise.'

What, however, we do know unquestionably, is the steady and triumphant progress of science, or organised thought, and it is a very proper subject of inquiry to consider the effects of this on the life we live as political and social beings. On the other hand, the scientist has his own special line of research, increasingly narrow as a rule, and is content to leave social reactions to 'historians' proper.

Hence the fatal gap which must be bridged, if science as a social and intellectual force, and history as a synthetic record of man's evolution, is ever to be realised. It will be clear from the examples given that the goal must be slowly and variously approached. But in the pioneer stage of any undertaking a special welcome is due to those who have the same vision of the goal, who wish to follow the same path as ourselves and actually begin to blaze a track through the jungle. For that we thank Prof. Knickerbocker, and wish his book success.

F. S. Marvin.

Watt: the Man and his Engine.

James Watt and the Steam Engine: the Memorial Volume prepared for the Committee of the Watt Centenary Commemoration at Birmingham, 1919. By H. W. Dickinson and Rhys Jenkins. Pp. xvi + 415 + 105 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 63*s*. net.

JAMES WATT died on Aug. 19, 1819, and to commemorate the centenary of his death energetic steps were taken in Birmingham. It was hoped that sufficient funds might be collected to erect a Watt Memorial Hall in Birmingham, to found a 'Watt Chair' in engineering at the University of Birmingham, and to publish a memorial volume. Commemoration proceedings lasting for several days were successfully held in Birmingham in September, but the sum collected fell far short of the amount aimed at. Finally, it was decided to found a 'James Watt Fellowship' in engineering, and for this purpose a sum of £5000 was handed over to the University of Birmingham. A portion of the remainder was used for this memorial volume, and the balance is in trust until such time that it may be used towards the objects for which it was originally subscribed. Urgent as is the need for a hall and buildings devoted to engineering and kindred sciences in Birmingham, it may be said that the volume under review is probably the fittest memorial to the great engineer.

A life of Watt was, apart from the centenary, long overdue. It is more than sixty years since Dr. Smiles wrote "The Lives of Boulton and Watt" in a popular style, and it was in 1854 that Muirhead published his work on "The Origin and Progress of the Mechanical Inventions of James Watt," dealing largely with letters and patent specifications. These are the only previous comprehensive works on the subject, although there have been numerous smaller popular books and papers dealing with some particular phase or side of the engineer's life.

The Committee was fortunate in obtaining for the memorial volume Mr. H. W. Dickinson and Mr. Rhys Jenkins. It had at hand a very great number of records, letters, and drawings, and the examination and selection of these in itself has been a great task. The three chief sources of information on the subject have been the Boulton papers, now in the Assay Office at Birmingham, the papers relating to Watt belonging to Major J. M. Gibson Watt—the present representative of the family, and kept at his seat at Doldowlod, Radnorshire—and the Boulton and Watt collection in the hands of the City of Birmingham. The numerous footnotes in the volume, and the many reproductions of original drawings, make one realise what a mass of information has fortunately been preserved having a direct bearing on the steady growth of the greatest implement which has helped forward the civilisation of the world. We share with the authors their regret that the volume finishes with the retirement of Watt from active business in 1800, but it is a matter of congratulation that one is now able to follow even so far the progress of the man and of his work.

The book is divided into these two sections, the

first and much smaller one dealing with "Watt the Man," while the much larger portion is devoted to "Watt and the Steam Engine."

The first portion is a very human document, and places before one a vivid picture of Watt in his younger days; and although, as stated, he was shy, modest, and unassuming, yet he was capable of attracting the friendship of men of position in the scientific world much higher than he then occupied. This trait in his character, in spite of the fact that later in life he became apparently less amiable, seems to have remained with him to his great advantage throughout his life. What must be fully appreciated is the fact that Watt was never apparently strong in health, and the arduous work he did in London in 1755–56 probably further weakened him. On his return to Glasgow he was fortunate in the circle to which he was admitted, including as it did so many eminent scientific men, several of whom were to remain his friends for many years. Perhaps it is due to the story of his watching the kettle, but many will be surprised when it is shown that he was twenty-nine years of age before the idea of a separate condenser, rightly said to be the greatest single improvement ever made in the steam engine, came to him. Two years after this he became a land surveyor, about the same time making the acquaintance of Dr. Roebuck, of Carron Works, and the following year meeting Matthew Boulton in Birmingham. It was the help and acquaintance of these two men that supplied what Watt lacked. Perhaps it was the financial difficulties that the former found himself in that even helped matters forward, for Watt and the engine he had built at Kinneil were transferred to Birmingham in 1773–74, and progress from this time was slow, it is true, but steady and ever growing under the guiding hand, encouragement, and advice of Boulton. The progress of the world would probably have been delayed had Watt found remunerative employment as a surveyor, or had he accepted appointments offered him in Russia shortly before this time.

The partnership with Boulton and the twenty-five years' life given to his patent extended from 1775 to 1800, and this period covers the connexion Watt had with the development of his engine and its details. In spite of the strenuous and anxious time he so often had, which his letters so clearly show, he still was able to take interest in other work. It was, in fact, during this time that he brought out the copying press, was interested in bleaching by chlorine, and investigated the composition of water. On the latter the authors' researches have not thrown any additional light.

The help Watt received from Boulton is ever in evidence, and, as the authors point out, Boulton in writing in 1769 to him, said, "I do not intend turning engineer," but his sound practical advice on engineering points was often of the greatest assistance to the inventor, and one can only regret that Watt in 1788 did not give, apparently, the financial assistance Boulton then required and would have liked to have received.

The chapter on Watt's life in retirement is short, but renews the regret one has that the efforts made to purchase for the nation his house at Heathfield were unsuccessful. One cannot, however, but be grateful that the room which was his workshop has been removed in its entirety to the Science Museum, South Kensington, and that it is under the care of one of the authors of this volume.

The second section of the book is of the greatest interest to engineers. It first of all deals in chronological order with the engines built under Watt's patent. Later it is shown that very little of the actual work was done at Soho in early days; it was not until 1795, indeed, that any castings were made at the new foundry. The procedure was for drawings to be made by Watt, and the various parts to be made in different localities, and the whole erected on the final site. Watt produced these drawings during nearly the whole of the time under review at his house at Harper's Hill, less than half a mile from Birmingham Town Hall. A very large number of these plans is reproduced, and with the copies of original drawings of details will be studied with interest by all who are attracted by the history of the development of the steam engine.

The developments of the various parts of the engine are dealt with in great detail. These show that although it is said with truth that Watt, after his patent, "made no change in principle, no improvements in the direction of securing increased economy of steam," yet he was ever working on perfecting these details and supplying other improvements of working. These, which are fully dealt with, and of which the construction is shown, include the valve and its gear, parallel motion, the governor, the indicator, etc. It seems somewhat strange that more attention was not given to the efficiency of the boiler, for at first, in Cornwall, where most business was done, payment was at the rate of one-third of the saving made in coal consumption over that used by the old atmospheric engine. If more had been done in this direction,

Watt might have overcome his dislike for greater pressures.

The question of the application of the crank to Watt's engine is considered at some length, and the steps he took in devising methods of producing means of avoiding it for 'rotative' engines is also dealt with comprehensively. It is interesting to note that in the four years after 'Pickard's' patent had run out, in 1792, only six engines with cranks were built by Boulton and Watt, the others being still fitted with the sun and planet motion. Watt was naturally dependent largely on his staff. Murdock, both as a craftsman and inventor, is well known, but interesting notes are included on Southern and others not so well known, and on certain engineers who were engaged in different directions. One would have thought that Rennie would have been included in the former list. The "Directions for erecting and working the newly invented steam engine," issued in 1779, are given in full.

The book is well produced, but its size, which is unavoidable, makes it one for the table rather than for the hand.

The Plague in Shakespeare's Time.

The Plague in Shakespeare's London. By F. P. Wilson. Pp. xii + 228 + 16 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 12*s.* 6*d.* net.

THIS work aims at narrating in detail the history of the plague in London in the early part of the seventeenth century. It is based on materials supplied by contemporary books and documents. The story opens with a brief account of our modern knowledge of plague, and contrasts this with the many and fantastic views held in Shakespeare's time of the cause and cure of the disease.

Plague has been a powerful stimulus in bringing about social reforms and in developing and shaping our ideas and laws on public health. The great mortality among the humbler classes during the prevalence of the Black Death in 1348–49 compelled and initiated reforms which ultimately led to the emancipation of the working classes. It was the destruction caused by plague which stirred the Government of the day to draw up and enforce orders to stay the disease. A very interesting account of the rise and development of the plague orders from their inception in 1518 is detailed in the second chapter of this book.

Among the permanent officials who were responsible for the control of plague epidemics, the brunt of the work fell upon the constables. They had to report the true number of persons who died of the disease; they had to shut up and mark infected houses and arrest "wandering beggars and idle persons." If they neglected their duties they were severely punished; at the same time they were in great danger of contracting infection. The places of casualties were quickly filled by deputies, since acceptance of the post was compulsory, recalcitrant citizens being brought before the Lord Mayor and duly punished.

When plague became epidemic certain temporary officials were appointed. For example, in 1583 each alderman was required to choose monthly two substantial and discreet citizens to be surveyors in each parish. But in May 1609 and afterwards, examiners were appointed for two months, and those who refused were imprisoned "until they shall conform themselves accordingly." The duties of the examiners were to take care that all orders were duly observed; they had to look for infected houses and to appoint and supervise the warders, searchers, and other minor plague officials.

The sanitation of London in Shakespeare's time was very primitive. It closely resembled that of an eastern city of to-day. The most potent factors in causing the plague were the great overcrowding, and the character of the houses. For example, a proclamation of Sept. 16, 1603, complained of the crowding of dissolute and idle persons in small and narrow rooms, and ordered all houses infested with multitudes of dwellers to be razed to the ground and not to be rebuilt. All attempts, however, to check the growth of London were in vain, and, far from remedying the evils, led to gross overcrowding and the erection of mean hovels in holes and corners of the city and suburbs.

Another potent cause of the trouble was the foul condition of the streets. The duty of cleansing the streets devolved mainly upon householders, but partly also upon scavengers and rakers. In Shakespeare's time two scavengers were appointed to each parish and held office for a year. Like the constables, they gave their services willingly or unwillingly for nothing. Their office was not menial; they were citizens and householders, men of some importance in the parish, civic dignitaries. They did not clean the streets themselves, but were responsible for the rakers who did. The work does not seem to have been done efficiently, for sensitive persons complained of the dunghills which pestered narrow lanes and alleys. The pudding wives and tripe wives were accustomed to throw into the channels, paunches, guts, and entrails, and also the water in which these were boiled.

Citizens were incredibly careless in disposing of carcasses. In 1578 it was found necessary to forbid them to throw out of doors any dead dogs, cats, whelps, or kitlings. In 1625 carcasses of horses, dogs, and cats lay rotting in Moorfields, Finsbury Fields, and elsewhere about the City. No wonder, then, that the streets of Elizabethan and Jacobean London were thronged with dogs. Many parishes supported a dog-killer of their own. We are quite prepared to accept, therefore, Defoe's estimate that forty thousand dogs were killed during the plague of 1665.

In such circumstances, rats, whether dead or alive, attracted minor attention, even as they do in an eastern city to-day. There were, however, we are told, many ratcatchers in Elizabethan London who, according to Richard Deering's "Madrigal of London Cries," shouted in the streets, "Rats or Mice. Ha' ye any rats, mice, pole cats, or weasles?" Or "Ha' ye any old sows sick of the measles? I can kill them, and I can kill moles, and I can kill vermin that creepeth up and creepeth down and peepeth into holes."

The picture of an eastern city to-day is completed when we learn that London was "a City of kites and crows." In these days in England kites and ravens were protected birds, because they were such excellent scavengers. Kites were so bold in London, it is said, that they snatched bread out of the hands of children while they were eating it on the streets.

What a reformation has been effected in our habits since these days. In this process we have expelled from our cities not only the kite, the carrion crow, and the black rat, but also with them the plague, relapsing fever, cholera, dysentery, and other diseases, now often called tropical diseases, but in truth diseases peculiar to a primitive state of social and economic development.

Much might be said about segregation as that measure is revealed in this carefully compiled work, but space forbids this. Nevertheless, a passing reference must be made to the Pest House, an illustration of which is reproduced on p. 82. A reprint of a map published in 1682 shows the situation of this building. The site, Mr. Wilson states, is a little north of the existing buildings of the French Protestant Hospital, a few hundred yards up Bath Street on the left-hand side as one walks from Old Street.

Not the least valuable parts of this book are the last chapters, which give a detailed account of the progress of the plague in London from 1603 to 1625. This account is enlivened by sundry references to contemporary history, and is illustrated by excellent reproductions of some of the original Bills of Mortality.

These chapters are followed by notes on a number of matters referred to in the text. Then follows an Appendix divided into two parts. Part I. deals with the Bills of Mortality of the sixteenth and early seventeenth centuries, the machinery which produced them, and an estimate of their trustworthiness. Part II. is concerned with an estimate of the population of London in the early seventeenth century.

Readers will find this book not only interesting but also a valuable work of reference to original documents which have a bearing on the plague in Shakespeare's time. The author and the publishers alike are to be congratulated on the excellence of their work.

Education in Hygiene.

(1) *Healthy Growth: a Study of the Relation between the Mental and Physical Development of Adolescent Boys in a Public Day School.* By Dr. Alfred A. Mumford. (Oxford Medical Publications.) Pp. xxiii + 348. (London: Oxford University Press, 1927.) 16*s.* net.

(2) *Personal Health.* By Prof. Emery R. Hayhurst. Pp. xi + 279. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1927.) 15*s.* net.

(3) *Good Health and Happiness: a New Science of Health.* By J. Ellis Barker. With an Introduction by Sir W. Arbuthnot Lane. Pp. 525. (London: John Murray, 1927.) 7*s.* 6*d.* net.

(4) *Towards Health.* By Prof. J. Arthur Thomson. Pp. viii + 242. (London: Methuen and Co., Ltd., 1927.) 7*s.* 6*d.* net.

THE replacement of instinct by reason in the ordering of human affairs has not proved an unmixed blessing where the health of the individual is concerned. Instinct unerringly acts not only for the benefit of the individual but also of the race; too often reason is short-sighted, and what recommends itself to reason as convenient and pleasant for the moment proves in the long run to contain seeds of disaster. For example, the discovery by primitive man of the art of cooking was undoubtedly an immediate benefit. Many new substances were rendered available as foods, and the nutritive qualities of others multiplied. But the result has been that the mammalian organs evolved to deal exclusively with raw fibrous material have become to a large degree superfluous. Our complicated and elongated alimentary canal remains a cumbrous and inconvenient heritage. Our teeth, no longer

required for the purpose for which they were evolved, have lost their survival value. They have consequently lost their resistance to decay, and are the most vulnerable of our organs.

The returns of industrial sickness and the results of school medical inspection both reveal an appalling amount of preventable illness in the population. It is largely the result of ignorance. For example, a school dental service has been introduced, not alone as a means to cope with the ravages of dental disease in children, but also as a preventive measure. But less than half of the parents take advantage of it at all, and of the small proportion who do, the majority take advantage of it too late to save teeth which are already decayed. So to the provision must be added a propaganda organisation.

The problem of the hygienist is now to spread amongst the population the necessary knowledge which all must have to enable them to avoid the insidious menaces which are the accompaniments of modern social life. "The people perish for want of knowledge." Therefore the ministries and the municipalities are concentrating upon health propaganda and health organisation. To aid the good work there is a brave outpouring of books, amongst which the four we have before us stand out as typical examples, each approaching the subject at a distinct and widely differing angle.

(1) Dr. Mumford sets out in "Healthy Growth" the untiring and conscientious work which he has carried out for many years in observing the growth and controlling the health of the boys at the Manchester Grammar School. He reviews the attempts made to use the mass of statistics which he has collected. One by one, accepted formulæ were tried and finally discarded in favour of the criterion of *time increment*. Some consideration of the results has already appeared in our columns (NATURE, May 8, 1926, p. 656). Though convinced that there is a definite relation between physical and mental growth, Dr. Mumford has experienced great difficulty in demonstrating it satisfactorily. He now thinks that he is able to do so by the use of an expression for physique consisting of the weight divided by the height multiplied by the square of the chest circumference. This he terms the 'buoyancy index,' $W/(H \times C^2)$. Groups of advanced scholars compared with groups of retarded scholars show positively that better buoyancy is associated with high mental performance. But when the advanced scholars are compared amongst themselves, it is found that those who obtain the highest marks have the least buoyancy. This somewhat anomalous result can be interpreted only by the assumption that the possession of a certain degree of physique is necessary for superior mental development, but competition at our secondary schools is so severe that those who excel in examination do so only at the expense of their physical development. Should this prove on further investigation to be well founded, the system of competitive examinations must receive a mortal blow.

"Healthy Growth" is by no means an easy book to read, but it is necessary for all those who have to deal with the problems of the adolescent youth. In view of what comes later, it is a remarkable achievement to have written a treatise on the growth of adolescents without one reference to diet.

(2) "Personal Health" is a popular text-book written by the professor of hygiene in the Ohio State University. It is beautifully produced and profusely illustrated. The method followed is to take the bodily systems in order and to discuss influences which promote and hinder their efficiency. It is well done, and the final result is summed up in fifteen rules for personal health, which are well balanced, sane, and will be supported by all hygienists.

It is sad to reflect upon the numbers

> "Who have died because they never knew
> These simple little rules and few."

Those connected with diet are excellent, and keep this much-debated subject in its proper focus. They are: Rule 7. Avoid overeating and overweight. Rule 8. Get back to Nature in the matter of foods you eat. Remember that Nature's food products are grains, vegetables, fruits, nuts, meat, milk, eggs, and water. Rule 9. Select your food widely from the above; get a certain part fresh every day, *i.e.* not canned or bottled. Drop fads and chew well. Do not diet except on medical advice.

Prof. Hayhurst's first rule is "Ventilate every room you occupy," and his fifteenth is "Keep serene no matter what happens."

Unfortunately, all such rules are counsels of perfection and cannot always be followed even when known. We were travelling to Cambridge lately by rail, and were careful to open the window by which we were sitting. Presently a fiery-faced don came across from the opposite end of the compartment and with some emphasis pulled up our window. After the air had become sufficiently close we ventured, when his attention was distracted, to drop the window ever so little. So soon, however, as our friend perceived the freshening atmosphere, he made an infuriated rush for the

window and banged it up again. The net result of this deplorable journey was that we had obeyed the first rule of health very imperfectly, and the last not at all.

(3) "At the age of forty every man is either a fool or a physician." Therefore the presentation of the point of view of the intelligent layman is very welcome. Mr. Barker, however, proves disappointing. His thoughts run chiefly on food. He makes great play with the comparative mortality tables furnished by the Registrar-General. He points out that doctors as a class suffer much more from digestive and renal diseases than do agricultural labourers. From this he makes the deduction that doctors do not understand the principles of health, particularly in relation to diet. It has not occurred to him that the corollary to this deduction is that the agricultural labourer understands more about health than does the doctor.

The truth is that the labourer's vocation forces him to adopt more or less a healthy mode of life while the doctor's condemns him, *malgré lui*, to an unhealthy one. The general practitioner lives a life unapproached for stress and hardship. During periods of epidemic prevalence he is constantly in contact with disease. He rarely has time for meals and must bolt his food. His day's work extends to twelve or fourteen hours without intermission. He cannot afford to take the rest he enjoins upon his patients. When he feels his temperature rising, he alone must not succumb, and therefore doses himself with antipyretics and stimulants and sets out in all weathers to visit the sick. When, dead beat, he retires to bed after an exhausting day, it is ten to one that he will be called out again into the bitter night. Living at this pressure, it is inevitable that digestion and arteries suffer. If Mr. Barker took the relative mortality statistics of soldiers and civilians, he would very probably find that the former die more frequently from bullet wounds; his deduction would be that the soldiers die because they do not understand fire-arms.

If Mr. Barker were right, what would be the answer to the question asked by Sir George Newman in his latest report: "Why is infantile mortality lowest in doctors' families?"

Mr. Barker gives the ideal regime he himself follows, which has restored his own personal health. Here is an extract: "My breakfast consists of a portion of bran porridge, made of equal weights of coarse oatmeal and ordinary bran cooked two minutes."

By all means the book should be read; more than half of it consists in interesting quotations from authorities ancient and modern, which make it a veritable medical anthology of the *vis medicatrix Naturæ*. But it is not wise to attempt to follow the advice it contains without first consulting the family doctor.

(4) Finally, we have a book from the fluent pen of a distinguished biologist. Naturally, it introduces a most valuable element into our discussions on health. Like all Prof. Arthur Thomson's books, it is written in that flowing, easy, informative style which makes them such a pleasure to read. He does not think it necessary to devote much space to food—only $2\frac{1}{2}$ pages out of 232. He focuses attention bravely upon the problems of heredity, of birth-control, of sex education, and other highly controversial questions. But his urbanity and fairness are such that he can step even on our favourite corns without greatly annoying us. The biologist sees the species rather than the individual, and reveals the important truth that much which is done socially for the weakly individual is not in the interest of the race as a whole. On birth-control, Prof. Thomson conducts a gentleman's controversy with Prof. Pembrey, but so just is he to his opponent, and so fairly does he state the latter's case, that we leave with the impression that upon this topic at least the physiologist is the better biologist.

The Lady Hygeia must often be at bitter feud with her sister the Lady Eugenia. It is useful to be reminded that the hygienist does not necessarily have the last word.

Animal Biology.

Animal Biology. By J. B. S. Haldane and Julian Huxley. (Clarendon Science Series.) Pp. xvi + 344. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 10*s*. net. Cheap edition, 6*s*. 6*d*. net.

DURING the last ten years there have been important changes in the biological sciences. The classical divisions into which animal biology falls are physiology and zoology. In both these subjects it is increasingly felt that a wider scope is necessary. In physiology this widening process is already advanced, as the flourishing condition of its daughter subjects, such as biochemistry, testifies. The position of zoology, on the other hand, is at present difficult. Modern zoology is founded upon the work of Darwin; yet although his work primarily depended upon observation of the living animal, its consequence was to make zoology drift more and more towards pure morpho-

logy. Detailed and comprehensive knowledge of animal types and their anatomy has of course been vital to zoology, but at the present time the sterility of the old methods, which restricted investigation to the comparison of the anatomies of dead organisms, is clear. It is not that morphological methods are unsound, but that the real problem of the living animal is how it lives and how it has been evolved, and to study this one must understand not only its morphology but also its function. It is not perhaps too much to say that such understanding demands a greater knowledge of physiology and the principles of physics and chemistry than the average zoologist has until recently possessed.

It is essential, then, that the zoologist should study function as well as form in the animals he observes. How necessary this is can be seen when one considers that a Lamellibranch mollusc feeds with 'gills,' so called, which have no respiratory function, and that its 'liver' has yet to be shown to possess *any* function in common with the typical organ of the vertebrate. The lamellibranch liver forms no secretion; it is an organ of phagocytic ingestion and of absorption. A digestive organ on a plan more different from a vertebrate liver is hard to conceive.

As for physiology, its intimate relation to medicine has resulted in its restriction almost entirely to the study of one single group—the vertebrates. Its great recent advances have now brought it to the stage when many fundamental generalisations are being made; but the process of generalisation is seriously handicapped by lack of knowledge of other types. There has been a tendency to consider animals other than vertebrates merely as 'lower animals' of simpler organisation, and with this has come the implication that the physiology of these simpler organisms would not differ fundamentally from that of the vertebrates. The fact that the animal kingdom consists of many separate phyla which have evolved along different lines for untold ages has not been fully appreciated.

The arthropod has evolved independently of the vertebrate and is in its own field just as highly developed. We have no reason to suppose that this tremendous morphological divergence has not been accompanied by as vast a physiological divergence. Yet it is common to find in textbooks a photomicrograph of an insect's muscle illustrating an account of the physiology of striped muscle, although almost all such work has been done on vertebrates. Now vertebrates and arthropods having been separate for so long, and having in all probability evolved striations in their muscle quite independently, there is no reason to assume *a priori* that we have similar contractile mechanisms in both cases. If we find that the processes actually are similar in such cases, it indicates a remarkable restriction in the types of physiological mechanism which can be arrived at by protoplasm. The recent work of A. V. Hill and others has shown that certain fundamental processes in contraction do, in fact, appear to be identical in the muscles of many different phyla.

A mechanism of this kind, which appears to depend upon a fundamental property of protoplasm, is obviously of far greater importance than one which is merely peculiar to a single group, the vertebrates, and the fact that several mechanisms common to the whole animal kingdom have recently been discovered is one of the most important steps made in physiology. Such discoveries simplify the whole problem, and the physiology of man himself can be elucidated by the study of other organisms of widely different origin.

It seems necessary, then, that the zoologist in his training should learn something of the physiology of the types he studies, and the physiologist should be familiar with the variety of animal forms and able to relate their physiological processes to those of the vertebrate. The question is, How is this to be done? The ideal condition is plainly to awaken a broad interest in the relations between the various sections of biology while the student is still young. It is at this point that such a book as "Animal Biology," by J. B. S. Haldane and J. S. Huxley, will prove extremely valuable, for the authors have succeeded admirably in co-ordinating the several branches of zoology and physiology.

The book opens with an introductory chapter based on the physiology of the frog. What knowledge of function the student has is connected with his own body, and from man to frog is an easy step in the development of ideas regarding function in different organisms. It is much better to begin in this way than to enter into a preliminary discussion of Amœba, protoplasm and its properties, a matter unfamiliar and of extreme complexity.

The next chapter gives a general account of development based on that of the frog, gametogenesis, Mendelian heredity, evolution, and natural selection. The inter-relations of these subjects are well expressed, and the explanation, which is much helped by the many illustrations, should

counteract the tendency to treat each subject as separate.

There follows a chapter on metabolism and the building up of protoplasm. It is a pity this is so short, and a brief outline of the chemical nature of the proteins, carbohydrates, and fats would easily be grasped by the student and would help to give him an idea of the molecular basis of protoplasm.

The next few chapters deal in detail with elementary physiology—respirations, functions of blood, digestion, excretion, and the nervous system. The whole book, especially in its early chapters, contains an amazing amount of information in a small space and repays attentive reading.

An interesting chapter on internal environment considers the composition of the plasma and the function of dissolved substances, endocrine secretion, and immunity. A clear and interesting account is given of the relationship of development and regeneration, and the effect on these of environmental factors. Chapters x. to xii. are very good reading in an easy style. The proofs of evolution are given, the possible modes of evolution criticised, particularly from the point of Mendelian heredity and the influence of natural selection, and finally the results of evolution discussed and compared. One of the most interesting features in the book is the table of comparative sizes of organisms (pp. 276-280). It comes as a shock to realise the immense variations in size met with in Nature. To choose a few:

$10^{57} \times 1{\cdot}8$ = minimum weight of universe.
$10^{27} \times 6$ = weight of earth.
10^{10} = big trees of California.
10^{-15} = smallest filter-passing organism.
10^{-18} = hæmoglobin molecule.
10^{-27} = an electron.

The book is well got up; there is an index and glossary of technical terms, and the illustrations are numerous and well reproduced. The price (6*s.* 6*d.*) seems very reasonable. It is hard to find anything to criticise even in details: the plasma of land animals is more near to sea-water diluted to 4 to 5 times its volume than to 3 times (p. 159); and it is scarcely true to imply (p. 172) that any severed piece of a Protozoon can regenerate the whole organism, since regeneration in Protozoa depends absolutely on the presence of nuclear material in the segment.

To sum up, the book is an excellent one, and could be advantageously read by the advanced worker as well as the student. One feels, however, that at the present time it will be of more value to the university student than to schoolboys under 16½, for whom it is apparently intended. The book is certainly not beyond the grasp of an intelligent boy, but there are so far few schools where the general scientific education would be sufficiently advanced at that age for such a book to be fully appreciated. One hopes that soon it will be otherwise. C. F. A. P.

Science and Psycho-Pathology.

Psychopathology: its Development and its Place in Medicine. By Dr. Bernard Hart. Pp. vi + 156. (Cambridge: At the University Press, 1927.) 7*s.* 6*d.* net.

IT is a fortunate circumstance that works of a strictly technical character in which no concession is made to easy understanding prove sometimes to have interest and value for a circle far wider than that to which they are primarily directed. This book is addressed to a medical audience, its point of view is that of an adept in a special branch of medicine, and it keeps to its theme with uncompromising closeness. Nevertheless, through a happy combination of its subject with its author's philosophic temper and expository skill, it is a work that anyone interested in the general field of science may be advised with confidence to read.

The book is made up of three parts. The second and third parts are entitled respectively "The Psychology of Rumour" and "The Methods of Psycho-therapy," and are comparatively short essays. The latter is of chiefly technical interest; the former is an examination of the psychological nature of testimony, a theme admirably suited to the easy lucidity and firmness of touch that are characteristic of Dr. Hart's writing.

The greater part of the book is occupied by three lectures on the development of psycho-pathology and its place in medicine. These were the Goulstonian lectures delivered before the Royal College of Physicians of London, and are thoroughly worthy of their author and of the occasion of their delivery. In these lectures there is given a comprehensive and judiciously compressed review of the efforts of medicine to explain and to treat the common class of disorders now universally regarded as of mental origin and known as the psychoneuroses. From this review there emerges the fact that the only system of doctrine which even affects to deal with the whole field in a radical and comprehensive way is that which has the rather awkward name of psycho-analysis and is the work of Sigmund Freud. It is naturally, therefore, to a critical examination of this system that Dr. Hart chiefly directs himself.

It may be said at once that the discussion is the

best that has been published on a very thorny topic. Dr. Hart is well equipped for his difficult task; he has knowledge and independence of mind, and is quite free from those defects of advocacy or detraction that have spoilt so much writing on this matter. He gives a summary but adequate general account of the Freudian system, and examines with especial care the claim that is made for it of being in strict accord with the methods of science. It may perhaps be well here very briefly to remind the reader that the work of Freud in psychology falls naturally into three broadly distinct divisions—a somewhat arbitrary separation that makes consideration of the great bulk of the material rather less difficult. In the first place comes the work on the elementary mechanisms of the mind by which were elucidated such processes as conflict, repression, and the effects a repressed system is capable of producing. This work is uniformly guided by the principle that mental events are determined by the relation of cause and effect as rigidly as are physical. It is already very widely accepted and has had a great influence on psychology in general. Secondly, there is the evolution of a comprehensive theory of the mind which assigns a practically complete primacy in power and significance to the impulse of sex. Thirdly, there is the elaboration of a method of examining the contents and working of the mind which is at once an implement of psychological research and a method of treatment for the psychoneuroses.

This is, of course, the famous method of psycho-analysis which has come to give its name also to the whole doctrine of Freud. The claim is made for this method that it is unique in the access it affords to the mind and that it is capable of exact scientific use. Upon the justice of this claim the whole Freudian system depends. The process of psycho-analysis—to describe it very crudely—consists in the patient talking about himself and his experiences under the direction and influence of the physician. In this relation the influence of the physician must and is admitted to become very great. In view of this fact, Dr. Hart points out that the psychological facts elicited by the physician can perhaps no longer be regarded as, so to say, the pure facts of observation, but should be looked upon as tainted by the physician's direction and so no longer fit material for the foundation of scientific theory. This is his principal criticism of the Freudian system, and as it is directed to the validity of the method on which the whole is founded, it is plainly fundamental. This objection is met from the psycho-analytic side by the view that the unconscious processes of the mind of which the physician is in search are characteristically refractory, and only to be influenced with the greatest difficulty. As, however, this feature of the unconscious is only to be ascertained by the process of psycho-analysis which is itself in question, the argument seems only to bring us back to our starting-point.

Of the element in the Freudian system which has aroused the sharpest dissent—the sex theory itself—Dr. Hart's discussion is a model of rational and open-minded inquiry. He finds no inherent irrationality in the theory, but although he is very sparing of *a priori* considerations in general, he seems to feel the difficulty, which perhaps comes most naturally to the biologist, of ascribing an exclusive influence in forming the mind to one impulse, and denying any influence to all the other impulses of the flesh.

The author discusses shortly the independent confirmation of the psycho-analytic doctrine that has been sought in therapeutic results, in the study of myth, and in that of insanity. In regard to the last-named subject, where of course his opinion is an authoritative one, he says that the evidence is "perhaps more convincing than in any other field, because phenomena can be observed in the speech and actions of the insane which are entirely conformable to the principles deduced from the psycho-analytic method, and in which any influencing of the patient by the physician is excluded by the nature of the case."

It has been possible to touch only on some of the topics of this invaluable review of the Freudian case. Enough has perhaps been said to show the exemplary tone in which it is written and the gratitude Dr. Hart has deserved both from the critics of Freud and from the disciples of this revolutionary genius. Dr. Hart describes his ultimate attitude as one of benevolent scepticism. The cause of psycho-analysis is especially likely to benefit by such criticism as his, for it has had to contend with a curious and perhaps unique disadvantage. It has given to its advocates a new insight into motives and has enabled them to explain and to discount hostile criticism, often quite correctly, as essentially conditioned by non-rational processes in the critic's mind of which he has been quite unaware. To possess an infallible answer to opponents is not wholly to the advantage of a developing body of doctrine. It may be inspiriting to the believer, but it tends to weaken that anxious search for truth in hostile opinion which is the last gift of the scientific spirit.

Man's Early Settlements.

Peasants and Potters. By Harold Peake and Herbert John Fleure. (The Corridors of Time, 3.) Pp. 152. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 5*s.* net.

Priests and Kings. By Harold Peake and Herbert John Fleure. (The Corridors of Time, 4.) Pp. 208. (Oxford: Clarendon Press; London: Oxford University Press, 1927.) 5*s.* net.

THE results of anthropological and archæological studies constantly need readjustment and comparison, and both must occasionally be controlled by the statements of antiquity. The period under review in the present studies presents very special difficulties, for on nearly every vital point there are almost as many opinions as doctors. The subject of the third part of "The Corridors of Time" is the development of the pastoral and the agricultural peoples between about 5000 and 3500 B.C., and involves a consideration of the domestication of animals, a study of the prehistoric period in Babylonia and Elam, of the early pre-dynastic age in Egypt, and of the earliest remains at Anau in Turkestan and in Crete, with a sketch of the anthropologists' views of the races of men involved. The fourth part is devoted to an account of the early history of Sumer and Akkad and of Egypt, and a description of all those settlements which in the authors' opinion may belong to the period 3500–2500 B.C., again with a synopsis of the probable migrations of races which may conceivably be connected with the period discussed. From the Nearer East the reader passes to the Mediterranean islands and Thessaly, back to Turkestan, thence to the Danube, finally to end by the Black Sea. The handy volumes form an interesting *aperçu* of an immense period of time over a very large area, involving many different studies.

The authors are so well aware of the diversity of opinions on wide questions that it is unnecessary to discuss the many debatable questions. The pertinent criticism is rather that some questions are represented as disputed on which competent opinion is agreed, while isolated opinions are accepted as certain which should rather be presented as very questionable. The First Dynasty of Ur is placed so early as 3752 B.C., while Ur-Nina of Lagash is dated shortly before 3000 B.C., a matter of great importance for Sumerian chronology; on epigraphical and archæological grounds it is impossible, on grounds stated by specialists, to assume a gap of 700 years. Doubt is expressed as to whether the principal object of the Egyptian mines in Sinai was turquoise or copper; but mining engineers have reported with no uncertain voice on the matter, and most Egyptologists believe that *mafkat* should be translated 'turquoise.' On the other hand, Dr. Frankfort's theory of the painted pottery of Susa is relied upon as certain, perhaps on the principle *qui tacet consentit*; but M. Pottier's careful study, together with the excavators' notes, presents another, equally possible, view, and no excavator of a Mesopotamian site could argue that the layer of earth between the graves called 'Susa I.' and the 'Susa II.' level is necessarily due to an abandonment of the site.

The question of origins, with which the authors are primarily concerned, must always be fascinating, and the two schools which profess the dogmas of the single or the multiple origin are likely to subsist for some time yet. But advances are slowly made. It is now generally accepted that we have no evidence of a true 'neolithic' age in Asia, as the writers correctly remark, though they fall into the error of referring to "stone age graves at Tell el Obeid." Yet another step remains to be taken. Apart from the pastoral and agricultural communities, cities existed for trade, which was as important in pre-dynastic Egypt and in early Sumer as it ever became in later times, for only so can the astonishing wealth of both civilisations be explained. Cities like Ur contained a considerable class engaged in industry, and the population did not consist solely of "Peasants and Potters." Trade is indeed frequently alluded to in these volumes, but the hasty and partly incorrect statement about the new Indian evidence has not allowed of a just consideration being given to two vital points: (1) the extent of trade connexions and their character; (2) the kind of cultural influence exerted in cases such as this, proved beyond a doubt. The vagaries of trade, also, deserve a closer consideration, and we could wish that the doubtful theories about racial connexions of dynastic Egyptians and Arabians and Sumerians had been omitted in favour of an explanation of the manner in which evidence of a trade connexion between Sumer and Egypt first appears late in the pre-dynastic period and seems to disappear after the Third Dynasty.

The absorbing interest of this problem leads too often to that speculation about the unknown which is the bane of archæology. As Egypt and Mesopotamia gradually become defined and limited in their possibilities, North Syria, Asia Minor,

Arabia become the dumping-grounds for theories. Yet what little we do know rarely favours the hypotheses. Is it really conceivable that the Egyptians were taught the art of making their stone vases by men from Arabia? Does a single stone vase in the form of a camel prove such a theory? What are the latest statements about that vase? Or again, did bedouin from the Arabian desert invade the plains of Babylonia? Every known invasion by Semitic-speaking peoples into Akkad followed the Euphrates valley from at least so far north as the Khabur, and none of these peoples were nomads straight from the desert.

The learned authors have undertaken a difficult task, and on the whole succeeded in the attempt to correlate various subjects. That their views evoke criticism is no more than they expect. The reader will not fail to appreciate the ability with which scattered matter has been collected and compressed into a form well calculated to instruct in strange lore. A second edition will probably be required; in that case some of the bad minor errors, such as Sharain for Shahrain, and Azag-Bau (an old, erroneous reading of the signs Ku[g]-Bau), some mis-statements about excavations, and some wrong citations of authorities, might be corrected.

Technology of Paints and Varnishes.

The Industrial and Artistic Technology of Paint and Varnish. By Alvah Horton Sabin. Third edition, revised. Pp. xi+459+9 plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 25*s.* net.

THE name of Sabin is so closely identified with the technology of paint that the reappearance of this book as a new edition will give a thrill of pleasure to most readers. The book is very like the earlier edition, preserves the same general form, and aims at giving an account of the principles involved in the manufacture, application, and use of paints and varnishes. It is obvious throughout that the book bears the impress of the author's own personal experiences, and consequently some may think that undue importance is laid upon certain aspects of the work whilst other sections receive inadequate treatment. The author has very wisely forestalled criticism in that regard by quoting in his preface the amiable maxim of Erasmus, that "a reader should sit down to a book as a polite diner does to a meal. The entertainer tries to satisfy all his guests; but if it should happen that something does not suit this or that person's taste, they politely conceal their feelings and commend other dishes, that they may not distress their host." The present reviewer entirely subscribes to this view of the matter, and in doing so finds a perusal of this book not only very pleasant but also stimulating to a high degree.

The first edition, published in 1904, was chiefly concerned with the subject of oleo-resinous varnishes; since then, important developments have taken place in varnish-making, particularly through the advent of Chinese tung oil, which has entirely changed, and in Sabin's opinion not always for the better, especially in the matter of durability, the character of many of the products of the varnish maker's art.

In America, where now tung oil trees are being grown extensively, the use of this oil has long been established as an essential raw material of the industry, for it possesses properties which are unique among the drying oils. In England, tung oil has also found its place in varnish-making practice, but the extent of its use here is nothing like what it is in America.

This condition is probably due to several causes apart from the innate conservatism of the Englishman. In the early days, it was generally regarded in England as a kind of substitute for linseed oil, a view which working experience should soon show to be incomplete. It took much time, however, for people to realise that the peculiar properties of tung oil, namely, its extraordinary capacity for rapid gelation under heat, the water-resisting quality of its films, and the power it has of carrying rosin varnishes into a high quality class of product, made the oil worthy of study on its own account.

Another important point which has a bearing upon the subject is the fact that American practice is far behind European in the use of heat-treated oils. This deficiency has been responsible for a readier application in America of special oils like tung and perilla. These essentially Eastern products have long been used in the regions of their origin and have formed the basis of the remarkable Chinese and Japanese and similar lacquers. The chapter devoted to this subject is most interesting and instructive.

Naturally, one would expect reference to be made to nitro-cellulose lacquers, but the treatment given is very general and rather short, although the author subscribes to the view that the extraordinary development in these lacquers during the last few years has had an influence upon the paint and varnish industry, the full effect of which cannot

yet be judged. The first use of a pyroxylin lacquer was recorded many years ago. The War brought an extraordinary demand for aeroplane dope and left a legacy in the shape of enormous plants for the manufacture of nitro-cellulose for which there was no immediate demand.

One thing has been achieved by the advent of cellulose lacquers, particularly through the agency of the enormous solvent industry which has grown up alongside: the paint and varnish industry now realises that it is a chemical industry. Proper application of this fact, with all that it implies, will do much to stimulate scientific development work all round, and to clear away the misunderstandings and uncertainties attending the 'secret' processes of the 'art,' which are a drag on real progress. As Mr. Sabin says, "the only trade secrets lie in the incommunicable intimate knowledge of the expert, and are made valuable only by his unceasing care, vigilance, and conscientiousness."

Mr. Sabin has throughout followed the historical method, and the text is freely embellished with historical comparisons. It is indeed most astonishing to realise the extent of the knowledge of centuries ago. The insight displayed by the ancients into the working of the processes they described is remarkable. The explanation of the wrinkling of paint as given by Eraclius more than a thousand years ago is almost uncanny, having regard to the present state of knowledge on that vexed question.

One closes the book with the feeling that it is unfair to dwell upon the glories of the immediate past. True it is that history is but the record of past events, which we should take, if we are wise, to mould our course in the future, but one feels rather uncomfortable in realising the extent of the knowledge of those early practitioners in this ancient art.

L. A. JORDAN.

Principles and Practice of Electrical Illumination.

Modern Electrical Illumination. By Cyril Sylvester and Thomas E. Ritchie. Pp. xi + 416. (London: Longmans, Green and Co., Ltd., 1927.) 42*s.* net.

ONE of the most noticeable features of the post-War period has been the increasing recognition of the importance of illumination in modern life, socially, commercially, and industrially. Illumination for social purposes has always been appreciated for its own sake, as witness the magnificent salons of the eighteenth century with their myriads of candelabra, representing the acme of their day. The commercial value of the attractive lighting of shop windows and showrooms is of course obvious, while many of our stores could prove that it is easily the cheapest form of publicity. These reasons will not, however, explain the great developments which have taken place in industrial establishments.

In the old carbon lamp days, illuminations of one foot-candle were regarded as adequate for most purposes, while before the invention of the Welsbach mantle, illumination intensities even lower must have been normal. The change in our standards is probably due in part to the increasing demands made on visual processes in almost all occupations as a result of the ever-growing complexity of modern civilisation, together with the somewhat belated realisation of the importance of good lighting for the most efficient functioning of the eye. It is only very lately, and largely as a result of war conditions and problems, that public attention has been focused on such matters as industrial fatigue, visual acuity, and the comfort of the worker in relation to output, spoilage, and accident. In Great Britain we have the evidence which is being provided by such impartial organisations as the Industrial Fatigue Research Board, the Illumination Research Committee of the Department of Scientific and Industrial Research, the National Illumination Committee, and the Illuminating Engineering Society.

The problems of illumination are very varied and have points of contact with many branches of engineering and science, so that we have been witnessing in the last few years the appearance of a new specialist—the illuminating engineer. Two of the foremost of these specialists are responsible for the work under review, in which they "have put forward the essentials of good lighting practice, have advocated those which should be adopted and have pointed out errors which should be avoided." Their first chapters deal with the eye, vision, colour and general principles, and are perhaps not so satisfactory as the rest of the book. Then follow chapters on industrial lighting, shop-window lighting —which is very well done—followed by an extensive treatment of street lighting. Motor-car headlight illumination is then dealt with, but is rather disappointing in its brevity, only one type of anti-glare device being mentioned. Chapters are devoted to flood lighting, domestic lighting, the lighting of public buildings, theatres, etc., electric signs, stage lighting, and train lighting, on all of which the authors have useful information and suggestions to communicate.

In the main the authors have accomplished their task in a very creditable fashion. The treatment is at times, however, inclined to be dogmatic even on matters of taste. For example, the authors are very fond of referring to the correct lighting or the correct type of fitting, whereas illumination problems, like quadratic equations, have more than one solution.

Much important data for the illuminating engineer are given in the form of tables, and several B.E.S.A. specifications of illumination materials are quoted in full. With regard to the tables, no attempt seems to be made to explain the application of some of them in practice; the tables of coefficients of utilisation appear as it were spontaneously, and the important depreciation factor is not explained either in the tables or in the glossary, though it is perhaps defined by implication on p. 267.

The work represents to a large extent the valuable personal experience of the authors, who have a penchant for the more luxurious and artistic aspects of the various problems with which they deal. Indeed, as the chief illuminating engineers of two important electrical companies, their experience of ambitious illuminating engineering schemes is probably unique. The average illuminating engineer has usually to treat his subjects (and his clients) in a more modest manner.

The illustrations, of which there are about 360, are a very valuable portion of the book, which is exceedingly well produced. The quality of the illustrations accounts for the apparent high price of the book, which is well worthy of study by architects as well as by all illuminating engineers.

Chinese Art and Handicraft.

Chinese Art. One hundred Plates in colour reproducing Pottery and Porcelain of all Periods, Jades, Lacquer, Paintings, Bronzes, Furniture, etc. Introduced by an Outline Sketch of Chinese Art by R. L. Hobson. Pp. 15+100 plates. (London: Ernest Benn, Ltd., 1927.) 30*s.* net.

THOUGH the splendid, well-nigh perfect, illustrations displayed in the one hundred colour plates of this volume may provide its most attractive feature for the general reader, all who desire to possess a clear and tersely written account of the progressive development of Chinese art, in many of its most important manifestations—valuable not only in themselves but also for their world-wide influence on the work of the artists and craftsmen of other nations—will appreciate Mr. Hobson's narrative, which forms the fitting prelude to the work; especially since his extensive knowledge of the subject matter has not overwhelmed his power of presenting the reader with a lucid and arresting narrative. The entire essay is, indeed, excellent; alike in its appreciative, yet judicial, tone and poise as well as in the selective power displayed in the marshalling of all the salient historic and cultural evidence in a brief précis which he modestly entitles an "Outline Sketch of Chinese Art." Were all descriptive accounts of national or racial achievements in art and handicraft written with such sympathy and understanding, the path of the student who is at the same time a collector, even on a modest scale, would become, at once, more pleasant as well as better garnished.

In striving to select an illustrative example of the spirit with which this essay is suffused, we cannot do better than extract a few sentences from the first page of the introduction:

"Another impression which recent discoveries have profoundly modified is that Chinese Art developed behind closed doors, unaffected by the doings of the outer world. It is now clear that in the greatest periods of her history China not only admitted, but welcomed, influences from Western and Central Asia—Scytho-Siberian, Hellenistic, Byzantine, Persian and Indian—and that, if in later times she suffered periods of virtual isolation, she was ready enough to experiment even with European art when she made its acquaintance in the seventeenth and eighteenth centuries. . . . So that during the years when her art traditions were being formed she was absorbing outside influences, and in many ways the art of the T'ang dynasty speaks in a language more intelligible to the European of to-day than does the more modern art which we have been taught to regard as typically Chinese."

The book is so profusely and admirably illustrated that every reader will feel impelled to turn again and yet again to an examination of the plates. The examples selected are, almost without exception, absolutely exemplary in their class; while, in addition to the specimens of pottery and porcelain, which seem naturally to appeal from the first onset to anyone who attempts to survey the vast panorama displayed by the artistic activities of the Chinese races throughout their long history, there are numerous beautiful reproductions of some of their magnificent achievements in painting (note the superb painting of "The Ch'ang Lo Palace, after Li Ssŭ-hsün," now in the British Museum); and in lacquer, of which Mr. Hobson has selected a series of notable and beautiful examples. Of this class the reader's attention may be specially

directed to the reproduction given on Plate lxxxviii. of one panel from a twelve-fold screen now in the Victoria and Albert Museum, and to that on Plate xciii., which gives a wonderful presentation of an oblong panel in carved red lacquer encrusted with jade, malachite, and imitation lapis-lazuli. The bronze covered-pail for sacrificial wine, dating from the Chou dynasty (1122–255 B.C.), now in the famous collection of Mr. Eumorfopoulos, as well as the bronze cover of a lady's toilet-box decorated with painted designs of the T'ang period and the bronze mirror-back with designs in low-relief, also of the T'ang period and from the same collection, are beautifully rendered on a series of plates. The T'ang dynasty dish in translucent green jade from the Alexander collection, as notable for its exquisite form as for its precious colour, Plate lxxx.; the vase in translucent jade from the time of the Sung dynasty from the Malcolm collection, Plate lxxxi.; and the brush-pot in jadeite, possibly of the Yüan dynasty, are enough to make any collector's mouth water.

WILLIAM BURTON.

Hondius's Map of the World.

Reproductions of Early Engraved Maps. 1: *The Map of the World on Mercator's Projection*, by Jodocus Hondius, Amsterdam, 1608. From the Unique Copy in the Collection of the Royal Geographical Society, with a Memoir by Edward Heawood. On 25 Sheets, and Index Sheet, 20 in. × 15 in., in paper cover. Memoir, pp. 24. (London: Royal Geographical Society; Edward Stanford, Ltd., 1927.) 63*s*.

THIS magnificent work, the first part of a projected series of reproductions of early engraved maps, will be welcomed by all historians of geography. The original map was acquired by the Royal Geographical Society in 1919. It is in twelve main sheets, each about 18½ inches by 13½ inches, surrounded by smaller sheets containing the title and decorative borders. Though the coloured boundaries and decorations are faded, and the paper darkened with age, most of the engraving is clear, and the collotype plates render its details faithfully; even on the reduced photograph of the whole map much of the lettering is legible.

Though Hondius's map is just a century later than the first-printed world map by Waldseemüller (1507), and though Mercator's copperplate in 1569 had popularised this kind of map—as the woodcut edition of it shows—its nearer precursors were on other projections, cylindrical and stereographic; and Hondius himself reverted to a projection in hemispheres in 1611–18. His own earlier maps (1588–91) and the globes in the Middle Temple Library (1592) seem to have been engraved in England; but he appears at Amsterdam in 1593, and worked there until his death in February 1612. Full details of his copious publications, and descriptions of those which are extant, will be found in Mr. Heawood's learned introduction to this facsimile; they give a striking illustration of the interplay of English and Netherland cartographers at this time.

The quaint custom of filling the waste spaces of ocean with letterpress gives to this map a double interest for geographers; for Hondius used this opportunity to expound Mercator's projection and illustrate his own graphic method of constructing the scale of latitude, thus avoiding the necessity of further reference to his former associate, Edward Wright, who had quarrelled with him for what Wright considered premature use of his own calculations. In other matters Hondius himself had less to contribute, either to Mercator in the uses of the map, to Plancius in its details, or to Blaeu in its decorations; on the other hand, some of his novelties are attributable to English sources—Drake for north-west America, Raleigh for Virginia and Guiana. Though he restores to the map the continental land south of Magellan's Strait, which he had broken in 1602 into islands "discovered by the English," he omitted the Arctic island-world imagined by Mercator, and so both cleared the way for later explorers and stimulated their zeal.

To his expert aid in appreciating the peculiarities of the map itself, Mr. Heawood has added the convenience of a translation of its quaint Latin letterpress, with its candid admission (for example) "that no space should be left vacant, we have appended the distribution of the Sons of Noah, that it may be manifest how the World began to be settled after the flood, and from what centres colonies were first sent out into other shores"; though Hondius has to admit that it is quite uncertain who was the father of America. It is interesting to note that in his allegorical group he gives two separate figures for the Americas—one in the background of his Asia, the other of his Europe and Africa—and in the letterpress contemplates European as well as Asiatic origin for American peoples. This is a more ingenuous device than the fourfold symbolism of the title-pages of the next generation—Grimston, Heylin, and their contemporaries.

J. L. M.

Our Bookshelf.

Primitive Culture and Customs.

Maya Cities: a Record of Exploration and Adventure in Middle America. By Thomas Gann. Pp. 256+32 plates. (London: Gerald Duckworth and Co., Ltd., 1927.) 21*s*. net.

Dr. Gann's account of his explorations in the season 1926–27 has no sensational discovery to record such as he has given us in previous volumes. It is not on that account lacking in interest. Travel in the forests of Central America could scarcely fail to provide some thrill, either by way of fresh discovery or of personal danger. Dr. Gann experienced both. He covered both new ground and old. His most important discovery he himself considers to be the series of lofty narrow-roomed temples to the west of Bacalar Lagoon, which he had named Tzibanchè; but his discovery of a ruined city, where a mound only was thought to exist, on the site he names Minanhā, seems likely to afford an even more fruitful field for future exploration. On the sites already known which he visited, he worked at Tuluum, Uaxactun, where there is the earliest and the longest series of Maya Old Empire dates, and Lubaantun, the site now being explored by the British Museum expedition. He also visited Tikal in search of a treasure temple of which the existence was revealed to an Englishman by Indians more than sixty years ago. He was unsuccessful in his search; but his determination to make it the objective of his next journey leaves his readers with a thrill in anticipation of his next book.

The Fellāhīn of Upper Egypt: their Religious, Social, and Industrial Life To-day, with special reference to Survivals from Ancient Times. By Winifred S. Blackman. Pp. 331. (London, Bombay and Sydney: George G. Harrap and Co., Ltd., 1927.) 15*s*. net.

For six seasons Miss Blackman has spent six months at a time living in intimate contact with the Fellāhīn of Upper Egypt. In this volume she gives a popular account of a part only of the information she has collected about their customs, culture, and beliefs. It is extraordinarily interesting, especially when she is dealing with customs relating to childbirth and fertility and the observances and practices of the village medicine man and woman. A curious combination of offensive and defensive magic is seen in the practice of cutting out human figures in paper, sticking pins in them, and then burning them as a cure for children suffering from the effects of the evil eye. The chapter on ancient Egyptian analogies, again part only of the author's material, indicates the value of such studies as these to the Egyptologist in providing material which may serve to elucidate obscure points in his own special field. It is to be hoped that Miss Blackman may be able to continue her studies and extend them to Lower Egypt.

Papers on the Ethnology and Archæology of the Malay Peninsula. By Ivor H. N. Evans. Pp. x+164+43 plates. (Cambridge: At the University Press, 1927.) 15*s*. net.

The papers which Mr. Evans has here republished, after most have appeared in various scientific periodicals, are classified into four sections: Pagan races, Malay beliefs, Malay and other technology, and archæology. Some are of rather a specialist interest, but all are important in varying degree, for the most part as pieces of first-hand observation. Mr. Evans has been fortunate enough to visit some of the Negrito tribes of Siam and has obtained linguistic and cultural material which, though slight, is still of considerable value for comparative purposes. The section on archæology contains additions to our knowledge of the early inhabitants of the Peninsula, especially in regard to bronze and iron; but the most instructive chapter here deals with the exploration of cave shelters, in which Mr. Evans finds a culture showing a considerable correspondence with that in the rock shelters of Indo-China and exemplified in the type of primitive implement found in Sumatra by Dr. P. van Callenfels.

Experimental Psychology.

Elementary Conditions of Human Variability: a Study of the Variation of Successive Responses to Similar Stimuli at Different Levels of the Cerebro-Spinal System of a Human Subject. By Prof. Raymond Dodge. (Columbia University in the City of New York. Publication No. 10 of the Ernest Kempton Adams Fund for Physical Research, established Dec. 17, 1904.) Pp. xii+107. (New York: Columbia University Press, 1927.) 1.50 dollars.

This, the tenth monograph published by the Adams Fund for Physical Research, unlike its predecessors, which came from the pens of workers in physical science, is written by a psychologist. The subject matter, however, has a direct appeal to the physicist, since it deals with that shortcoming of the individual observer from the ideal which has long passed under the term of 'personal equation,' a factor which varies from observer to observer, and in the same observer from moment to moment. The present monograph gives a quantitative analysis of the changes occurring in certain selected human reactions, *e.g.* the knee-jerk, the lid reflex to sound, horizontal vestibular nystagmus, word reactions and memory tests, all of which permit of a trustworthy technique in their recording.

From a series of observations taken at various times throughout the day and extending over a period of two years, certain types of variation in the responses become evident; *e.g.* diurnal rhythm and general depressions, to mention only two of interest in industry as regards efficiency

and incidence of accidents. The effects of repetition on motor co-ordinations, the development of refractoriness, the course, transfer, and loss of training and phenomena of the learning process indicate other interesting points which are discussed. Subjective details are presented, but the value of this contribution to psychological science rests mainly on the information obtained from the trustworthy physical methods used for recording.

The Effects of Music: a Series of Essays. Edited by Max Schoen. (International Library of Psychology, Philosophy and Scientific Method.) Pp. ix+275. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1927.) 15*s.* net.

A NUMBER of investigators have collaborated in the issue of this volume, which presents, under the editorial supervision of Dr. Max Schoen, studies of the effects of music and its more or less mysterious influence upon human personality. A few are reprints, notably one by Dr. Charles S. Myers, on individual differences in listening to music (*British Journal of Psychology*). The rest are in the main chosen from among papers submitted in a competition conducted by the American Psychological Association.

The effects of vocal and instrumental music on the moods of 20,000 selected individuals were obtained by phonograph recordings. These are fully described by Dr. Schoen and Dr. Esther L. Gatewood. Such collections of data through the medium of broadcasting would doubtless be impracticable; but the suspicion arises whether not a little of the acute and varied criticism extended to the official broadcast programmes may represent the expression of moods of the character detailed by the writers. Another section, of considerable general interest, by Dr. Ida M. Hyde, studies the changes produced by contrasted musical selections on electro-cardiograms, pulse rate, systolic, diastolic, and pulse pressures, and blood velocity. There is much in these essays which is of value both to professional teachers and to students of music.

Medical Manuals.

(1) *Sunshine and Health.* By Dr. Ronald Campbell Macfie. (Home University Library of Modern Knowledge.) Pp. 256. (London: Williams and Norgate, Ltd. [Thornton Butterworth, Ltd.]; New York: Henry Holt and Co., 1927.) 2*s.* net.

(2) *Clinical Application of Sunlight and Artificial Radiation: including their Physiological and Experimental Aspects, with Special Reference to Tuberculosis.* By Dr. Edgar Mayer. Pp. xvi+468+38 plates. (London: Baillière, Tindall and Cox, 1926.) 45*s.* net.

(1) "SUNSHINE AND HEALTH" is one of the Home University Library series, and is therefore written with the object of summarising our knowledge of this subject for the benefit of the general reader. The author, Dr. Campbell Macfie, is but little concerned with therapeutics. He presents a short historical survey of man's speculations and theories of sunlight, and then proceeds to describe concisely, but with a wealth of detail, the nature and properties of radiant energy, its biological value and therapeutic uses. Radiation other than solar, and various types of lamps used in actino-therapy, receive brief reference.

Dr. Macfie is careful not to exaggerate the importance of light in evolution and growth, emphasising the fact that radiation cannot impart the vital spark to a group of molecules, however complexly arranged; its functions are stimulation, regulation, and reinforcement, in the development of living things. He points out that light, though necessary to plant life, is not an essential feature in animal physiology. He warns the reader that sunshine can play but a minor part in healthy metabolism, that man is as likely to suffer from excess of insolation as from deficiency, and that some of the results of actino-therapy might be due to other factors operating at the same time. The well-established facts, however, are by no means ignored, and full credit is given to radiant energy as a therapeutic agent in rickets, lupus, and other conditions.

(2) The volume which Dr. Edgar Mayer has written is entitled "Clinical Application of Sunlight and Artificial Radiation," but it contains also a very detailed and inclusive study of the biological, physiological, bactericidal, and experimental aspects of the subject, with an extensive bibliography and a complete index of authors and subjects.

Although actino-therapy is considered mainly in its application to tuberculosis, the survey of radiation in its other aspects could not be more comprehensive. The value of this book lies not only in its complete presentation of the subject. So rapid has been the development of the use of light as a therapeutic agent that the medical profession has been left somewhat bewildered, while unqualified practitioners and fascinated laymen apply ultra-violet rays indiscriminately. It must be remembered that the subject is still in its infancy; harmful effects of the application of actinic energy have been noted, and the tragedies of pioneer X-ray workers are still in our minds. Only by careful observation and cautious scientific investigation can this form of energy be made a useful agent in the struggle against disease.

The Principles of Ante-Natal and Post-Natal Child Hygiene. By Dr. W. M. Feldman. Pp. xxiv+743+14 plates. (London: John Bale, Sons and Danielsson, Ltd., 1927.) 25*s.* net.

THE author intends this book as a companion to his "Principles of Ante-Natal and Post-Natal Child Physiology," child hygiene including "everything that tends to preserve the life, health and welfare of the child during its various stages of ante-natal and post-natal development." The intra-uterine development is regarded as the most important period in the child's career, and consequently the question of heredity is fully discussed, together with the relative importance of this factor and of environment when applied to child welfare and eugenics.

Three chapters are devoted to the causes and prevention of ante-natal, intra-natal, child and maternal mortality; much of this mortality is preventable, and the means available for dealing with the various factors responsible are clearly set forth. Half the total infant mortality occurs in the first month of life, and one-third on the first day; this is due to lack of adaptation in some direction to its changed environment on the part of the new-born child.

The second half of the book deals very fully with post-natal hygiene, and contains an immense amount of very practical information as to nutrition, breast feeding, artificial feeding, diet, exercise, and sunlight. The author gives not only the requirements of the child under varying conditions, but also the reasons for his statements, together with much of the experimental evidence available. The prevention of disease, both infectious and otherwise, is considered, and the book ends with chapters dealing with physical and mental growth, the psychology of the child, and adolescence.

The whole book is extremely interesting, because wherever possible the author has given the history of customs connected with the subject under discussion, and portraits of relevant investigators. Many statistics are also included, and there is an excellent chapter dealing with statistical methods and the pitfalls to be avoided. E. E. Hewer.

Local Immunization: Specific Dressings. By Prof. A. Besredka. Edited and translated by Dr. Harry Plotz. Pp. xi + 181. (London: Baillière, Tindall and Cox, 1927.) 16*s.* net.

This small but unduly costly book is a translation, with some additions and emendations by a fellow-worker, of Prof. Besredka's "Immunisation locale," published in 1925 (Masson et Cie). According to Besredka, the production of immunity to various infective organisms is best achieved by bringing to bear on the cells most receptive for the specific micro-organism, either the micro-organism itself or a filtrate of its growth, the final issue being a desensitisation of these receptive cells so that a further inoculation of germs is rendered inert. In anthrax infection the author believes that the guinea-pig skin is the only receptive tissue in that animal, while in enteric fevers the cells which require desensitisation are those of the intestinal mucous membrane. In the latter disease immunisation is produced by oral administration of the killed organism in association with bile, which is held to facilitate, by its catarrhal action on cells of the intestinal mucosa, the impression of the specific oral antigen on these receptive cells, with resulting desensitisation. These examples of local immunity are, in the author's view, not accompanied by any very marked development of antibodies demonstrable in the blood serum.

Both the experiments and the interpretation put upon them by Besredka and his pupils have given rise to considerable controversy, and it may be stated that the great majority of workers who have entered this field of research have not reached conclusions in agreement with Besredka's particular theory. None the less, the subject of local immunity is one of intense interest, and Besredka has done good service in raising the issue, as it has directed attention to many peculiarities in local defence mechanisms, particularly in the skin, and to the bearing of quite non-specific inflammatory processes on local defence.

Actions and Uses of the Salicylates and Cinchophen in Medicine. By Prof. P. J. Hanzlik. (Medicine Monographs, Vol. 9.) Pp. xiii + 200. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1927.) 16*s.* net.

The salicylates are among the most commonly used drugs and are administered in a wide range of morbid conditions; they are freely advertised to the public and somewhat recklessly taken for many transient ailments in which a physician is not consulted. They have received extensive investigation in the laboratories of pharmacologists and bio-chemists. Yet there is by no means complete understanding of their effects, and much controversy has centred round their mode of action. Recent work, however, has done much to rid these drugs of erroneous traditions which have been handed down with their use, and Prof. Hanzlik's monograph is of considerable value in summarising research and indicating present views on the subject.

Among the more important conclusions are the facts that salicylates are not specific for acute rheumatism, and that their good effects in this disease appear to be due mainly to their antipyretic and analgesic action, allowing comfort and rest. Most doctors prescribe sodium bicarbonate with salicylates with the intention of avoiding toxic effects, but there seems to be little trustworthy evidence that alkalis prevent salicysm; their main use is to counteract gastric irritation. The metabolic influence of salicylates and cinchophen—which is better known in Great Britain as 'atophan'—is fully described, but the therapeutic value must depend on a fuller understanding of morbid metabolism. Considerable prominence has been given to cinchophen during the last few years in advertisements and medical literature, and it should be emphasised that idiosyncrasy to this compound is by no means rare, and very unpleasant effects have followed its use in medicinal doses.

Prof. Hanzlik discusses many interesting features, and his book will certainly be of value, not only to physicians who use these drugs, but also to pharmacologists and others who are specially concerned with them.

Manual of Psychiatry. Edited by Dr. Aaron J. Rosanoff. Sixth edition, revised, enlarged, and illustrated. Pp. xvi + 697. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 30*s.* net.

This well-known text-book maintains the high standard set in previous editions. The chapters on the personality and on word associations and their application are particularly welcome in a text-book of this nature.

In discussing the presence of spirochætes in the

brain in general paralysis, no mention is made of the excellent work of Jahnel during the past few years, and the illustrations showing spirochætes in the brain are poor. The treatment of general paralysis is considered in a very brief manner; a chapter might well have been devoted to this, one of the most interesting and fruitful subjects in modern psychiatry. Malarial treatment is dismissed in nine lines! The author appears to consider that the high temperature of the malarial attacks is the curative factor—this is not the commonly accepted theory. There is also no mention of the use of hexamine in the prevention of paretic convulsions. Under the etiology of dementia præcox we find no mention of Mott's well-known work. Kretschmer's recent contributions on the relation of physique and character to syntonic and schizoid states and to manic-depressive insanity and schizophrenia are not even mentioned.

Notwithstanding these faults, the manual ought to be in the hands of every alienist.

Modern Methods in the Diagnosis and Treatment of Renal Disease. By Prof. Hugh MacLean. (Modern Medical Monographs.) Third edition, revised and enlarged. Pp. viii + 135 + 4 plates. (London: Constable and Co., Ltd., 1927.) 12*s.* net.

THE appearance of a third edition of Prof. Hugh MacLean's monograph on renal disease is a sure indication of the well-deserved popularity of this book. Since the first edition was published, the importance and value of renal function tests have become definitely established. Experience has shown that the methods given in former editions are sufficient and trustworthy, so that no alteration has been required in the sections dealing with investigations of kidney disease. Indeed, there is little material revision in this edition except in the chapter on treatment, which has been rewritten with full practical details. The principles of treatment are based strictly on the pathology of renal impairment and its known effects; and although therapeutic measures are considered thoroughly, and in some cases suggested tables of diets are given, it is possible to apply these principles to any given degree and type of renal disease. The simplicity of classification, and the practical way in which it is written, entitle this book to be considered one of the most valuable publications on the subject.

Bird Life.

The Baby Bird and its Problems. By W. Bickerton. Pp. xvi + 135 + 39 plates. (London: Methuen and Co., Ltd., 1927.) 10*s.* 6*d.* net.

WHEN we had read the first chapter of this book, we admit that we put it down feeling slightly dazed by it. "The Call of Spring" may be described as an ecstasy of adjectives. Long, long sentences are but partly broken by an infinite variation of colons, semi-colons and commas, generally followed, we notice, by an 'and' or a 'but.' We have, however, read this short chapter again and have come to the conclusion that in it the author does himself gross injustice. When we came to the later chapters, which are longer and in which, therefore, the author has had more to write and less time to think, the language becomes much more simple and infinitely more interesting.

We do not suppose that the book is intended for grown-up students but it is full of information for the young, whilst the information is given in a very charming manner. Naturally, in a book of this kind, a record consisting almost entirely of the author's own observations, there are bound to be many *dicta* with which his readers will not agree. For example, he says that the stone curlew is a mountain breeder. He holds up the dove as an emblem of peace, though it is well known to possess a character for quarrelsomeness surpassed by few other birds. Again, when he comments on some of his bird problems, we are inclined to think that he sometimes reverses cause and effect. Thus, on p. 37, he says that some birds construct no nest because their young are born in an advanced stage of development, yet the converse would hold equally good. Again, he says that birds which lay white eggs have learnt to lay them in holes and burrows in the ground. Most naturalists believe that eggs have protective coloration because they are not laid in holes of trees and burrows in the ground. It is probable that primitive birds hid their eggs, as do lizards nowadays, in crevices of rocks and other places in the dark, so that white or yellowish eggs are the primitive type.

An interesting chapter is the one on "Eggs; their Qualities and Meanings," in which the author compares the size of the egg with the length of the bird, though this would have been still more valuable had he compared the weights, for we see no reason why a long-tailed small bird should lay an egg larger than a large bird with a short tail. The photographic illustrations at the end of the book are admirable and are a fitting *finale* to a book in which children may learn much and their elders may read with interest.

(1) *Realities of Bird Life: being Extracts from the Diaries of a Life-loving Naturalist.* By Edmund Selous. With an Introduction by Julian S. Huxley. Pp. xvi + 351. (London: Constable and Co., Ltd., 1927.) 14*s.* net.

(2) *The Charm of Birds.* By Viscount Grey of Fallodon. Pp. xii + 243. (London: Hodder and Stoughton, Ltd., 1927.) 12*s.* 6*d.* net.

(3) *The Heart of a Bird.* By Anthony Collett. Pp. viii + 287 + 8 plates. (London: Nisbet and Co., Ltd., 1927.) 10*s.* 6*d.* net.

THESE three recent books on the evergreen subject of bird life have something in common. All of them deal with field observation and are based almost wholly on personal experience. All of them are descriptive rather than analytical. Each in its own way succeeds in conveying not a little of the charm of these living things and of the pleasure to be derived from intimacy with their ways.

(1) From the point of view of scientific interest, chief place may be given to Mr. Selous, who once again enriches our knowledge of bird behaviour.

He presents his material in the form of extracts from his diaries, loosely arranged in chapters according to their principal topics. It is a very readable book, into which one may pleasurably dip at almost any point. It is also packed with valuable observational records, dealing especially with courtship behaviour among birds, an extremely interesting subject of which too little is known. For the student desirous of obtaining information on particular points, the form of the book is a disadvantage, but this can be overcome by the use of an index of unusual adequacy.

(2) Lord Grey writes with his accustomed distinction. As the respective titles indicate, his record is less objective than that of the more deliberate observer. One is more aware of the personality of the writer, and one is made to feel and to share the pleasure which watching birds has given him. Of all the aspects of bird life upon which he touches, song seems to have interested him most, and nearly half the book is given mainly to this subject. No novelty is claimed for any of the observations: the most familiar fact is stated with the simple and infectious pleasure of one who has discovered it anew for himself. Nevertheless, there is much here on the subject of bird song which is not often to be found in books, even those of more ambitious aim. The woodcuts by Mr. Robert Gibbings are well suited to the work.

(3) Under a not altogether happy title, Mr. Collett gives us twelve pleasing essays, each dealing with the bird life of one of the months of the year. He generalises to a greater extent than the other authors just mentioned, his method being to sum his knowledge rather than to recount his separate experiences, but it is quite evident that he has seen what he describes.

(1) *Days with the Golden Eagle.* By Seton Gordon, in collaboration with his Wife. Pp. xx + 176 + 19 plates. (London: Williams and Norgate, Ltd., 1927.) 12*s.* 6*d.* net.

(2) *The Book of the Golden Eagle.* By Capt. C. W. R. Knight. Pp. xii + 296 + 33 plates. (London: Hodder and Stoughton, Ltd., 1927.) 21*s.* net.

THE almost simultaneous appearance of two works on the golden eagles of Scotland suggests a comparison and contrast. The main theme of both volumes is the life-history of the eagle, from egg to adult, as it is revealed day by day to the patient watcher by the eyrie; and both stories are vivid with the personal experiences of the authors, for in bird photography interest in the doings of the photographer appears to be second only to interest in his quarry. Mr. Seton Gordon, however, devotes only about a quarter of his space to this detailed study. The remainder of his book is given over to more general themes bearing upon the golden eagle: an account of Scottish eyries, descriptions of typical eagle country, the incidence of eagles on grouse preserving and sheep farming, Highland stories and traditions of the eagle, and the history of the golden and white-tailed eagles in Britain.

Captain Knight confines his account to his own observations; it is, in short, a sprightly history of his experiences in the taking of his wonderful eagle film, and of his training of a young eagle to fly to the lure. Mr. Gordon's book is for the reader who would know almost all that is to be known about the golden eagle; Captain Knight's for him who prefers a racy story of eyrie-hunting expeditions.

Zoology in the Laboratory.

(1) *A Laboratory Course in General Zoology: a Guide to the Dissection and Comparative Study of Animals.* By Prof. Henry Sherring Pratt. Pp. x + 244. (Boston, New York, Chicago and London: Ginn and Co., Ltd., 1927.) 7*s.* 6*d.* net.

(2) *The Skate* Raja erinacea *Mitchill: a Laboratory Manual.* By Prof. Charles W. Creaser. Pp. xi + 57. (New York: The Macmillan Co., 1927.) 4*s.* 6*d.* net.

(3) *The Biology of the Frog.* By Prof. Samuel J. Holmes. Fourth revised edition. Pp. x + 386. (New York: The Macmillan Co., 1927.) 10*s.* 6*d.* net.

(4) *Textbook of General Zoology.* By Prof. Winterton C. Curtis and Prof. Mary J. Guthrie. Pp. xv + 412. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 18*s.* 6*d.* net.

(5) *Leitfaden zu tierphysiologischen Übungen.* Von Prof. Dr. Paul Kruger. Pp. viii + 92. (Berlin: Gebrüder Borntraeger, 1927.) 3 gold marks.

THE output of new text-books or of new editions of old ones is as steady as the advance in scientific knowledge and advances in teaching methods. For the latter reason it is always very interesting to compare the productions of different countries and to note the trends in teaching. American text-books are usually of special interest, for they may be used by the English student (if the language used remains reasonably English) and the American publisher has the advantage of a wider sale than in his own land. Naturally, they must be of high grade. English publishers of text-books should not forget the American market, a field which is frequently less well explored by advertisement than it might be.

(1) Pratt's laboratory manual is called "General Zoology," but it is nothing of the kind unless general be taken to mean 'diffuse.' It is an extraordinary collection of elementary references to invertebrate types; only structure is mentioned and often only external characters. To this are added the frog and the perch. It is difficult to see for whom it could possibly be intended.

(2) The laboratory manual on the skate is the kind of handbook which might be used as a guide to dissections of this type. Such books, if they are going to be useful for the student, should be illustrated. This specimen contains only two old illustrations. Its style is bad and many expressions are extraordinarily misleading.

(3) Holmes's work on the frog stands on a different plane, and is an effort to provide a complete description of the frog, including its physiology, habits, and instincts as well as structure. Much information is brought together which otherwise

only exists in scattered form. The only fault of the book is that it remains clearly a new edition of an old work, many chapters of which have needed considerable revision. Here and there the revision is still not up-to-date.

(4) Curtis and Guthrie's work is another American text-book which demonstrates how usual it is in America (compared with England) to combine the study of function and structure in zoological laboratories. It is a well-written volume and, on the whole, up-to-date. The physiology is perhaps rather 'thin,' two short chapters comprising the physiology of the vertebrate type, and this is practically human physiology. On the other hand, there are many good features, and the different sections are well balanced.

(5) Kruger's little book of 92 pages (costing 3 marks in Germany) is very interesting, for it shows that zoology students in Berlin have a short practical course in animal physiology. The book is a student's guide to this laboratory work. It is mainly a collection of bio-chemical tests and is extracted from a larger volume by the same author. It must be a very useful manual to German students.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. (1) Dritter Band: *Tardigrada; Pentastomida; Myzostomida; Arthropoda, Allgemeines; Crustacea; Arachnoidea.* Sechste Lieferung. Pp. 593-720. Siebente Lieferung. Pp. 721-848. Achte Lieferung. Pp. 849-976. Neunte Lieferung. Pp. 977-1158+xvi. (2) Siebenter Band: *Sauropsida, Allgemeines; Reptilia; Aves.* Zweite Hälfte, Erste Lieferung. Pp. 112. Zweite Lieferung. Pp. 113-224. (Berlin und Leipzig: Walter de Gruyter und Co., 1927.)

(1) THE sixth, seventh, eighth, and ninth parts of the third volume of this handbook contain the descriptions of the rest of the orders of Crustacea—Anaspidacea, by Dr. P. A. Chappius, Mysidacea, Cumacea, Tanaidacea, Isopoda, and Euphausiacea, by Prof. Carl Zimmer, Amphipoda by Prof. J. Reibisch, and Decapoda and Stomatopoda by Prof. H. Balss. Under each order is found an account of the structure (usually with adequate references to physiology), distribution, life-history, ecology, and classification, with a list of the more important memoirs. Numerous figures from recent papers are included. Three pages have been added in order to include a summary of the results of the observations of Prof. Graham Cannon and Miss Manton (1927) on the feeding of Hemimysis. The account of the Crustacea extends to 800 pages. The figures of larval forms of the Decapoda should have included better representations of the internal anatomy, which is too much neglected even in the Phyllosoma larva, where the internal structure could have been well shown.

The contributions to this volume maintain a high standard, and the articles will be of great service to teachers of zoology and to advanced students. The volume is provided with an excellent index.

(2) In these two parts Dr. E. Stresemann deals with the external features of birds, the structure and arrangement of feathers, coloration, skeleton, musculature, nervous system, and sense organs, and the digestive, respiratory, and vascular systems. The microscopic structure of the more important organs and their physiology receive careful attention. The account is well illustrated, and a large proportion of the figures is from recent memoirs. The author is successfully handling a difficult subject, and his volume on birds promises to be a very helpful and up-to-date part of the 'Handbuch.'

Sagitta. By S. T. Burfield. (Liverpool Marine Biology Committee Memoirs on Typical British Marine Plants and Animals, edited by Dr. James Johnstone, 28.) Pp. viii+104+12 plates. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd., 1927.) 6*s.* 6*d.*

THIS latest addition to an excellent series of memoirs will be welcomed by all zoologists, especially by senior honours students. *Sagitta bipunctata* Quoy and Gaimard, or the 'arrow-worm' as it is appropriately termed in common speech, is a well-known and important member of the marine plankton and has frequently been studied, from both the morphological and ecological aspects, by workers on both sides of the Atlantic. This book is a detailed account of the anatomy and minute histology of this living slip of transparency, and the author has included sections in which what is known of the affinities, occurrence, habits, vertical distribution, and parasites are briefly discussed. Gametogenesis and development also receive attention. The whole is illustrated by more than a hundred line-drawings and diagrams, but one feels that some of these would have been more effective had they been reproduced on a rather larger scale. Probably space-saving considerations precluded this possibility. The preparation of the memoir has obviously entailed a great deal of work, and the author is to be congratulated on its successful accomplishment.

Recent Advances in Anatomy. By Prof. H. Woollard. (The Recent Advances Series.) Pp. vii+302+4 plates. (London: J. and A. Churchill, 1927.) 12*s.* 6*d.*

PROF. WOOLLARD has written a very stimulating sketch of some of the progressive movements in anatomy, which gives an idea of the wider vision that is now opening out in this hoary subject. He has not attempted, however, to deal with the whole range of anatomical progress, but has discussed only these topics of which his associations in America, in Holland, and at University College, London, have given him a personal knowledge and interest. The vitalising influence of the functional point of view is everywhere apparent in the wide range of topics, neurological, cytological, and embryological, he has thus selected;

and the book will exert a healthy influence in emphasising the expression of this principle in the growing points in anatomy.

The chief criticism is that the author has crowded into a limited space an amazing amount of detailed and novel information without including enough of the older knowledge to link on the new data. Hence he is not easy to follow and understand. When the time comes for preparing a new edition of this work—which is so useful that the occasion should not be delayed very long—the author ought to make a drastic revision, not merely to correct the typographical errors and the too numerous ambiguities, but also to prune the list of facts, so as to give more room for interpretation.

Natural History of Insects.

Mosquito Surveys: a Handbook for Anti-Malarial and Anti-Mosquito Field Workers. By Malcolm E. Macgregor. (Published for the Wellcome Bureau of Scientific Research.) Pp. 293. (London: Baillière, Tindall and Cox, 1927.) 15*s.* net.

In 1922 the author was sent to Mauritius on behalf of the Colonial Office to make a thorough study of malaria, and he has prepared this account of the mosquitoes of that island and of Rodriguez primarily for the information of the Medical and Health Department. The first part forms a clear and concise introduction to mosquito anatomy and life-history which the author is well qualified to provide, but "trochanta," "pleuræ," and "collecterial" are surely due to slips of the pen. The statement that the spermathecæ are usually three in number requires further qualification. There are said to be (p. 50) two diverticula of the œsophagus, whereas three, the correct number, are indicated in the figure and given on p. 219. The method suggested for determining the sex of the pupa is "by the presence or absence of rudimentary testes," but a quicker determination can usually be made by examining the processes in which the external genital armature is developing.

The second part is devoted to the classification of mosquitoes and to a useful account of the four species of Anopheles found in Mauritius—the genus is absent from Rodriguez—and of the Culicines found in both islands. Keys are given to aid in the identification of the larvæ and adult insects. It is doubtful whether the key to the Culicine genera of the world should have been included, for its use requires considerable expert knowledge not likely to be possessed by those for whom the book is primarily intended.

The third part contains many helpful suggestions for work in the field and in the laboratory; for example, a device for keeping creosote in small glass bulbs in insect store-boxes, methods of mounting mosquitoes on celluloid strips, the rearing of larvæ in captivity, and the mounting of parts of larvæ, pupæ, and adults as microscopic specimens. Ten pages are devoted to suggestions for anti-malaria and anti-mosquito surveys and for mosquito control.

The Plant Lice or Aphididæ of Great Britain. By Fred V. Theobald. Vol. 2. Pp. v+411. (Ashford, Kent, and London: Headley Bros., 1927.) 30*s.*

Entomologists will welcome the appearance of the second volume of Mr. Theobald's invaluable book on the British aphides. This volume follows on the same lines as the previous one. It deals with the remaining genera and species of the tribe Aphidini, and in addition certain members of the tribe Callipterini. Altogether 26 genera and about 150 species are dealt with, and of the latter 64 and 36 respectively belong in the genus Aphis and Anuraphis. The remaining genera contain only from one to eight British species.

The labour entailed by this monumental work is evident from a study of the complex synonymy of many common species, and we are deeply indebted to the author for the way in which he has straightened out the chaotic tangle in which many important species have been struggling in the past. It is clear that the habits and behaviour of many economic species vary considerably in different countries.

The inevitable change of the specific name of well-known species may trouble the economic entomologist for a time, but the correct name will have the value of permanency. In this respect it is to be hoped that the type of the genus Aphis will be soon definitely agreed upon by the acceptance of the latter as a *genus conservandum.*

We do not understand why *Aphidella secreticauda* Theob. (gen. et sp. nov. 1923) should become *Aphidiella secretocauda* in the present volume, as we are not aware of any published note explaining the change and the name in its original form has already passed into the literature.

With these two volumes now available, it is evident that this authoritative work will be welcomed by entomologists, not only in Britain but also throughout the world. James Davidson.

Faune de France. (Fédération française des Sociétés de Sciences naturelles: Office centrale de Faunistique.) 15: *Diptères* (*Nématocères*), *Chironomidæ, Tanypodinæ.* Par M. Goetghebuer. Pp. 83. 18 francs. 17: *Diptères* (*Brachycères*). (*Asilidæ.*) Par E. Séguy. Pp. 191. 35 francs. (Paris: Paul Lechevalier, 1927.)

The appearance of volumes of the "Faune de France" series has frequently been noticed in these columns. No. 15, by M. Goetghebuer, of Ghent, deals with the little studied group of midges comprising the subfamily Tanypodinæ, and his account is the only comprehensive one dealing with the European forms. No. 17, by M. E. Séguy, of the Natural History Museum of Paris, is devoted to the Asilidæ or robber flies and is profusely illustrated with 384 figures. His contribution is particularly interesting, as the prey of each species are listed wherever known, and there is a useful account of the metamorphoses based largely upon the recent work of Melin. Both volumes are well up to the standard of their predecessors and will unquestionably prove of real assistance to students of the British species in the groups reviewed. The Office Centrale de Faunistique concerned with the publi-

cation of those monographs is to be congratulated on their excellence and the general uniformity of treatment that is being maintained in this truly admirable series.

Thysanoures, dermaptères et orthoptères de France et de la faune européenne. Par Prof. C. Houlbert. (Encyclopédie scientifique: Bibliothèque de zoologie.) Tome 2. Pp. iv + 357. (Paris: Gaston Doin et Cie, 1927.) 32 francs.

THE first volume of the above work was published in 1924, and the appearance of the second completes the account of the Orthoptera. The latter are treated under two sub-orders—the Dictyoptera, which include the Blattidæ and Mantidæ, and the Eutelioptera, which embrace the remaining families. The descriptions given of the various species are concise and clear, while the numerous illustrations are useful aids to identification. These features, together with the handy pocket size of the book, should make it a serviceable companion for the field naturalist in many parts of Europe. There is a considerable bibliography at the end of the book, and most of the chief works dealing with Orthoptera are listed.

Pages of History.

Avicennæ de Congelatione et Conglutinatione Lapidum: being Sections of the Kitâb Al-Shifâ. The Latin and Arabic Texts edited with an English translation of the latter and with Critical Notes. By E. J. Holmyard and D. C. Mandeville. Pp. ix + 86. (Paris: Paul Geuthner, 1927.) n.p.

THE authors show that the Latin treatise "De congelatione et conglutinatione lapidum," which is printed in early alchemical books as a work of Avicenna's, is a translation of part of Avicenna's book, "The Book of the Remedy (*Kitâb al-Shifâ*)," and is therefore one of the few medieval translations from Arabic for which the original text dealing with alchemy is available. The work has been attributed to Aristotle, but is clearly a part of the treatise of Avicenna written as a commentary on Aristotle about A.D. 1022. In the Latin translation the work is divided into three parts, the last two having the titles "De causa montium" and "De quatuor speciebus mineralium." The work contains some very interesting geological speculations on the formation of stone, rock, and mountains, on the nature of minerals, and an adverse criticism of the alchemists. The authors consider that it probably represents opinions arrived at by Avicenna late in life, and that at an earlier period he probably composed books in favour of alchemy.

It is interesting to see these Latin translations of Arabic works, until a short time ago airily dismissed as 'forgeries,' brought into relation with their authentic originals, and we may hope that before long others may be added to the list. Messrs. Holmyard and Mandeville have made a very interesting and useful contribution to the history of chemistry.

An Introduction to the Study of Experimental Medicine. By Claude Bernard. Translated by Henry Copley Greene. With an Introduction by Prof. Lawrence J. Henderson. Pp. xxi + 226. (New York: The Macmillan Co., 1927.) 12*s.* 6*d.* net.

STRIKING evidence of the growing interest in the history of medical science is furnished by the recent appearance of this translation of the great French physiologist's classical work, which was first published more than sixty years ago. The translation is preceded by an introduction by Lawrence J. Henderson, professor of biological chemistry at Harvard University, who attributes the insufficient recognition which Bernard's writings have received to their having been overshadowed by the growth of bacteriological research. The introduction is followed by a translation of an appreciation of Claude Bernard by Paul Bert, who was his favourite pupil and successor at the Sorbonne.

Bernard's work consists of three parts. In the first, which deals with experimental reasoning, he emphasises the importance of the experimenter being at once a theorist and a practitioner, and maintains that physiological and pathological states are controlled by the same forces but differ only because of the special conditions under which the vital laws manifest themselves. In the second part, which is devoted to experimentation on living beings, the case for vivisection is luminously set forth. The third part contains applications of the experimental method to the study of vital phenomena, as illustrated by Bernard's own investigations.

The translator is to be congratulated on his excellent rendering of the French text.

School Science.

Readable School Biology. By O. H. Latter. (Bell's Natural Science Series.) Pp. xii + 143. (London: G. Bell and Sons, Ltd., 1927.) 2*s.* 6*d.*

THE publishers are to be congratulated upon the production of what should prove a popular addition to their Science Series, and the veteran naturalist and science master of Charterhouse upon the astounding range of biological fact and theory which he has concentrated into less than 150 pages. Well printed and containing 48 figures (many of them original), the book is very good value for money. The author has struck the distinctively modern note in biological teaching by emphasising the physiological aspect of his subject; so that the general reader will not be tired by tedious descriptions of types or by long lists of unfamiliar names. There is, indeed, a section on 'classification'; but here the reader is directed to general principles, the evolutionary scale, and the mind is left with an impression of living organisms rather than of museum specimens in jars correctly labelled.

The endeavour to live up to the title "Readable" has inveigled the author into some rather strained anthropomorphic analogies; that on p. 136 is particularly unfortunate in that it gives entirely

erroneous conceptions both of the behaviour of the chromosomes during meiosis and of their relation to inheritance. A number of Mr. Latter's colleagues will not be disposed to accept his assertion that "with classes taking Biology as part of their *general education*, personal practical work by the pupils themselves is sheer waste of time and money"; this need not, however, prevent even such from using his book, which is eminently readable.

Elementary General Science. By J. B. Jenkins. (Bell's Natural Science Series.) First Year's Course. Pp. viii+149. Second Year's Course. Pp. vii+171. (London: G. Bell and Sons, Ltd., 1927.) 2*s*. each.

THE arrangement of the subject matter of this introduction to physics and chemistry is unusual. Each volume is divided into three parts. In the first, very full instructions are given for carrying out a series of experiments, and each experiment is followed by a list of questions to assist the pupil to make the correct observations and inferences. In the second, the results of each experiment are discussed, and the third deals with the applications of the facts acquired.

Part I. is reminiscent of a cookery book, and it is disappointing to find that right to the end of the two years' course it is necessary to ask a question to ensure an observation or an inference. "Is the test-tube still intact?" follows the bursting of a test-tube by filling it with water and freezing the water! The electric bell would afford a valuable lesson but for the diagram and explanation, which 'give the show away.' Many of the experiments are more suitable for demonstration than for individual work.

There is something to be said for separating Parts II. and III., as a pupil frequently remembers the application but forgets the fact or principle, because the former made a vivid impression before the latter had been grasped.

Smith's Inorganic Chemistry. Revised and re-written by Prof. James Kendall. Pp. xxvi+1030+15 plates. (London: G. Bell and Sons, Ltd., 1927.) 12*s*. 6*d*. net.

IN this new edition of a well-known text-book, Prof. Kendall has been able to preserve the general plan and spirit of the original and at the same time to incorporate a considerable amount of new material. Of the many new topics dealt with, special mention may be made of the new views on the ionisation of strong electrolytes, which are very skilfully explained in simple language. The book is one of very modern conception and gives an excellent account of the elements of inorganic chemistry, with sections on physical chemistry and the organic chemistry of everyday life.

Elements of Chemistry. By Prof. Harry N. Holmes and Louis W. Mattern. Pp. xi+519. (New York: The Macmillan Co., 1927.) 7*s*. 6*d*. net.

HOLMES and Mattern's book is chiefly noteworthy for the many excellent illustrations of chemistry in its applications to industry and daily life. There are more than 250 illustrations, many of them from photographs, and they certainly convey a most vivid picture of the ramifications of chemistry in all parts of modern life. For this feature alone the book is well worth inclusion in a school library. The text contains many references of interest to industrial processes, and teachers of elementary chemistry should find the book useful and stimulating.

Classified Problems in Physics. Part 1: *Mechanics and Hydrostatics.* By Dennis Brook Briggs and M. Briggs. Pp. viii+128. 3*s*. Part 2: *Magnetism and Electricity.* By Dennis Brook Briggs. Pp. viii+128. 3*s*. Part 3: *Heat, Light, and Sound.* By Dennis Brook Briggs. Pp. viii+183. 3*s*. 6*d*. (London: Sidgwick and Jackson, Ltd., 1928.)

IN addition to some hundreds of problems, mostly numerical, of the standard of the school certificate examination, these books contain definitions, proofs of formulæ, and worked examples. The purpose they serve is difficult to see. They are not text-books, and as supplements they are, or should be, unnecessary. The pupil who solves more than a small fraction of the problems is learning arithmetic rather than physics. The teacher might find the problems useful, but would not need the other portions of the book.

Miscellany.

Coal in Great Britain: the Composition, Structure, and Resources of the Coalfields, Visible and Concealed, of Great Britain. By Dr. Walcot Gibson. Revised and enlarged edition. Pp. viii+334+8 plates. (London: Edward Arnold and Co., 1927.) 21*s*. net.

THE fact that a new edition of Dr. Walcot Gibson's well-known book "Coal in Great Britain" has been called for seven years after the original publication of the book is evidence that the work has filled, and has filled satisfactorily, a want in coal mining literature. The new edition follows quite closely the arrangement of the previous one, but some of the material in the first edition has been expanded, so that the new volume contains 334 pages as against 311 in the earlier edition. A brief chapter has been added on the origin and composition of British coalfields; the chapters dealing with the coalfields of North Staffordshire, Yorkshire, and Nottinghamshire have been somewhat enlarged, and have been brought up-to-date by the light of recent investigations. This is perhaps particularly true of the great Yorkshire, Nottinghamshire, and Derbyshire coalfield, where development has been proceeding very actively during recent years, although there is still room for much investigation, seeing that the author himself admits that "the northern, eastern, and southern productive limits of the concealed basin remain conjectural." Full advantage has been taken of recent publications on the coalfields of Scotland, although these are still dealt with in one chapter, whereas the material available would readily have warranted a considerably more extended description. Perhaps the most disappointing chapter in the book is that dealing with the

East Kent coalfield, in the description of which advantage does not appear to have been taken of the most recent information. The new edition remains, however, as was the first, the best brief comprehensive survey that we possess of the coalfields of Great Britain.

Wireless Direction Finding and Directional Reception. By R. Keen. Second and enlarged edition. Pp. vii + 490. (London: Iliffe and Sons, Ltd., 1927.) 21*s.* net.

THIS work was first published in 1922 under the title "Direction and Position Finding by Wireless." In the interval, the wireless direction-finder, both in its application to navigation and as a useful instrument for scientific research, has developed to a considerable extent; and it is not surprising, therefore, to find that a second edition of Mr. Keen's book has been called for. The book has been revised in a thorough manner and considerably enlarged, while its scope has been usefully extended to include directional reception for communication purposes.

The earlier chapters deal in a clear and simple manner with the fundamental theory of directional receiving aerials, whether of the closed loop type used in direction-finding, or the extended open type used for beam communication. A description is then given of the various practical types of direction-finder used for aerial and marine navigation, and in the case of the Bellini-Tosi system, detailed working instructions are given for the choice of site, erection and calibration of the direction-finder on ship or shore. The navigational side of the subject is dealt with in three chapters, containing details of the special maps and charts which are required and the necessary instruction in field and nautical astronomy. Modern research is summarised in a chapter on the phenomena of night errors and coastal refraction, and the relation of these to the propagation of electromagnetic waves is explained.

A most valuable portion of the book is the bibliography of 374 references, which have been well chosen and are arranged chronologically in an excellent manner. The book is well illustrated by a large number of diagrams and photographs, and the production leaves nothing to be desired. It should undoubtedly be in the possession of everyone interested in the subject of directional wireless.

R. L. SMITH-ROSE.

A Survey of the Social Structure of England and Wales: as Illustrated by Statistics. By A. M. Carr-Saunders and D. Caradog Jones. Pp. xvii + 246. (London: Oxford University Press, 1927.) 10*s.* net.

THE compilation of accurate statistical data for public edification is a twentieth-century phenomenon. It is a logical outcome of the demand of the reasonable for facts upon which to base action and opinion. The facts which have emerged have been of incalculable assistance to social reformers, whose appetite has grown until at the present time a varied and abundant but somewhat indigestible fare is available for consumption. This volume is a praiseworthy effort to assist the public in its task of assimilation. It gives form and coherence to the vast accumulated mass of statistics from official and unofficial sources which bear on the various aspects of the social life of the community. Even more valuable still, it points out the existing gaps in the statistical data available.

By virtue of its presentation of facts without prejudice, the judicial calm with which the many defects in our social structure are noted and commented on, this volume can be commended to all serious students of social science. But those who expect to find prescriptive remedies for our social ills or a general social theory will be disappointed. The authors are content to give the outlines of the problems confronting society, such as those connected with the numerical preponderance of women, the effect of heredity, environment, and education on quality of population, the distribution of wealth, and the social aspect of the methods adopted by various sections of the community for the protection or improvement of their position in society. It merits the closest attention of scientific workers because of its suggestiveness and the clarity with which it blazes the trail for others in this fascinating, if perplexing, field of research. A. G. C.

Pitman's Dictionary of Industrial Administration: a Comprehensive Encyclopædia of the Organisation, Administration, and Management of Modern Industry. Edited by John Lee. Complete in about 30 fortnightly Parts. Part 1. Pp. xv + 48. (London: Sir Isaac Pitman and Sons, Ltd., 1928.) 1*s.* 3*d.* net each Part.

WITH the present trend towards amalgamation and co-operation of effort in industry with the view of improving the organisation of production and marketing effort, this work should be specially welcome to those now actually engaged in the organisation, administration, and management of modern industry, or those who hope to attain positions of importance in the future. In America and Germany nearly every industry has its authoritative work of reference; and while there are several text-books in Great Britain devoted to single aspects of the problem of scientific management, this dictionary is, so far as we are aware, the first attempt to cover the whole subject in comprehensive fashion. A reference to the first part shows that every subject and problem that are likely to arise in a well-organised undertaking are dealt with briefly, and without the over-theorising from which many similar treatises, written from the academical rather than from the practical point of view, suffer. The student and practical man will find articles on production, administration, marketing, insurance, finance, welfare, accident prevention, hygiene, transportation, power, and other aspects of the one big problem of efficient management. Unlike some other similar works, the dictionary is generously cross-referenced to enable the student to find the information he is seeking with the minimum of trouble. A really full index in the last volume should still further enhance the value of the work.

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Technology.

G. Bell and Sons, Ltd.—Old English Porcelain. A Handbook for Collectors, W. B. Honey. *Ernest Benn, Ltd.*—Modern By-Product Coking Practice, E. Bury and S. J. Morgan; Textile Microscopy, L. G. Lawrie. *Chapman and Hall, Ltd.*—The Cleaning of Coal, Dr. W. R. Chapman; Ice Cream Plant and Manufacture, R. G. Reid; Quantity Surveying for Builders, W. L. Evershed, new edition; Bells Thro' the Ages; The Founder's Craft and Ringer's Art, J. R. Nichols; Photographic Art Secrets, W. Nutting; The Problem of Fermentation: the Facts and Hypotheses, Dr. M. Schoen, translated by H. L. Hind; Artificial Silk, Dr. F. Reinthaler, translated by Prof. F. M. Rowe; Horology: the Science of Time Measurement, and the Construction of Clocks, Watches, and Chronometers, J. E. Haswell. *C. Griffin and Co., Ltd.*—Paint Technology, F. Noel Heaton. *Iliffe and Sons, Ltd.*—Moving Coil Loud Speakers, F. H. Haynes. *Crosby Lockwood and Son.*—Modern Furniture Veneering, E. W. Hobbs; Masonry: a Practical Guide to the Art of Stone Cutting, W. R. Purchase, new edition. *Longmans and Co., Ltd.*—The Science and Practice of Confectionery, Prof. D. Ellis and D. Campbell. *Macmillan and Co., Ltd.*—The Finishing of Jute and Linen Fabrics, T. Woodhouse, new edition. *Methuen and Co., Ltd.*—The Technical Arts and Sciences of the Ancients, A. Neuburger, translated by Dr. H. L. Brose.

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ornaments in glass paste. Finally, small beads of glass paste lying in masses show a pattern worked in colours, probably part of a garment, a new feature in Mycenæan art. Pottery dates the tomb at about 1300 B.C. No human remains were found, and Prof. Persson suggests that the tomb may have been the cenotaph of a chief. This would agree with the great attention known to have been paid to the dead by the Mycenæans and with practices suggested in several Homeric passages.

THE Boyden Station of the Harvard College Observatory, which was situated at Arequipa, Peru, from 1890 until 1927, has now been re-established near Bloemfontein in the Orange Free State. Photographic work with two telescopes was resumed in September 1927, using the temporary quarters provided by the city of Bloemfontein while the permanent station is under construction on a low kopje a short distance south of Mazel's Poort, the power station settlement of the city. Bloemfontein is providing the permanent site for the new observing station, and making roads and other improvements for the Harvard Observatory. Under the former director, Prof. E. C. Pickering, and the present director, Prof. Harlow Shapley, the Harvard Observatory has maintained for forty years a very active interest in the southern sky, and nearly one-half of the great collection of astrographic plates at Harvard were made at its Boyden Station. The observing conditions at Arequipa were excellent for about eight months of the year, but a prolonged cloudy season from November to March badly hampered the systematic observations. The cloudy weather at Bloemfontein is more evenly distributed through the year, and at the same time the transparency and seeing are extraordinarily good. The transfer of the station and its enlargement were made possible through gifts by the International Education Board and by Harvard University. A new 60-inch reflecting telescope, to be the largest instrument in operation in the southern hemisphere, is being constructed for the Boyden Station. Other instruments that will be in operation are photographic doublets of eight inches and twenty-four inches aperture, a 10-inch photographic triplet, the 13-inch Boyden refractor, and photographic cameras of one, three, and five inches aperture. The problems under investigation include extensive studies of variable stars, extra-galactic nebulæ, globular star clusters, proper motions, and spectral classification and analysis. The transfer and erection of the station are under the immediate supervision of Dr. J. S. Paraskevopoulos.

THE *Annual Report* of the Committee of Management of the Lewis Evans Collection of Scientific Instruments at Oxford has just been published. It records the restoration of the main exhibition room in the Old Ashmolean Museum to its original condition, and the unveiling by Viscount Cave, as Chancellor of the University, of the memorial windows to Dr. Plot and to Sir Christopher Wren. All the astrolabes in the collection have now been photographed in preparation for an illustrated catalogue; important memoirs on the subject of the astrolabe have been published by Dr. R. T. Gunther, the curator of the collection. Among recent accessions are a 6-in. reflecting telescope made by Sir William Herschel, and the fine silver microscope made by G. Adams for George III. The telescope has been presented by Dr. Herbert N. Evans, of Exeter College, himself a cousin of Dr. Lewis Evans; it was formerly in the possession of Archdeacon Nathaniel Jennings, who had a small private observatory on the north side of Regent's Park, London. The George III. microscope, apart from its interest as an example of the silversmith's art, admirably illustrates the advance made in one century from the instrument designed by R. Hooke, of Christ Church, in 1665. Among other accessions are a 'thunderhouse' and a frictional electric machine, both of which are associated with Joseph Priestley. The Report ends with a reference to the finances of the collection, which in spite of liberal gifts from the great City Companies and other public bodies both within and without the University, cannot yet be said to be on a satisfactory footing.

PROF. A. LABBÉ'S work on copepods in the saline waters of Croisic, and his claims to have established an evolution from one genus to another, have been discussed by Mr. R. Gurney and Mr. A. G. Lowndes in the columns of NATURE (Sept. 4, Oct. 16, 1926; Aug. 27, 1927). These 'allomorphs,' or transition forms, he affirms may be produced by slight alteration in the environment, both in the laboratory or, within a longer period, naturally in the marshes themselves. Thus in eight stages, during seven years he claims to have transformed Canthocamptus into Cyclops, and similarly many forms have been changed from one genus to another. Mr. Gurney's criticisms are based, first, on the incomplete evidence given, Prof. Labbé himself admitting that his aquaria were not absolutely free from contamination by other species, and giving no exact details of his experiments so that the evidence can be weighed; and secondly, on the wrong identification of his forms, some of the new genera being apparently identical with those already known, and the figures themselves inaccurate. Mr. Lowndes attacks the problem from another quarter, questioning the results on the grounds of the impossibility of such small increases in the *p*H being capable of producing such momentous results, and referring to his own work on freshwater Cyclops which retain their individual characters within a wide *p*H range.

WE have now a communication from Prof. Labbé in support of his own observations, upholding the identifications in spite of criticisms, his contention being that Mr. Gurney could not possibly prove that forms were identical which he did not see. He suggests sending to Mr. Gurney a lot of the copepods for analysis; an offer which we hope will be accepted. Secondly, in answer to Mr. Lowndes he agrees that freshwater copepods can often bear a much greater range of *p*H than those in salt water, but holds that variation in *p*H will not necessarily bring about morphological variation. Thus the quoted Artemia

showed no change, whatever the variation in *p*H. On the other hand, with small change in surroundings alteration may take place. As he says, "Allelogenesis is likely to succeed only under proper conditions of equilibrium between inner and outer *p*H." To find such conditions "is the fundamental problem of allelogenesis, which I have not yet solved." Prof. Labbé quotes his previous work on the cycles of Dunaliella as suggesting some solution of the problem of internal adjustment, and finally states that he will carry on his researches 'quite undisturbed.' It is to be hoped that he will bring forward more exact descriptive and experimental evidence in support of his interesting and revolutionary statements.

WE much regret to announce the death on Mar. 4, at the age of seventy-five years, of Sir Aubrey Strahan, K.B.E., F.R.S., lately Director of the Geological Survey of Great Britain, and of the Museum of Practical Geology, London.

THE Council of the British Association will nominate Sir Thomas Holland, rector of the Imperial College of Science and Technology, as president of the Association for the meeting to be held in South Africa in July and August 1929. Mr. O. J. R. Howarth, Secretary of the Association, expects to proceed to South Africa in May next to confer with authorities there on arrangements for the meeting.

MR. W. L. HICHENS, chairman of Messrs. Cammell, Laird and Co., and well known for his work in scientific administration and industry, has been elected a member of the Athenæum Club under Rule II., which provides for election by the Committee of "persons of distinguished eminence in science, literature, or the arts, or for public services."

THE following officers were elected at the annual general meeting of the Geological Society of London, held on Feb. 17: *President*, Prof. J. W. Gregory; *Vice-Presidents*, Dr. F. A. Bather, Prof. E. J. Garwood, Dr. E. Greenly, and Mr. H. W. Monckton; *Secretaries*, Mr. W. Campbell Smith and Dr. J. A. Douglas; *Foreign Secretary*, Sir Arthur Smith Woodward; *Treasurer*, Mr. R. S. Herries.

DR. W. ROSENHAIN, Superintendent of the Metallurgy Department of the National Physical Laboratory, Teddington, since 1906, has been elected president of the Institute of Metals for 1928-29. Dr. Rosenhain is a graduate of the University of Melbourne, Australia, whence he came to England in 1892 with a research scholarship of the Commissioners of the 1851 Exhibition. He has carried out a large amount of metallurgical research both on non-ferrous metals and on iron and steel, and is also well known in connexion with glass technology.

DR. HERBERT E. IVES, who recently received the John Scott medal and premium for his contributions to electrical telephotography and television, has given the amount of the premium (1000 dollars) to the Optical Society of America, to found and endow a medal. This medal, to be awarded every two years for distinguished work in optics, is to be named "The Frederic Ives Medal," in honour of the donor's father.

A CONFERENCE on "Malting Barley" will be held at the Rothamsted Experimental Station at 11.30, on Thursday, Mar. 15. The subjects of the addresses to be delivered are "What the Barley Buyers Want"; "The Influence of Season on the Yield and Quality of Barley"; "Cultivation and Treatment of Barley grown for Malting in the Vale of Taunton"; "Cultivation and Treatment of Barley grown for Malting on the Lincolnshire Heath"; "Malting Barley: Old and New Varieties"; and "Five Years' Experiments on Malting Barley."

AT a meeting of the Royal Society of Edinburgh held on Mar. 5, the following were elected fellows of the Society: Dr. E. A. Baker (Edinburgh), Prof. G. B. Barbour (Peking), Mr. H. W. Brown (Edinburgh), Rev. Dr. W. S. Bruce (Banff), Prof. A. J. Clark (Edinburgh), Dr. A. Couttie (Edinburgh), Dr. W. Murdoch Cumming (Glasgow), Mr. W. R. Dawson (London), Mr. E. W. Fenton (Edinburgh), Dr. James Forrest (Dundee), Prof. J. Fraser (Edinburgh), Dr. K. Fraser (Carlisle), Mr. W. G. Harding (Oxford), Mr. A. D. Hobson (Edinburgh), Mr. W. V. D. Hodge (Bristol), Dr. A. Hunter (New York), Mr. P. J. Johnston-Saint (London), Prof. R. W. Johnstone (Edinburgh), Dr. T. J. Jones (Liverpool), Mr. T. L. MacDonald (Glasgow), Prof. T. J. Mackie (Edinburgh), Prof. G. Matthai (Lahore), Dr. J. E. Nichols (Edinburgh), Dr. C. H. O'Donoghue (Edinburgh), Dr. G. H. Percival (Edinburgh), Mr. R. S. Pilcher (Edinburgh), Mr. C. E. Price (Edinburgh), Mr. O. F. T. Roberts (Aberdeen), Mr. R. Senior-White (Kasauli, India), Mr. A. D. B. Smith (Edinburgh), Mr. A. M. Watters (Hawick), Mr. J. M. Whittaker (Edinburgh), Dr. J. Williamson (St. Andrews).

THE fifth International Botanical Congress will be held at Cambridge on Aug. 16–23, 1930, with excursions during the following week. As at present arranged, the Congress will be organised in the following sections: Palæobotany, morphology (including anatomy), taxonomy and nomenclature, plant geography and ecology, genetics and cytology, plant physiology, mycology and plant pathology. For each of these sections a British sub-committee has been appointed, by which the programme will be arranged. The chairmen of these sub-committees and their addresses are as follows: Palæobotany, Prof. A. C. Seward, Botany School, Cambridge; morphology (including anatomy), Prof. F. E. Fritsch, Danesmount, Tower Hill, Dorking, Surrey; taxonomy and nomenclature, Dr. A. W. Hill, Royal Botanic Gardens, Kew, Surrey; plant geography and ecology, Prof. A. G. Tansley, Department of Botany, The University, Oxford; genetics and cytology, Sir John Farmer, Imperial College of Science and Technology, London, S.W.7; plant physiology, Dr. F. F. Blackman, Botany School, Cambridge; mycology and plant pathology, Dr. E. J. Butler, Imperial Bureau of Mycology, 17 Kew Green, Kew, Surrey. Communications made to the Congress by means of papers or by participation in the general discussions will be permissible in English, French, or German. An executive committee of British botanists has been appointed, with Prof. Seward as chairman,

to make the necessary arrangements; Dr. A. B. Rendle is acting as honorary treasurer, and Mr. F. T. Brooks, 31 Tenison Avenue, Cambridge, and Dr. T. F. Chipp, Royal Botanic Gardens, Kew, are honorary secretaries of the Congress.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A teacher of woodwork and geometry at the Walthamstow Technical College—The Clerk to the Governors, 1 Selbourne Road, E.17 (Mar. 12). An assistant master for mathematics and science at the Acton and Chiswick Polytechnic Junior Technical School—The Principal, The Polytechnic, Bath Road, Chiswick, W.4 (Mar. 16). A principal and head of the metallurgical department of the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (Mar. 23). A full-time teacher of engineering subjects at the Shrewsbury Technical College—The Secretary to the Committee of Management, Guildhall, Shrewsbury (Mar. 27). A biochemist and a protozoologist at the Medical Research Institute in Nigeria—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Mar. 31). Inspectors of agriculture under the Department of Agriculture and Forests of the Sudan Government—The Controller, Sudan Government, London Official, Wellington House, Buckingham Gate, S.W.1 (April 7). A professor of organic chemistry in the Central College, Bangalore, University of Mysore—The Registrar, University of Mysore, Mysore, India (April 25). A junior assistant in the Research Department, Woolwich (under the directorate of Explosive Research)—The Chief Superintendent, Research Department, Woolwich, S.E.18.

ERRATUM.—In NATURE of Mar. 3, p. 315, col. 2, lines 20 and 24, it was stated that Prof. A. V. Hill had calculated that the Woolworth Building in New York could be climbed in eight seconds, and that it had been done in nine seconds. These times should be eight minutes and nine minutes respectively.

Our Astronomical Column.

COMETS.—After the discovery of Reinmuth's comet, an examination was made of earlier plates taken at Königstuhl, with the result that the following position of the comet was derived: Jan. 29·10757 U.T.; R.A. $9^h\ 23^m\ 35^s{\cdot}6$; N. Decl. $17°\ 41'\ 19''$; from this position, combined with those of Feb. 22 and 25, Dr. A. C. D. Crommelin has derived the following elliptical orbit (the position for Feb. 22, on revision of measures, was given as $9^h\ 15^m\ 7^s{\cdot}5$, N. Decl. $21°\ 44'\ 55''$):

T	1928 Feb. 1·6502 U.T.	
ω	9° 26′ 37″	1928·0
Ω	124 53 11	
i	8 0 16	
ϕ	30 2 13	
log a	0·5701080	
log q	0·2685923	
Period	7·164106 years.	

The following ephemeris is for 0 h. U.T.:

	R.A.	N. Decl.	log r.	log Δ.
Mar. 8	$9^h\ 14^m\ 31^s$	23° 8′	0·2748	9·9889
16	9 16 44	23 31	0·2778	0·0132
24	9 20 54	23 35	0·2814	0·0402

The orbit does not closely resemble that of any comet in the catalogues, but there is a distant resemblance to that of Denning's comet, 1894 I. It is of interest that the aphelion point of the above orbit lies close to the perihelion point of comet Schwassmann-Wachmann, and the two comets were close together in the middle of 1924, if the orbit of Reinmuth is near the truth; it represents within $2\frac{1}{2}''$ an observation made at Milan on Feb. 28.

Mr. James Young obtained a photograph of Encke's comet, Feb. 6·7708 U.T., from which he derives the following position: R.A. $22^h\ 49^m\ 54{\cdot}5^s$, N. Decl. $0°\ 18'\ 55''$. This gives Feb. 19·829 for the date of perihelion, which is 3 hours later than Matkiewicz's predicted date, Feb. 19·6984, rather an unexpectedly large discordance. The acceleration of this comet, which formerly attracted so much attention, seems to have completely died away. This renders it difficult to explain the acceleration by resisting medium, as such a medium could scarcely have been present in the last century and absent now.

Mon. Not. Roy. Astro. Soc. for January contains reproductions of the drawings of Skjellerup's comet by Mr. Chidambara Aiyar on Dec. 15, when it was about 2° from the sun.

THE DRAYSON PARADOX.—This paradox had its sole basis in a carelessly written paragraph in Sir J. Herschel's "Outlines of Astronomy." It asserts that the pole of the equator moves around a centre that is 6° distant from the pole of the ecliptic, so that the obliquity varies between $23\frac{1}{2}°$ and $35\frac{1}{2}°$; the ice-ages are asserted to have occurred at the epochs of maximum obliquity. Drayson also erroneously claimed that the proper motions of stars were merely an effect of this movement of the earth's axis.

The observational evidence against the Drayson theory, and its lack of a dynamical basis, have been frequently brought before the public during the last half-century, but it still claims adherents. Mr. A. H. Barley, its principal advocate, has recently brought out a pamphlet, "The Ice Age" (W. E. Baxter, Ltd., Lewes, Sussex), in which the old assertions of Drayson are repeated, and the further claim made that the very small errors in the predictions concerning the recent solar eclipse (spoken of as 'serious errors' in the pamphlet) were due to the non-acceptance of Drayson's views. The argument here is a repetition of that used by Mr. E. J. Stone in several papers between 1883 and 1892; he ascribed the errors of Hansen's lunar tables to a change in the ratio of mean to sidereal time, brought about by the substitution of new solar tables in the *Nautical Almanac*. He was correct in asserting that some such change took place, but he multiplied its effect by 365; Sir G. Airy showed in a letter to the *Observatory* in May 1883 that sidereal time, from the manner in which it was derived, could not be in error by the amount that Stone asserted.

Prof. de Sitter discussed the errors of the lunar tables in NATURE of Jan. 21, p. 99, and gave the evidence in favour of the conclusion that they are due to small variations in the earth's rate of rotation, not to changes in the direction of its axis.

Research Items.

HAWAIIAN JAWS AND TEETH.—Mr. H. G. Chappel has examined the collection of Hawaiian mandibles, both those attached to crania and those without crania, and mostly dating from before the coming of the white man, in the Bernice P. Bishop Museum, Honolulu, with a view to the study of the teeth and dental disease. The results are published in *Memoirs of the Bernice P. Bishop Museum*, vol. 9, pt. 3. The teeth show comparatively little irregularity, only 9·9 per cent. Only 17·2 per cent. have the incisor knocked out as a sign of grief for a relative. This custom was more prevalent among the men than the women, and on Hawaii than on the other islands. There is little caries owing to developmental faults. From forty to sixty years of age it increases considerably, and is more prevalent in mandibular than in the maxillary teeth. Alveolar abscesses grow more prevalent as age advances, as does pyorrhea; between forty and sixty years of age only 6·57 per cent. are free from it. As regards the jaws, there are more orthognathous females than males and little prognathism in either sex. The majority of males and females show a greater height and width of the ramus of the mandible on the left side and a greater height of the body of the mandible on the right side. The males of the island of Hawaii show a greater bigonal width than those of the other islands.

CANCER STATISTICS.—The Ministry of Health has issued two further reports on cancer. One of these (*Reports on Pub. Health and Med. Subjects*, No. 46) deals with cancer of the rectum, and is based on an examination, by the Departmental Committee, of the records of rather less than 6000 cases of this disease. It is found that, on an average, the patients did not come to operation until twelve months after the occurrence of the first symptoms, and that rather less than half the patients when seen by the surgeons were considered to be operable. Of those operated on, about one-sixth died as the result of such operation, sepsis being the cause of half these deaths, but two out of every five were alive three years afterwards. The other report (*ib.*, No. 47) deals with the treatment of cancer of the uterus at the Samaritan Free Hospital, and has been prepared by Dr. Janet Lane-Claypon and Mr. W. M'K. H. M'Cullagh. Again the same fact emerges that something like half the patients are inoperable when they present themselves, and that the first symptoms were noticed six months previously. The operative mortality in cancer of the cervix was only about 6–7 per cent., and the number surviving five years after hysterectomy was about 34 per cent. for the vaginal, and 44 per cent. for the abdominal operation. For cancer of the body of the uterus, the number surviving five years after operation was 61·5 per cent. It has long been recognised that childbirth is a predisposing cause of cancer of the cervix, and the data here collected suggest that there is also a definite association of the disease with early miscarriage before the fœtus is viable. Many other details have also been analysed in the two reports, such as the earliest symptoms of the disease noticed by the patients, the mortality of various operative procedures and the chief causes of death therefrom, and the duration of life without operation.

HARMFUL NOISE.—The Engineering Section of the National Safety Council, at its sixteenth annual congress, held at Chicago on Sept. 26-30 last, reports the results of a research committee set up to deal with the elimination of harmful noise. The report begins by attempting to define noise, but admits that the line of demarcation between musical sound and noise cannot be sharply drawn. The interest in noise elimination is widespread, and many articles have appeared throughout America during the year. Dr. E. E. Free made a noise survey of the city of New York, and Mr. R. F. Novis of Chicago. Such surveys, however, cannot be utilised as a basis for determining which noise should be eliminated and which may be tolerated. People who are ill can tolerate only a minimum of noise, but no one knows what noises are harmful, or how much noise is harmful to people who are not ill. Several attempts have been made to measure the effect of noise upon the human organism, but so far the data for formulating a definition of harmful noise are not available. The report suggests that the services of physiologists, neurologists, otologists, psychologists, and physicists should be enlisted in order to investigate the problem. Prof. John J. B. Morgan, of Northwestern University, has made a preliminary study of the effects of noise by comparing the electrocardiograph records of subjects in a quiet and in a noisy environment. The noises were produced by Western Electric audiometers, the sound being amplified and given to the subjects through a loud-speaking telephone. Prof. Morgan's tentative conclusions are (1) that the heart action is modified by the noise, but that the effect is more apparent in the irregularity of the action than in the average rate; (2) that subjects vary in the way they respond and that different sounds have different effects; (3) that the suggestion of a 'horrible din' to a hypnotised subject quickens the pulse, thus indicating that the emotional attitude towards the sound may be of greater significance than the quality of the sound itself. The report concludes that the method indicates a way of approach to the very difficult problem of harmful noise.

ZOOLOGICAL STUDIES OF CENTRAL ASIA.—The Commission for the Study of Natural Resources of the Russian Academy of Sciences has just published a list of literature on animals of Turkestan, compiled by M. M. Ivanova-Berg, under the editorship of Prof. Leo Berg. The list comprises a volume of large size, 235 pp. in all, and covers all literature on animals of Central Asia, both wild and domestic. Central Asia is given wide limits, and includes the Kirghiz steppes, Turkestan, Dzhungaria, Kashmir, N.W. India, Afghanistan, and northern Persia, but the literature on the fauna of the Caspian Sea is not included, except that dealing with fisheries on the eastern coast. Russian literature is dealt with very exhaustively, but it is not claimed that foreign papers are fully represented. The total number of entries is 4894. Titles are classified; first are quoted systematic, zoogeographical, and similar papers on each group; then a section on pests of agriculture follows; another special section on locusts (more than 300 entries); then fisheries; animal breeding generally and by branches; bee-keeping; silkworm industry. Two supplements bring the bibliography practically up to the end of 1927. Two indexes, one of geographical names mentioned in titles, another of species of animals, conclude this volume, which will be found very useful by anyone working on scientific or economic problems of Central Asia.

POLYZOA FROM THE ADRIATIC AND MEDITERRANEAN.—Dr. Antonia Neviani ("La *Schizotheca serratimargo* Hks. sp. nell' Adriatico e suoi ospiti." *Memorie della Pont. Accademia delle Scienze—I nuovi Lincei*, Ser. 2, vol. 10) redescribes this interesting species, first discovered by Hincks in 1886 from the Adriatic,

and, although only fragments were then obtained, attributed by him to the genus Schizoporella. Dr. Neviani, having succeeded in finding several fine specimens in the Mediterranean, gives a detailed account of these, together with other encrusting polyzoa growing on them. *Schizotheca serratimargo*, as it is now called, is a calcareous polyzoon living in the coralline zone attached to various stones, shells, madrepores, and nullipores from the Mediterranean and the Adriatic Seas, the Suez Canal, and the coast of Morocco, also occurring fossil in the Pliocene and post-Pliocene of Italy. A full list of records is given, showing that from 1909, when it was recorded by Waters from the Red Sea, it was not again mentioned until 1925, when Canu and Bassler included it in their list of Bryozoa from Morocco and Mauritius. It is unfortunately exceedingly delicate to handle and breaks up at the slightest touch. The 'guests' or animals growing upon it include Spirorbis and serpulids and five species of calcareous polyzoa, all belonging to different genera.

PARASITES OF THE EUROPEAN CORN BORER.—*Circular No. 14* (Oct. 1927) of the United States Dept. of Agriculture embodies a résumé of the present status of imported parasites of the European corn borer. The authors, Messrs. D. W. Jones and D. J. Caffrey, mention that since native parasites do not effectively attack this insect, it has been deemed necessary to import certain species which parasitise it in its original habitat in France, Belgium, Italy, and Hungary. Twelve different species of parasites have been introduced into the United States between 1920 and 1927, numbering more than 355,000 individuals. All these were sent to the Corn Borer Laboratory at Arlington, Mass., and from there distributed, after they had mated, among infested areas. A certain number of parasites were kept back in order to build up an increased stock before liberation, and in this way 1,535,000 additional parasites were obtained. Systematic collections and observations in the vicinities where these liberations took place, have resulted in the recovery of six of the species concerned in circumstances indicating that they have become established in the United States, and that they are actually preying upon the corn borer. Although strenuous efforts are being made to import, breed, and establish these various parasites in corn borer infested areas, it is too early at present to decide whether they will prove effective aids in controlling the pest. Judging from the experience with similar parasites imported to aid in controlling other foreign pests, several years will elapse before any important effect can be expected. In the meantime, every effort to control the corn borer by other methods needs to be assiduously maintained.

GENETICS OF CHERRIES.—In a study of the genus Prunus, including the plums and cherries, Mr. C. D. Darlington (*Jour. of Genetics*, vol. 19, No. 2) finds that 8 is the basal number of chromosomes and that many of the species and varieties are polyploid. The chromosome number runs so high as 48, and some varieties have chromosome numbers which are aneuploid (not an even multiple). Self-sterility is prevalent and hybridisation has occurred between different forms. This has created a swarm of hybrid forms which render impossible any clear demarcation between species with the same number of chromosomes. Homologous series of variations also occur in Prunus, which are attributed to crossing and segregation among related types. The sweet cherries (*P. avium*) have some trivalent chromosomes, the total number of chromosomes being $2n = 17–19$. The sour and Duke cherries (*P. cerasus*) are tetraploid ($2n = 32$), and the bivalent chromosomes are often grouped in pairs at meiosis. The sweet cherries are of ancient cultivation, but the Duke varieties, developed largely in the seventeenth century, are regarded as aberrant $4n$ segregates from diploid gametes of sweet cherries, perpetuated by grafting. Tetraploidy also has the effect of removing the bar to self-fertility. It is found that cherries which are diploid, or nearly so, can produce tetraploid seedlings, and vice versa.

MENDELIAN GENES AND DEVELOPMENT. — The Amphipod *Gammarus chevreuxi* has provided useful material for genetic study. Messrs. E. B. Ford and J. S. Huxley (*Brit. Jour. Exptl. Biol.*, vol. 5, No. 2) have made an analysis from a developmental point of view of the factors controlling eye-colour. The normal black-eyed type gives rise to various mutational eye-colours, such as red, which may differ not only in the final adult colour, but also in the rate at which pigment is deposited. Segregation for slow or rapid development of the pigmentation may occur in a simple mono-hybrid ratio, but in certain families an apparent failure to segregate was found to be due to accessory rate-factors. Many of the facet-colour genes therefore influence the time relationships governing the deposition of melanin, all coloured eyes passing from colourless through scarlet; later they may darken to black by the addition of melanin. Graphs for developmental rates of different factors are given, and conditions which may bear a similar interpretation in various other animals are discussed. It is suggested that a multiple allelomorph series may represent the developmental curves of a single substance, differing in rate of formation of the substance, time of beginning deposition, and equilibrium position finally reached.

NEW CARBONIFEROUS PELECYPODA.—An important little paper on certain Carboniferous Pelecypoda, or, as he prefers to call them, lamellibranchs, has just been published by Mr. J. Wilfrid Jackson of the Manchester Museum (*Mem. and Proc. Manchester Lit. and Phil. Soc.*, vol. 71, No. 10: reprinted as *Notes from the Manchester Museum*, No. 31). The genera dealt with are Pterinopecten, Posidonomya, and Posidoniella. The author shows that more than one form has been included in the first-named genus as *P. papyraceus* (Sow.) and distinguishes five species. The differences between them depend on surface ornamentation, and occur on specimens from different horizons, but are not so marked as those exhibited by contemporary Goniatites, nor are the various species of equivalent value to the Goniatites for zonal purposes, mainly owing to the scarcity of well preserved specimens. Two new species of Posidoniella are also described. The paper is illustrated by three very good plates.

CRYSTALLINE CARNOTITE.—The usual carnotite deposits of the plateau region of Utah and Colorado are impregnations in sandstone formed when the rocks were first exposed to the percolation of meteoric waters. Geologically this date has been placed in the Eocene, and the lead-ratios indicate a numerical age of at least 42 million years, in good agreement. A discovery of crystalline carnotite has now been made in a situation near the upper end of the Grand Canyon, where the date of formation would be considerably later in the Tertiary. This unique material is thoroughly described by F. L. Hess and W. F. Foshag in the *Proc. U.S. Nat. Mus.*, vol. 72, art. 12, 1927. Lead is present, as shown by spectroscopic tests, but in quantities too small to be determined chemically in the limited samples available. However, the age was estimated from a measurement of the proportional radioactivity. The radium–uranium

ratio was found to be only 68 per cent. of the normal ratio, corresponding to an age of 6·8 million years, which agrees well with the geological indications. With further investigations of this kind it will become possible to date the various stages in the history of the Grand Canyon from the Eocene to the present day.

SURVEY WORK IN THE UNITED STATES.—Among the many accomplishments of the United States coast and geodetic survey for the year ending June 1927, the *Annual Report* directs particular attention to three of importance. The first is the completion of the field work necessary to make a readjustment of the first order triangulation west of the ninety-eighth meridian. The second is the investigation of the first order level net of the United States. The adjustments started from Galveston and were carried to the Pacific and Atlantic coasts. This levelling shows that mean sea-level on the Atlantic coast is more than a foot above mean sea-level on the Pacific coast. The third notable achievement was of a different nature, namely, the construction of a light movable steel tower for use in triangulation in flat regions. The use of this improved tower is expected to reduce the cost of first order triangulation in level lands as much as 25 per cent. A further advance in survey methods is the adoption by all the vessels of the survey of echo-sounding apparatus. After extensive tests and modifications, a satisfactory apparatus has been developed. The *Report* contains key maps of the state of various surveys.

ARE AURORÆ ACCOMPANIED BY NOISES ?—Reports of swishing sounds accompanying auroral displays are common, but are still regarded with doubt, because of the difficulty of reconciling the production of such sounds at low levels with the extreme rarity and altitude (about 100 km.) at which auroræ appear. There have, however, occasionally been reports of auroræ being seen at much lower levels ; some years ago, in a letter to NATURE, Dr. G. C. Simpson discussed various cases of the kind, including some instances in which he was able personally to investigate the report on the spot ; his conclusion was that in these cases the effect was an optical illusion. Another report of a low level aurora, by Mr. J. H. Johnson, appeared in the December (1927) issue of the *Publications of the Astronomical Society of the Pacific*. "A singular aurora—an array of dancing streamers having prismatic colours," accompanied by swishing sounds, was seen at Eagle, Alaska, 64° 47′ N., 141° 10′ W. in front of a bluff half a mile away, which rises to a height of 1200 feet above the town. There seems to be no reason to doubt that a remarkable luminous phenomenon occurred not far from the observer, and at less than 1000 feet above ground level ; but it must have been of a very different character from that usually called an aurora. Even the top of the streamers did not appear above the summit of the bluff, and no mention is made of the presence, at the same time, of high-level aurora properly so-called.

NEW RESULTS WITH SOFT X-RAYS.—In a recent paper in the *Journal de Physique* (vol. 8, p. 484) J. Thibaud and A. Soltan have directed attention to differences between their measurements of wave-lengths betwen 40 A. and 80 A., made with a ruled grating, and those made by Dauvillier with a crystal. The latter, if calculated directly from the Bragg formula, are always too high, apparently because the index of refraction of the material used differs from unity by as much as 0·01 in this region. Their own results include new values for the *K* lines of nitrogen and boron, and for the *N* and *O* rays of several heavy elements, and have enabled them to find the energies of the *L* level for the lighter elements. The *N* rays examined consist of regular doublets. In a later note in *Comptes rendus*, it is reported that continuous spectra are also present in association with the characteristic soft X-rays, if heavier currents are passed through the generating tubes (NATURE, Mar. 3, p. 321).

A NEW SEPARATING FUNNEL.—In the *Chemiker Zeitung* for Jan. 25 is a description of a new form of separating funnel, consisting of a combination of two stoppered pear-shaped bulbs, between which is inserted a 3-way stop-cock. Each of the bulbs carries an elongated hollow stopper of special design. The new funnel, which offers considerable advantages over the older type, is in use in the technological laboratory of the Chemical Institute at Buda-Pesth.

MEASUREMENT OF THE CONCENTRATION OF DILUTE SOLUTIONS.—The accurate determination of concentrations of dilute solutions of organic compounds is a matter of considerable difficulty when the usual methods of analysis are employed. It is possible to utilise the interference refractometer for this purpose to obtain rapid and accurate measurements, and some of the difficulties encountered in the calibration of the Zeiss interferometer are discussed by R. Macy in the *Journal of the American Chemical Society* for December 1927. A greater degree of accuracy is attainable with solutions of aromatic than with solutions of aliphatic compounds, and the reading for two substances in the same solution is very nearly the sum of the separate readings for each.

ADSORPTION OF OXYGEN ON CHARCOAL.—Using four different types of charcoal, A. F. H. Ward and E. K. Rideal have investigated the adsorption and heat of adsorption of oxygen, the rate of autoxidation, the area of methylene blue adsorption, the ash content, the true and apparent bulk densities, and the particle size, and an account of their work is contained in the *Journal of the Chemical Society* for December 1927. In the case of a charcoal with a large ash content, the initial heat of adsorption for oxygen was very high and the carbon surface appeared to be unstable. For the other charcoals, the areas of the active portions were found to be proportional to the rates of autoxidation and were of the same order as when determined from the poisoning of autoxidation by amyl alcohol. The results obtained do not support the supposition of Keyes and Marshall that the high initial heat of adsorption corresponds to the establishment of a unimolecular layer and that the lower subsequent heats are due to the building up of thicker oxygen films.

THE REACTIONS BETWEEN OXYGEN AND COAL.—An investigation of the spontaneous combustion of coal is being carried out by the Safety in Mines Research Board, and some of the results obtained are described by Messrs. W. Francis and R. V. Wheeler in the *Journal of the Chemical Society* for December 1927. The amounts of oxygen fixed by the vitrain portion of newly won coal and by vitrain from the same seam after prolonged atmospheric oxidation at 150° C. were measured at various temperatures, and the quantities of the products of the reaction determined. The oxidation of coal appears to take place by the formation of unstable oxygenated groupings, which are carboxylic in character and ultimately cause the ulmin portion to become soluble in alkalis. The reaction seems to depend upon the presence of an adsorbed layer of oxygen, which is continually renewed so long as oxygen enters into combination. The oxygenated groupings are decomposed into water and oxides of carbon and the coal 'revivified' by heating in a vacuum.

Medical Research.

THE thirteenth annual report of the Medical Research Council[1] gives, as usual, a summary of research work covering a very wide field; some of the more important aspects of this work only will be referred to here. At the end of the year under review Sir Frederick W. Andrewes and Sir Cuthbert S. Wallace retired from the Council, their places being taken by Sir Hugh K. Anderson and Prof. T. R. Elliott. The work of the Council has suffered by the deaths of Dr. John Brownlee, Director of the Statistical Department, of Dr. T. S. P. Strangeways, well known for his work on the artificial culture of cells and tissues, and of Prof. E. H. Starling, who was chairman of the committee on the physiology of muscular work, under the Industrial Fatigue Research Board. As in previous years, reference is made to the effective augmentation of the resources of the Council by the facilities provided by the universities and other centres of research throughout Great Britain to research workers who are advancing knowledge under grants provided by the Council. Payments towards the cost of particular investigations have also been made by the Miners' Welfare Fund, the Dental Board of the United Kingdom, the Empire Marketing Board, the Distemper Research Council of the *Field* newspaper, the British Empire Cancer Campaign, the trustees of the late Sir William Dunn, and by an anonymous donor for a microscope designed by Mr. J. E. Barnard.

During the year the Council has worked in close co-operation with many Government departments, with the Development Commission, the Department of Scientific and Industrial Research, and the newly constituted Colonial Medical Research Committee. The Report points out that it should now be recognised that medical science is one and indivisible, and that laboratory investigations into tropical diseases may be more usefully carried out in a temperate climate, whilst observations on measles or tuberculosis may be more fruitful of results when made in the tropics. It is hoped that eventually an 'Imperial Research Service' may be built up by which problems of nutrition or disease may be readily investigated wherever it is convenient and the results applied wherever they are required.

Biological Standards.

During the year the Therapeutic Substances Act 1925 came into operation, and standard preparations are now required for the assay of diphtheria and tetanus antitoxins, antidysentery serum (Shiga), old tuberculin, insulin, pituitary (posterior lobe) extract, arsenobenzene, novarsenobenzene, and sulpharsenobenzene. Standard solutions of the antitoxins and of the serum are distributed at regular intervals to all licensees for the manufacture of these substances under the Act; standard preparations of insulin and of pituitary posterior lobe have similarly been distributed. The standards of the arsenical derivatives are held at the National Institute for Medical Research, where also the routine testing of all batches of these drugs is carried out. The standards agree with those accepted or recommended by the health organisation of the League of Nations in all cases in which an international standard has been adopted. At the present time an international investigation is proceeding into the potency of scarlatina streptococcal toxin and antitoxin, with a view to the eventual creation of a standard and the definition of acceptable units. The demand for standard agglutinable cultures and sera, prepared at the Standards Laboratory at Oxford under the direction of Prof. G. Dreyer, has continued to increase; the Council has decided that the whole cost of the laboratory cannot be met from its funds, and during the year the system of making charges for such standard preparations was adopted, without greatly affecting the demand for them.

[1] Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1926–27. (Cmd. 3013.) Pp. 152. (London: H.M. Stationery Office, 1928.) 3*s*. net.

Basic Constituents of the Tissues.

In recent years it has became clear that a number of different bases can be extracted from normal tissues. Some have been known for a long time, but only recently has any evidence been obtained as to their possible functions; others have only recently been isolated, and their physiological properties have still to be investigated. In last year's report the successful synthesis of spermine

$$(NH_2 \cdot (CH_2)_3 \cdot NH \cdot (CH_2)_4 \cdot NH \cdot (CH_2)_3 \cdot NH_2)$$

by Dudley and Rosenheim was referred to; from the current report it is seen that the same authors, working with W. W. Starling, have isolated, identified, and synthesised a new base, spermidine

$$(NH_2 \cdot (CH_2)_3 \cdot NH \cdot (CH_2)_4 \cdot NH_2),$$

which is present in the tissues together with spermine. Although the latter was first discovered in sperm, it appears to be a constituent of most tissues and not to bear any particular relationship to the reproductive processes; it is, in fact, absent from bull's semen, eggs, and milk.

The most abundant and the longest known of the nitrogenous extractives of muscle is creatine, but until the past year we held no clue as to its function. It has now been shown by P. Eggleton to exist during life in the form of an unstable compound with phosphoric acid in equimolecular proportions which is broken down in contraction and resynthesised during subsequent rest in the presence of oxygen; it can be isolated from rabbit muscle in the form of a barium salt. Hence the creatine complex plays a part in the chemical processes accompanying contraction, as well as the glycogen and lactic acid; it is connected apparently with the velocity of contraction. The next most abundant base in muscle is the peptide carnosine; Dudley and Thorpe have prepared a large quantity of it, and are at present investigating its properties and reactions. This work was undertaken following an examination of muscle for the base histamine, after Best, Dale, Dudley and Thorpe had extracted it from both liver and lung; it was found that muscle also contained it. Histamine, together with choline, appears to be responsible for the depressor effect of all tissue extracts (except those from the suprarenal and pituitary glands, which are pressor), upon the blood pressure; its effect in this respect is due to its dilating the capillaries; at the same time it stimulates most smooth muscular tissues and thus produces also constriction of the arteries, but the former effect is the more important, since it is produced by much smaller doses.

Particular importance has been lent to this identification of histamine in many tissues by the work of Sir Thomas Lewis and his collaborators on the reactions of the blood-vessels of the skin in man to injury. These investigators have brought forward much evidence to show that almost all forms of injury or irritation act in a similar way by causing the liberation of a chemical substance allied to histamine (or quite probably histamine itself), to which the reddening and swelling of the skin are due. After the application of various stimuli or of histamine, these cutaneous blood-vessels contract imperfectly or not at all to adrenalin or pituitary extract, and also become

refractory to histamine itself. It is possible that the collections of small dilated blood-vessels which appear on the face as age advances or following much exposure to the weather, are also caused by over-stimulation of the skin, since they are refractory to the stimulus of these different hormones. If these conclusions can be extended from the skin blood-vessels to those of the deeper tissues, they should influence considerably our conception of the reactions of different organs to injury or to nervous stimulation.

THERAPEUTICS.

The year 1927 saw the centenary of the publication by Richard Bright of his observations on kidney disease. A. A. Osman, applying modern methods of biochemistry to the study of Bright's disease, has found that administration of alkalis is of great benefit in treatment and in prophylaxis, and has been able, further, by means of simple tests, to demonstrate the type of case likely to suffer from nephritis as a complication of other diseases, especially scarlet fever. Thus the incidence of nephritis and albuminuria in 316 untreated cases of scarlet fever was 5·5 per cent., but in 620 cases treated by alkalis it was only 0·6 per cent. Again, alkalis can effectively prevent the onset of anuria under conditions in which this symptom may occur, and also the appearance of nephritis in metallic poisoning, or in poisoning with general anæsthetics or after exposure to infection. The after-effects of nephritis have also been studied in a group of more than 10,000 patients who suffered from this disease during the War. In many of them the original kidney lesion has cleared up, leaving behind, however, as sequelæ, cardio-vascular impairments with high blood pressure. This study may throw light on the origin of certain cases of high blood pressure for which at present no definite cause can be found.

During the year a report by J. G. Forbes has been published dealing with the prevention of diphtheria; susceptible individuals can be detected by the Schick test and protected against the disease by toxoid-antitoxin immunisation. An important step forward in the control of this disease appears to have been taken.

King and his colleagues have continued their syntheses of substances likely to have a chemo-therapeutic action; about 50 colourless compounds, closely related to complex dyes, have been examined for trypanocidal activity by Miss Durban and Miss Marchal, and a relationship has been found between the appearance and intensification of curative action on one hand and of affinity for cotton fibres on the other. King and Balaban have also examined some gold and mercury derivatives of the thioglyoxalines. One of the gold compounds, containing 58 per cent. of the metal in soluble combination, appears to have some curative action in experimental tuberculosis (Douglas). In human patients suffering from tuberculosis, another gold compound, sanocrysin, exerts, in selected cases, a favourable influence; in animals it appears to be effective only in those having enough resistance to enable them to exploit the temporary advantage, whatever it may be, given by the drug.

Cohen and Browning have examined the trypanocidal properties of aminostyrylquinoline and aminoanilquinoline compounds. In connexion with this work it has been shown that substances which are retained in the body and exert their therapeutic action slowly, are effective by killing only a few of the parasites, products from which stimulate the tissues to produce antibodies which destroy the remainder. Further, if a subtherapeutic dose of a chemotherapeutic substance such as crystal violet be given a short time before a curative dose of an arsenical compound, etc., the injection of the latter may be ineffective; this observation has an obvious and important bearing on practical therapeutics.

Colebrook and Hare have found that by proper spacing of the doses of organic arsenical compounds it is possible to produce and maintain a bactericidal potency of the blood against streptococcal infections. These authors have also made the interesting observation that the white blood corpuscles of patients suffering from severe streptococcal infections are much more sensitive to the toxic action of arsenical compounds than those from healthy individuals.

PATHOLOGY.

In investigations into tuberculosis, A. S. Griffith has shown that the bovine bacillus is the chief cause of the disease in domestic mammals; it was, in fact, the only type found in the horse, cat, and goat. In sheep, and especially in swine, the avian type of the bacillus is also found. The human type occurs in the dog, and also in wild animals kept in captivity. In man a high proportion of tuberculosis is directly due to the bovine bacillus, conveyed chiefly through the medium of infected milk, emphasising the importance of the elimination of this disease from dairy cattle.

Hill and Brad have continued their investigations into the effects of diet upon reproductive power and liability to cancer in mice. The natural span of life appears to be about three years. Five diets have been used: grain and green food; cooked meat, vegetables, pudding, tinned fruit, and salt; white bread, margarine cakes, biscuits and a little milk; a low protein diet and the same diet with one-third browned by frying. Breeding is good except on the third (or white bread) diet. Cancer occurs fairly frequently in the older mice; in the females its incidence may reach 50 per cent.; the commonest sites are the mammary gland and the lung. The important point, however, is that mice on all diets are about equally affected; no evidence has been found that the first diet protects against this disease or that the others predispose to it.

Work on the filter-passing viruses has been continued during the year, without, however, leading to any striking advance; the chief difficulty at the moment is to discover some method by which they can be grown in artificial culture. As regards canine distemper, it is now possible to immunise dogs successfully, but the methods at present in use can only be employed successfully in a specialised laboratory.

APPLIED PHYSIOLOGY.

J. A. Campbell has now completed his experiments on acclimatisation to low oxygen pressures. He found that this is due to the tissues, especially the heart muscle, becoming tolerant of the low oxygen pressure. Estimation of the tissue oxygen and carbon dioxide tensions, by injecting nitrogen into the tissues and then withdrawing samples for analysis, showed that the local oxygen tension remained low after acclimatisation. In the same way, exposure to increased oxygen pressures led to a marked rise in the oxygen tension in the tissues. It appears, then, that the tissue oxygen tensions depend directly upon that of the inspired air.

In conclusion, reference may be made to the work carried on by H. M. Vernon and his collaborators on industrial fatigue. A great variety of subjects has been investigated, including hours of work, accident causation, machine design, ventilation and heating, rest pauses and illumination. Practical application of the results obtained should lead to the greater comfort and efficiency of the industrial worker.

Association of Technical Institutions.

IN the unavoidable absence of the president for 1928 (Sir Alfred Mond), Lord Riddell gave an address at the opening session of the annual general meeting of the Association of Technical Institutions, held at Stationers' Hall, London, on Feb. 24 and 25. Since he had been president of the Association during 1927, Lord Riddell was able to give some of the impressions of technical education he had gathered from his examination of its problems. He commented on the great work and scholarship of the staffs of the institutions: he noted the widespread recognition which is now being accorded to the liberal quality of technical education: he stressed the necessity of developing day classes. At present, he said, there are about 850,000 pupils in technical institutions; of these 750,000 attend evening classes. Yet when one considers the numbers of young persons in England and Wales between the ages of fourteen and twenty-five, it is obvious that 100,000 day pupils does not represent the maximum of day work which ought to be possible. Finally, Lord Riddell presented a vigorous defence of modern young people against what are practically perennial charges of slackness and deterioration. This defence, Lord Riddell said, was necessary and opportune, since Sir John Reith, of the British Broadcasting Corporation, had recently implied such charges. He had, however, asked Sir John to come and address the meeting.

Sir John Reith's short address was not only devoted to the points referred to by Lord Riddell. As an engineer, he criticised the present training of engineers, and made a plea that greater cultural qualities should be given in that training. It would appear, however, that Sir John's views concerning the cultural qualities he urges are not a little confused. To illustrate the engineer's lack of them he related a story. With a friend he ascended a steep road. When they reached the top a marvellous panorama of the countryside was unfolded to their view. Deeply moved by its beauty, Sir John turned to note the effect of it all upon his companion. The latter, however, appeared to ignore it. "Listen to that traction engine coming up the road," he said; "it is knocking abominably!" It may have been a disappointing remark, but it was not evidence that appreciation of beauty was lacking. There are obscenities of sound as well as of sight: John Masefield's "dirty British coaster with a salt-caked smoke-stack, butting through the Channel in the mad March days" may be different from the "stately Spanish galleon dipping through the tropics," but it possesses its own qualities of beauty.

Col. Ivor Curtis's paper on education in the Royal Air Force was the very interesting story of an educational experiment: an experiment which had to be made for a branch of the Service which was without tradition. A central problem was to overcome the scepticism of the Service and to make it a working partner. The experiment has succeeded. The nature of the Royal Air Force makes it essential that all work should lead to the development of individual resource. In connexion with the actual scheme as it now exists (one-third of the Royal Air Force is obtained through the apprenticeship scheme and two-thirds from men recruited after the age of eighteen), the success of libraries at scattered centres has been particularly marked.

In view of the present tendency to investigate the qualifications and examinations of builders and architects, papers on the training of the architect and on technical education for the building trades by Messrs. T. P. Bennett and F. E. Drury respectively were greatly appreciated.

The report of the Council for the year contained an excellent record of work done in connexion with the University of London Bill, Matriculation (University of London), libraries in technical institutions, Architects' Registration Bill, the Emmott and Malcolm committees on education and industry, and examinations for part-time students.

The Indian Science Congress.

THE fifteenth session of the Indian Science Congress was held in Calcutta on Jan. 2, 1928. In the absence through illness of His Excellency the Viceroy, who had intended to preside at the inaugural meeting in the Senate House of the University on Jan. 2, the proceedings were opened by His Excellency Sir Stanley Jackson, the Governor of Bengal. This is the third time the Congress has been held in the second city of the Empire, the first occasion being in 1914, when the first meeting was held, the second in 1921. To commemorate the fact that Calcutta was the birthplace of the Congress, and to bring out the rapid growth of this movement, the original *Proceedings* of the 1914 meeting were reprinted and distributed to the members. In fourteen years the space taken in recording these proceedings has increased seventeen-fold.

It was fitting that Dr. J. L. Simonsen, one of the two originators of this movement and the man to whose self-sacrificing labours as honorary secretary the Science Congress owes its origin and steady growth, should have been elected president for this meeting. The difficulties in starting an organisation which required the co-operation of so many autonomous bodies, such as the universities, a number of research institutes, as well as the many independent Government departments which deal with applied science in a continent the size of India, were considerable. The task of steering an unofficial movement past the many difficulties which were encountered during the early years was still greater. For this piece of public service India owes a great debt to Dr. Simonsen. The Congress is now firmly established and fulfils a very useful function in providing an annual meeting ground for men of science in India and in breaking down the barriers imposed by distance, by race, and by that condition which, for want of a better word, may be described as departmentalism.

In his presidential address, Dr. Simonsen first gave a short history of the origin and progress of the Congress, and directed attention to the services rendered thereto by a number of distinguished men of science, among whom Sir Sidney Burrard and the late Sir Henry Hayden took a prominent place. The Asiatic Society of Bengal from the beginning also did much to foster the movement. Dr. Simonsen then dealt with the growth of the research spirit in the Indian universities, and passed on to the present academic standing of these bodies. While the former is in a satisfactory condition and shows definite signs of progress, the general academic standing of the universities of India is being steadily lowered. This latter manifestation was attributed partly to the fact that the control of these universities is now largely in the hands of laymen, and partly to the circumstance that a university degree in India is regarded as a stepping-stone to Government

employ. Two reforms were advocated to meet the situation—the control of the curriculum and of the examinations should be placed in the hands of the professional staff; admission to the various Government departments should be based on Civil Service examinations conducted by an impartial authority. The last portion of the presidential address dealt with the importance of the study of natural products (see NATURE, Feb. 11, p. 216).

Much useful work was accomplished in the various sectional meetings. Among the most successful was that of the Section of Mathematics and Physics, where as many as eighty-one papers were presented. In his address, Dr. J. de Graaf Hunter gave a sketch of the results of studies of the figure of the earth from the earliest times. A spheroid has been used latterly as a reference figure and the geoid has been exhibited in relation to it. By this means determinations of the spheroids which best fit the geoid in India and the United States have been made on the basis of isostasy and without. In the case of India, isostasy does not account for the geoidal anomalies, and large areas appear to have density anomalies larger than has recently been considered probable. The study of the geoid, combined with pendulum results, promises to yield further information about these crustal anomalies and may possess an industrial value.

The Section of Chemistry as usual attracted many members, and one hundred and forty-four papers were contributed. In his sectional address, Prof. S. S. Bhatnagar, of the University of Lahore, dealt with the progress of physico-chemical research in India and gave an interesting review of the past history and present position of this branch of science.

Another address which attracted a good deal of notice in the local press was that given by Dr. Michael P. West in the Section of Psychology. Two diametrically opposed types of educational psychology were contrasted, one emphasising the type, the other individual growth. Stress was laid on the need of a new type of institution which would give the child the means and opportunities for developing its own peculiar interests.

In the Section of Botany, Prof. M. O. Parthasarathy Iyengar gave an interesting review of various aspects of the study of algæ and emphasised the need for a handbook of Indian algæ as a means of stimulating research. This section, which was well attended and in which the discussions often reached a high level, reflected the great attention which has been given to botany in recent years by the Indian universities and the vastly improved teaching in this subject.

The other sections represented in the Congress were Agriculture, Anthropology, Zoology, and Geology. Owing to the recent session in Calcutta of the Far Eastern Association of Tropical Medicine, the Medical Section of the Indian Science Congress did not meet in 1928.

Three evening lectures, all of which were well attended, were given in the Senate House of the University: on radiations and their uses, by Prof. G. R. Paranjape; on applications of chemistry in modern warfare, by Prof. J. C. Ghosh; and on inheritance in plants and animals, by Prof. M. A. Sampathkumaran.

A very full programme of excursions was arranged by the local secretaries, and much hospitality was shown both by individuals and by public bodies. The University of Calcutta placed the Senate House and the other University buildings at the disposal of the Congress. Visits were arranged to the various research centres in Calcutta, such as the School of Tropical Medicine, the Bose Institute, and the Indian Museum.

University and Educational Intelligence.

BIRMINGHAM.—At the annual meeting of the Court of Governors, held on Founder's Day, it was announced that Mr. and the Hon. Mrs. Anstruther-Gough-Calthorpe had most generously made to the University a free gift of 40 acres of land adjoining the site of the University buildings at Edgbaston. It is hoped that this gift will allow of the provision of more playing fields in the near future and will give ample room for extension of the University for many years to come. It may be recalled that the site of the present buildings was also a gift of the Calthorpe family.

CAMBRIDGE.—Dr. N. J. T. M. Needham, Gonville and Caius College, has been appointed University demonstrator in biochemistry.

Sir J. J. Thomson gave the First Founder's Memorial Lecture at Girton College on Mar. 3 on the subject "Beyond the Electron."

LONDON.—Mr. Bernard Ashmole, who, since 1925 has been Director of the British School at Rome, has been appointed as from Aug. 1 to the Yates chair of archæology tenable at University College.

Prof. Robert Robinson has been appointed as from Aug. 1 to the University chair of organic chemistry tenable at University College. Prof. Robinson studied at the University of Manchester, where he obtained the D.Sc. degree in 1910. He has occupied professorial chairs at Sydney, Liverpool, St. Andrews, as well as at Manchester, and has had considerable experience in industrial chemistry with the British Dyestuffs Corporation. He is the author of numerous papers mainly on the constitution of the colouring matters, brazilin and hæmatoxylin, on the isoquinoline alkaloids, and on the alkaloids gnoscopine, harmine, and strychnine.

MANCHESTER.—Honorary degrees to be conferred on Founder's Day, May 23, include the following—LL.D.: Right Hon. Sir Alfred Mond, Bart.; D.Sc.: Prof. David Hilbert, professor of mathematics in the University of Göttingen, and Prof. C. T. R. Wilson, Jacksonian professor of natural philosophy, Cambridge. It is expected that Dr. Richard Willstätter, who was unable to be present last year, will receive the honorary degree of D.Sc. at the same ceremony.

NEWCASTLE-ON-TYNE.—At a meeting of Armstrong College Council held on Mar. 5, the resignation, as from Sept. 30, of Prof. J. J. Welch, professor of naval architecture since 1907, was accepted with regret.

The following new appointments were made as from Oct. 1: (1) Prof. T. H. Havelock, at present professor of applied mathematics in the College, to be professor of mathematics and director of the Department; (2) Dr. G. R. Goldsbrough, since 1919 lecturer in applied mathematics and reader in dynamical astronomy, to be professor of mathematics. Prof. Havelock, who is a graduate in science of the University of Durham and was for a time fellow of St. John's College, Cambridge, was appointed to the College as lecturer in applied mathematics in 1906, and promoted to the professorship in 1914. Since that date the Department of Mathematics (under Prof. Jessop) and the Department of Applied Mathematics (under Prof. Havelock) have been separate. Prof. Jessop having now reached the retiring age, the two departments will be combined and Prof. Havelock will take charge.

OXFORD.—Prof. David M. Watson, Jodrell professor of zoology and comparative anatomy in University College, London, has consented to deliver the Romanes Lecture for 1928 in Oxford on May 4 at 5 P.M. The subject chosen is "Palæontology and the Origin of Man."

Calendar of Customs and Festivals.

March 11.

ST. SOPHRONIUS.—Patriarch of Jerusalem at the time of its capture by Omar in A.D. 638. When the Mosque erected by Omar on the site of Solomon's temple fell in the night, the Jews told the Caliph that it would not stand until the True Cross was removed from Calvary, which the Caliph then ordered to be done. It is Sophronius who records that it was the custom at mid-Lent for the Cross to be taken out of its case to be reverenced.

March 12.

ST. PAUL OF LEON, A.D. 573; son of a Welsh prince who migrated to Brittany at the age of sixteen, where he remained for the rest of his life, travelling about the country and finally being invested with the see of Leon, much against his will, by King Childeric. In art he is represented either with a bell or with a cruse of water and a loaf of breaf, or driving a dragon into the sea to signify that he expelled the Druidical superstition out of Brittany. Popular legend incorporated in his life also credits him with the origin of megalithic monuments, for the avenue known by his name on an island in Morbihan is said to be composed of rude stones which grew from the pebbles with which his sister marked a path on the sands when the island was enlarged in answer to their prayers. The saint was the first to teach the people to domesticate wild bees and wild pigs. The bell, a familiar object in Christian antiquities of the Celtic period, is prominent in his legend. A bell was refused him by King Mark—in those days, it is said, seven bells were rung before each of the King's meals; but much later in life God sent him one "after many years of wishing and longing." The people called it by a special name because it was "green and oblong," obviously a bronze bell of a familiar type. In popular belief the bell is an effective protection against the spirits of evil and would be peculiarly appropriate to a missionary engaged in expelling Druidism with its magical practices from the country.

ST. GREGORY THE GREAT, elected pope on the death of Pelagius II. in 590; one of the greatest figures in the Church, and responsible for the mission to Britain under St. Augustine which established Christianity in England. Many miraculous relations have been associated with him, of which the best known is that the Host visibly changed into the appearance of Christ enduring His passion in response to his prayers in order to convince a woman who disbelieved that the bread was flesh. On another occasion when disbelief was expressed in the efficacy of a cloth with which the relics of a saint had been wiped, as was then usual to save the relics from harm by touching, the cloth was cut at his behest, and blood poured from it as from the living body of the saint.

The processions at Rome on the festival of St. Mark, known as the 'Greater Litanies' or the 'Black Crosses,' were instituted by St. Gregory at a time of plague to avert the wrath of God from the city.

March 13.

ST. MOCHOEMOG, ABBOT OF LIATHMOR.—Of this Irish saint who lived in the middle of the seventh century, many marvellous happenings are related, but not least remarkable are the circumstances of his birth. His father, Beoan, married a beautiful damsel named Nessa of the race Nan-desi. In recompense for building, for his wife's sister, St. Ytha, a beautiful convent, he was promised a son; but before the promise could be fulfilled he was killed and decapitated in battle. His wife found his head and took it to her sister, reproaching her for the non-fulfilment of the promise. Nessa, following the instructions of St. Ytha, joined the head to the body and restored her husband to life. A son was born who was brought up by St. Ytha in the service of God, and later became the saint. The resemblance of the story of Beoan to incidents in Irish pagan legend needs no emphasis.

March 16.

ST. FINIAN LOBHAR, OR THE LEPER; a descendant of Alild, king of Munster. A remarkable legend relates that St. Ruadanus had a miraculous tree in his cell which dropped a liquor into a bowl from nine o'clock to sunset that sufficed to dine him and his brotherhood every day. St. Finian visited him to persuade him to live like other people, and marked the tree with a cross so that the liquor ceased to flow. Ruadanus, on discovering what had happened, bade his servant fill a vessel with common water from a fountain. This he did, and it was at once changed into the marvellous liquor which had filled the bowl. Finally, St. Finian, after turning some of the liquor sent to him back into water, persuaded St. Ruadanus to live like other people and not to work any more miracles.

The emphasis in this story on the difference in mode of life suggests that it records not so much an encounter between two monks as a contest between a Christian missionary and a pagan magician, or even one of the fairy folk, *ruadh*, red, being one of the epithets most frequently associated with fairies.

March 17.

ST. PATRICK, born about 387.—His place of birth is uncertain, variously said to be Kilpatrick, Cornwall, Pembrokeshire, or Boulogne. At the age of sixteen he was carried off from Boulogne to Antrim by Niall of the Nine Hostages, returning home and entering the church six years later. He came back to Christianise Ireland in 432 and died in 465. Popular lives of the saint attribute to him the performance of many marvels. It is well known that he drove all snakes, toads, and noxious beasts out of Ireland; less familiar, that no spider will come near King's College, Cambridge, because it is built of Irish wood. It is not surprising to find him associated with the Celtic cross. He placed a cross at the head of every Christian buried outside a burial ground. There may also be a vague recollection of sun worship in the story of the fingers of St. Patrick affording a bright light when a horse was lost in the dark, and when at his death there was no night for twelve days. Tradition says that it was at a sun festival coinciding with Easter, after a solemn vigil when no fire had been lit for days, that St. Patrick preaching to the pagans made that symbolic use of the shamrock through which it became the national emblem worn on the saint's day at a time of universal rejoicing. But just as the saint's day may preserve the memory of the sun festival, the shamrock may possibly represent the traditional Celtic feeling for the group of three which is seen in the old Welsh triads, where the occurrence of groups of famous threes of a kind is celebrated endlessly.

Societies and Academies.

LONDON.

Royal Society, Mar. 1.—**A. E. H. Tutton**: (1) The hexahydrated double sulphates containing thallium. Thallium salts corresponding to the potassium, rubidium, cæsium, and ammonium salts of the isomorphous series $R_2M\left(\begin{matrix}S\\Se\end{matrix}O_4\right)_2 . 6H_2O$ have been prepared. Four of them are double sulphates containing thallium as the R-metal, and magnesium, ferrous iron, manganese, or copper as the M-metals; six are double selenates. (2) The hexahydrated double selenates containing thallium. The six salts are those in which R is thallium and the M-metal is magnesium, nickel, cobalt, ferrous iron, manganese, or copper. The results of the whole investigation (both papers) agree in showing that, as previously proved, potassium, rubidium, and cæsium salts of the great series invariably show crystal forms and properties which vary regularly with the atomic number of the alkali metal. The ammonium members, while showing no relation to atomic numbers or weights, resemble the corresponding rubidium salts containing the same M-metal so closely as to be practically iso-structural. Thallium salts invariably occupy a position well within the limits (as regards angles and constants) of potassium and cæsium salts. Thallium salts, however, have one strikingly outstanding property, that of very high optical refraction, occasionally exceeding even that of monobromonaphthalene and yet more so that of carbon disulphide.

W. H. J. Childs: The distribution of intensity in the band spectrum of helium: the band λ4650. Measurements of the intensity distribution in the helium band λ4650 (first of the main series) show that the predicted distribution is of the correct type, but agreement with observation is by no means complete. Notably the P and R' branches are much stronger, relative to the Q branch, than theory indicates. An expression of the form $ie^{-E/kT}$ where i is a linear function of j', is adequate to describe the observed distribution. As with many other bands, the temperature obtained by assuming that distribution of angular momentum is governed by the Boltzmann factor is much higher than the true temperature of the gas. In this case effective temperatures of approximately 750 A. and 1000 A. are found, depending on conditions of excitation. A higher temperature is obtained from the Q branch than from the P and R branches. Examination of Doppler width of band lines shows, however, that there is a distribution of translational velocities corresponding to true temperature.

M. C. Johnson: Studies in the behaviour of hydrogen and mercury at the electrode surfaces of spectrum tubes. The proportion of a hydrogen positive ray spectrum which is due to the neutralisation of protons is decreased by a temporary admission of mercury vapour. The accompanying domination of the spectrum by mercury can be delayed and weakened by the substitution of nickel for aluminium as the cathode material. The resistance at electrodes of different sensitivities to mercury contamination is not altered by that contamination if the tube is filled with hydrogen, but is sensitive to a change from hydrogen to air. Mercury is only liberated from a contaminated cathode during discharge. A solid mercury cathode can be made to disintegrate under bombardment in a manner different from its thermal evaporation, but the excessive disintegration product of the contaminated aluminium is from aluminium. The hypothesis is put forward that the increased cathode disintegration is the secondary effect of the removal of a surface layer of oxygen, allowing disintegration afterwards by ordinary proton bombardment, and allowing escape of hydrogen from the aluminium structure. The spectrum changes are then consequences of the mass and critical potentials of mercury.

W. E. Curtis: The structure of the band spectrum of helium. Details are given of three new helium bands which have the final electronic level $2P$ in common. Two of them are due to the vibrational transition $1 \longrightarrow 1$, the initial electronic levels being $3S$ and $4S$. The other has an initial electronic level of effective quantum number 2·96, but its term type is uncertain. The rotation terms have been accurately evaluated for the three new bands and for three others previously described which also have the final level $2P$. The new evidence presented favours the view that the helium and hydrogen molecules are structurally similar.

H. A. Wilson: The Saha theory and the conductivity of flames containing alkali metal vapours. Noyes and Wilson have shown that the equilibrium constants for the reaction $M = M^+ + e$ (where M denotes atom of alkali metal and e electron) can be deduced from measurements of the electrical conductivity of flames at about 2000° K, and that equilibrium constants so obtained agree approximately with those calculated by the Saha theory. This assumes that all salt sprayed into the flame is reduced to metal vapour and that all negative carriers are free electrons. It is now shown that these assumptions may be omitted without affecting the equation. Bennett's results on the conductivity of rubidium in flames give a value of the equilibrium constant nearly equal to that given by Saha's theory; Gouy's results on light emitted by sodium flames require the fraction of sodium reduced to metallic state to be independent of the concentration of sodium, and hence the fraction of ions which are electrons must be independent of concentration.

R. G. Lunnon: Fluid resistance to moving spheres. By timing the falls of metal spheres in water, through distances up to two metres, the resistance of a fluid at high speeds has been measured both for accelerated and for uniform motion. During accelerated motion, the resistance is increased in a regular way, which can be described approximately in terms of a carried mass, varying from one-half to twice the mass of the displaced fluid.

N. F. Mott: The solution of the wave equation for the scattering of particles by a Coulombian centre of force. The solution splits up into incident wave, representing on-coming electrons, and scattered wave; the quantum theory result agrees exactly with that of classical theory. The analysis is applicable to α- and to β-particles.

G. H. Briggs: A redetermination of the velocities of particles from radium-C, thorium-C and -C′. A redetermination by the magnetic deflexion method of $H\rho$ for α-particles from radium-C gives $3{\cdot}993 \times 10^5$ E.M. units. Using the theoretical value of e/m deduced from electrochemical data, the velocity is $1{\cdot}923 \times 10^9$ cm. per sec. The corresponding values found by Rutherford and Robinson were $3{\cdot}983 \times 10^5$ and $1{\cdot}922 \times 10^9$. Velocities for thorium-C and -C′ were found to be $1{\cdot}704 \times 10^9$ and $2{\cdot}053 \times 10^9$.

Physical Society, Feb. 10.—**Allan Ferguson** and **Eric J. Irons**: A simple graphic method for the determination of galvanometer and fluxmeter constants, with a note on the measurement of intense magnetic fields. The paper deals with methods for evaluating the principal construction constants of moving coil instruments by the graphical treatment of observations of logarithmic decrement and its variation with circuit resistance.—**J. C. Hudson**: The application of electrical resistance measurements to

the study of the atmospheric corrosion of metals. The procedure is suited for quantitative field tests on the atmospheric corrosion of metals, and is based on the determination of the change produced on exposure in the electrical resistance of wire specimens. The method is capable of great accuracy. In the case of copper, the percentage resistance change due to corrosion is inversely proportional to the diameter of the wire; it is thus possible to use the method as an 'acceleration test' by conducting experiments on relatively thin wires, which are appreciably affected by corrosion within a few weeks.—C. J. Smith: On a method of constructing the caustic curve formed by refraction at a plane surface. The method depends on the properties of an ellipse which cuts the rays orthogonally.

Royal Meteorological Society, Feb. 15.—L. F. Richardson and R. E. Munday. Memoir No. 2 (published 1926): The single-layer problem in the atmosphere and the height-integral of pressure. Atmospheric tides are supposed to be such that a single vector suffices to specify the momentum of a whole column of air. Are ordinary weather disturbances of the same sort, or must each column be regarded as two or more layers moving independently? The answer to this question is extracted from the international collection of the records of registering balloons. It is found that Laplace's equations for *free* tidal oscillations are a very bad description of ordinary disturbances of the European atmosphere; in other words, the 'dynamic height' of the atmosphere is extremely variable.—L. F. Richardson, D. Proctor, and R. C. Smith. Memoir No. 4 (published 1926): The variance of upper wind and the accumulation of mass. Using the pilot-balloon observations made during the War, Durward's study of the variation of wind between two places at the same time is continued, by working up specially simultaneous observations at short distances (11 to 28·5 km.), and, surprisingly, the variation is found to be greater. Paired times at the same place are also investigated. The mathematical study of smooth functions accustoms us to the idea that accuracy is to be obtained by proceeding to the limit of smallness; but the wind seems not to possess the required kind of smoothness.—J. Glasspoole: The distribution over the British Isles of the average number of days with rain during each month of the year. While the east is the dry side of Great Britain and of Ireland, in the case of the number of days with rain the increase is more pronounced from the south-east to north-west of the British Isles. Actually, the average number varies from 150 along the Thames Estuary to 270 in the Outer Hebrides. There are only 10 days with rain on the average along the Thames Estuary in June, July, and September, and 26 in December in the north-west of Scotland and in the mountains of Kerry, Connemara, and Donegal. June is the month of fewest days with rain over the British Isles generally, namely 14, while December has most with 20. May also has less days with rain than either July or August, so that the popular call for early holidays is well supported by rainfall statistics. The amount of rain per rain-day is greater during the last six months of the year than the first six months, so that on the average May and June are again more favourable for holiday makers than July and August.

CAMBRIDGE.

Philosophical Society, Jan. 16.—N. Feather and R. R. Nimmo: The ionisation curve of an average α-particle. Systematic photometry of the track images from a cloud expansion chamber made possible the calculation of the variation of the light scattering power of an α-particle track over the last two centimetres of its length in standard air, and the variation of this quantity was finally identified with the variation of ionisation along the track. In air, helium, and hydrogen, the maximum ionising efficiency of the α-particle occurs when it possesses the velocity appropriate to the distances 3·0, 2·55, and 2·25 mm., respectively, from the end of its path in standard air.—F. L. Arnot: The interference of light in a wedge. When white light from a very narrow slit is reflected from a thin wedge, and then analysed in a spectroscope, interference bands are seen in the spectrum provided the edge of the wedge is parallel to the slit-source and to the slit of the spectroscope. Under certain conditions, the bands become clearer and more sharply defined as the width of the source is increased. These conditions are (1) that the light is incident on the wedge from the direction of its thick edge, and (2) that the distance between the wedge and the spectroscope has a certain value depending upon the angle of incidence of the light on the wedge.

PARIS.

Academy of Sciences, Jan. 30.—The president announced the death of Félix Henneguy.—E. Goursat: The rôle of the double characteristics in the problem of the deformation of surfaces.—Hadamard: The ergodic principle.—A. Rateau: The number of specific turns and the specific power of motor turbines.—C. Sauvageau: The Adelopyceæ of the Litosiphon.—René Maire and Louis Emberger: General view of our phytogeographical knowledge of Morocco: the regions, domains, and sectors.—A. Khintchire: The law of large numbers.—S. A. Janczewski: Homogeneous differential systems of the fourth order.—Rolf Nevanlinna: Complements to the theorems of unicity in the theory of meromorph functions.—Paul Dumanois: Concerning the theory of antidetonants. The hypothesis that antidetonants, such as lead tetraethyl, act by accelerating combustion is regarded as disproved by the experimental work of Moureu, Dufraisse, Chaux, Pigrot, Aubert and Villey, Egerton and Gates, Dumanois and Lafitte. The suggestion that antidetonants act by preventing the formation of peroxides (Moureu, Dufraisse, and Chaux) during compression is more in accord with the known facts.—Pierre Dive: The rotation round an axis of a heterogeneous fluid mass with ellipsoidal stratification.—Émile Belot: The origin of satellites with inverse revolution and the velocity of the primitive nebula.—Nicolas Kryloff: The variational algorithm and the fundamental problem of mathematical physics.—J. Nageotte: The study of myeline vesicles with the ultra-microscope.—C. and H. Gutton: The high frequency electrical discharge. The potential at which discharge (in hydrogen) takes place is measured as a function of the pressure, at wave-lengths of 3 to 5620 metres.—J. Aicardi: A new method of alinement by Hertzian waves. A description of a method of radio signalling by the use of which a ship or an aeroplane can follow a definite route during fog.—Jean Thibaud: Absorption discontinuities in the intermediate domain (*K* bands of carbon, nitrogen, and oxygen).—G. Balasse: Study of the continuous emission spectrum produced by the electrodeless discharge. The theory suggested in a previous communication leads to the conclusion that a continuous emission spectrum must be produced for all elements. This has already been proved experimentally for the elements cadmium, potassium, lead, calcium, mercury, and phosphorus, bismuth, sulphur, and iodine have now been added. Since these nine elements are distributed in five different columns of the periodic table, it may be considered that the continuous emission spectra produced by the electrodeless discharge is a general phenomenon extending to all elements.—A. Couder: The con-

struction and trial of a telescope mirror of a particular form in Pyrex glass. The mirror is made in the form of a cylindrical tube closed at one end. The surface of the end is worked into a parabolic mirror of 136 cm. focus. The deformations produced by flexure are discussed: owing to the low coefficient of expansion of Pyrex glass, the thermal deformations have proved to be negligible.—**Y. Rocard** and **Ph. de Rothschild**: The absence of enlargement of spectral lines after reflection. It is concluded from the results of the experiments described that the enlargement of the lines by reflection on a mirror, the atoms of which possess thermal agitation, and might be expected to result in a considerable lowering of the order of limiting interference, does not exist.—**Néda Marinesco**: The molecular weight and association of chlorophyll in solution. The molecular weight determinations are based on the diffusion coefficient and the viscosity (Einstein equation). For sufficiently dilute solutions (less than 0·053 gram per litre) the molecular weight of chlorophyll is about 800, corresponding to the 817 for one atom of magnesium: for higher concentration there is evidence of the presence of associated molecules.—**G. Denigès**: The direct micro-estimation of the phosphoric ion by ceruleomolybdimetry in liquids from the animal organism, natural waters, fermented drinks, etc.—**Paul Dop** and **F. Duffas**: The water-bearing calyx of Clerodendron.—**S. S. Kharbush** and **Mlle. Panca Eftimiu**: The phenomena of chromatic reduction in the family of the Erysiphaceæ.—**Maurice Fontaine**: The reactions, at high pressures, of the pneumogastric of the frog immersed in a hypotonic solution.—**C. Motas**: A new Hydracarus collected at the Grand Lautien (Var).—**Y. Manonélian** and **J. Viala**: Nerve cells and the virulence of the suprarenal capsules.—**E. Rouboud**: The unfitness of *Plasmodium præcox* for development during the winter in *Anopheles maculipennis*, and its epidemiological consequences for northern Europe.

GENEVA.

Society of Physics and Natural History, Dec. 15.—**Aimé Pictet** and **H. Vogel**: The synthesis of milk sugar. An equimolecular mixture of β-glucose and β-galactose heated to 175° C. in a vacuum gives lactose. The reaction takes place in two phases,

$$C_6H_{12}O_6 = C_6H_{10}O_5 + H_2O$$

and $C_6H_{10}O_5 + C_6H_{12}O_6 = C_{12}H_{22}O_{11}$ (lactose).

—**E. Briner** and **A. Morf**: Some new addition compounds of phenols with ammonia. Ammonia in the presence of β-naphthol, α-naphthol, α-oxyanthraquinone, salicylic acid, pyrocatechol, resorcinol, hydroquinone, or pyrogallol has given in each case one or two addition compounds corresponding to fixed conditions of temperature and pressure.—**E. Briner** and **G. Lunge**: The reactions between nitrogen peroxide and sulphur dioxide. These two substances in the liquid state give the compound $S_2O_9N_2$, containing six normal acid functions. It may be regarded as an anhydride of nitrosylsulphuric acid.—**R. Wavre**: The field of gravity in the interior of the planets.—**Raoul Pictet**: Integral transformation into motive power of the heat furnished to a gas. According to the author, who does not accept the second law of thermodynamics, it should be possible to convert the whole of the heat furnished to a gas into work.

ROME.

Royal National Academy of the Lincei, Nov. 20.—**G. Scorza**: Fundamental sub-groups of a group.—**L. Tonelli**: An observation on derivation by series.—**U. Cisotti**: The solenoidal character of Ricci's tensor for ternary forms.—**S. Franchi**: Tectonic enigmas in the mountains of Valdieri and along the valleys of Gesso, Stura, and Vermenagna.—**S. Baglioni** and **L. Settimj**: The nutritive value of the nitrogenous substances of certain types of preserved foods. Experimental investigations on albino rats. The nitrogenous matter contained in the dilute acid extract of cheese, dried stockfish, and dried edible fungi, and that contained in the part of cheese, stockfish, casein, and commercial hydrolysed casein which is insoluble in dilute acid, is capable not only of maintaining in equilibrium the nitrogen balance of albino rats, but also of allowing an accumulation of nitrogen and an increase in body-weight. The highest percentage increase in body-weight is obtained by means of a mixed diet composed of hydrolysed casein, the insoluble part of stockfish, and the soluble part of the fungi. The nitrogenous matter of that portion of the fungi which is insoluble in water is incapable of maintaining in equilibrium either the nitrogen balance or the weight of albino rats.—**D. Graffi**: Functions of vectorial variety.—**Cristina Eula** and **Odoardo Franceschi**: Projective study of surfaces.—**R. Cacciopolli**: A class of surfaces admitting of quadrature.—**U. Crudeli**: A category of stationary motions of (heavy) viscous liquids between two vertical cylindrical (round) tubes.—**A. Masotti**: The contact between lines of flux and lines of current in the motions of fluids.—**A. Rosenblatt**: Energy flux in the exceptional case of Kutta-Joukowski's theorem.—**B. Caldonazzo**: Viterbi motions and the triple orthogonal systems of surfaces determined by them.—**L. Fernandes**: The resolution of an absorption band regarded as common to praseodymium and neodymium. At a temperature approximating to that of liquid air, the line of wave-length 469 A. of the absorption spectra of praseodymium and neodymium is resolved into thin, sharp lines, the intensities and wave-lengths of these differing considerably with the two metals.—**A. Ferrari** and **A. Baroni**: The crystalline structure of the double cæsium cadmium chloride $CsCdCl_3$: considerations on the monometric structure of the type $A[BX_3]$. This salt exhibits a monometric lattice, with an elementary cell with the side 5·20 A. The ion $CdCl_3^-$ has dimensions lower than those given by the sum of the dimensions of the component ions Cd^{++} and Cl^-; this property appears to be general for complex ions. The crystallographic analogy between cadmium and mercury is emphasised by the identity in structure between the salts $CsCdCl_3$ and $CsHgCl_3$.—**G. Natta** and **M. Freri**: X-ray analysis and crystalline structure of cadmium–silver alloys. For the α-phase of the system cadmium–silver, representing solid solutions of cadmium (up to 44 atomic per cent.) in silver, the length of the side of the elementary cell varies linearly with the composition, increasing from the value 4·07 A. for pure silver to 4·14 A. for the alloy containing 31 atomic per cent. of cadmium. For the β-phase, corresponding with the compound AgCd and with solid solutions of cadmium in this, the photograms are of quite different appearance, the few lines present being arranged easily according to a body centred cubic lattice of the cæsium chloride type, and the calculated intensities agreeing well with the experimental values. Petrenko and Fedorow observed that at 460° the compound AgCd undergoes a transformation, which they interpreted as a decomposition of the unstable β-alloy into the neighbouring α- and γ-phases. The results now obtained show, however, that this consists of a polymorphic transformation, since all the lines of the photograms conform well with a hexagonal or rhombohedral lattice with the axial ratio 1·62; the side of the cell is $a = 3·01$, and the elementary cell contains one molecule of AgCd, the calculated density being 9·57.—**G. Piccardi**: Relations between the ionisation potentials of the first and second order of homologous elements.—**R. Savelli**: Fruits of two varieties borne by the same plant.

Official Publications Received.

BRITISH.

Indian Physiologist. Edited by Prof. Nibaran Chandra Bhattacharyya No. 1, January. Pp. 52. (Calcutta: Chuckervertty, Chatterjee and Co. Ltd.) 8 annas.

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1927. (No. 2142.) Pp. v+59. (Ottawa: F. A. Acland.) 15 cents.

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 3, No. 25: The Anatomy of a Fœtal African Elephant, Elephas africanus (Loxodonta africana). Part 2: The Body Muscles. By Dr. Nellie B. Eales. Pp. 609-642+5 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6s.

Association of Technical Institutions. Agenda Paper and Report of Council (1927) for the Annual General Meeting to be held on Friday, February 24th, and Saturday, February 25th, 1928, at the Stationers' Hall, London, E.C.4. Pp. 64. Paper read at the Annual General Meeting, February 24th and 25th, 1928, on Education in the Royal Air Force. The Story of an Educational Experiment. By Col. Ivor Curtis. Pp. 27. Draft of Paper to be read at the Annual General Meeting, February 24th and 25th, 1928, on Technical Education for the Boot and Shoe Industry. By F. W. Roberts. Pp. 19. Draft of Paper to be read at the Annual General Meeting, February 24th and 25th, 1928, on Part-time Courses in Commerce in Small Schools. By Principal S. Carter. Pp. 16. Draft of Paper to be read at the Annual General Meeting, February 24th and 25th, 1928, on the Co-operation of Education with Industry and Commerce. Commercial Education. By Principal G. H. Austin. Pp. 16. Draft of Paper to be read at the Annual General Meeting, February 24th and 25th, 1928, on The Training of the Architect. By T. P. Bennett. Pp. 16. (London.)

University of Leeds. Twenty-third Report, 1926-27. Pp. 192. (Leeds.)

Ministry of Health. Seventh Report of the Advisory Committee on the Welfare of the Blind to the Minister of Health, 1926-27. Pp. 33. (London: H.M. Stationery Office.) 6d. net.

Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending June 30th, 1927. (New Series 16.) Edited by Prof. Alexander Meek. Pp. 57. (Cullercoats.) 5s.

Pharmaceutical Society of Great Britain: Pharmacological Laboratories. Second Annual Report, 1927. Pp. 23. (London.)

Government of the Gold Coast. Report on the Survey Department for the period April 1926-March 1927. Pp. 34+2 plates+4 maps. (Accra: Colonial Secretariat; London: The Crown Agents for the Colonies.) 2s.

Transactions of the Optical Society. Vol. 28, 1926-27, No. 5. Pp. 225-304+xii. 10s. Vol. 29, 1927-28, No. 1. Pp. 48. 10s. (London.)

Department of Agriculture, Ceylon. Bulletin No. 81: Notes on the Cultivation of Sisal, with special reference to Ceylon. By G. Harbord. Pp. 15+11 plates. 40 cents. Bulletin No. 82: Field Experimentation with Rubber (Hevea brasiliensis). By L. Lord and L. Abeyesundera. Pp. 21. 40 cents. (Peradeniya, Ceylon.)

FOREIGN.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 596-F: Laboratory Tests on Physical Properties of Waterbearing Materials. By Norah Dowell Stearns. (Contributions to the Hydrology of the United States, 1927.) Pp. iv+121-176+plates 11-13. Bulletin 795-F: The Gilbert District, Nevada. By Henry G. Ferguson. (Contributions to Economic Geology, 1927, Part 1.) Pp. ii+125-145. 5 cents. Professional Paper 141: Upper Triassic Marine Invertebrate Faunas of North America. By James Perrin Smith. Pp. iv+262+121 plates. 1.50 dollars. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Forty-eighth Annual Report of the Director of the Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1927. Pp. ii+77. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 72, Art. 7: Redescription of Types of American Muscoid Flies in the Collection of the Vienna Natural History Museum, with Incidental Notes. By J. M. Aldrich. (No. 2703.) Pp. 35. (Washington, D.C.: Government Printing Office.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 11, Part 1: Insects of Porto Rico and the Virgin Islands. Diptera or Two-winged Flies. By C. H. Curran. Pp. 118. (New York City.)

The Science Reports of the Tôhôku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 10, No. 4: On *Hipparion Richthofeni* Koken. By Hikoshichirô Matsumoto. Pp. 59-75+plates 29-32. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 28: An Electrical Indicator for High-speed Internal-Combustion Engines. By Jûichi Obata and Yahei Yosida. Pp. 397-408+plates 21-25. 0.50 yen. No. 29: On Preparation of Lead Tetraethyl. By Yoshio Tanaka and Tsutomu Kuwata. Pp. 409-420. 0.22 yen. No. 30: Theoretische Untersuchungen über die Querruderwirkung beim Tragflügel. Von C. Wieselsberger. Pp. 421-447. 0.55 yen. (Tôkyô: Kôseikai Publishing House.)

Proceedings of the American Academy of Arts and Sciences. Vol. 62, No. 7: The Viscosity of Mercury under Pressure. By P. W. Bridgman. Pp. 187-206. 50 cents. Vol. 62, No. 8: The Compressibility and Pressure Coefficient of Resistance of Ten Elements. By P. W. Bridgman. Pp. 207-226. 50 cents. (Boston, Mass.)

The Carnegie Foundation for the Advancement of Teaching. Twenty-second Annual Report of the President and of the Treasurer. Pp. vi+168. (New York City.)

University of California Publications in American Archaeology and Ethnology. Vol. 23, No. 5: Achomawi Geography. By Fred B. Kniffen. Pp. 297-332+plates 55-59+2 maps. 45 cents. Vol. 23, No. 6: Pitch Accent in Hupa. By Pliny Earle Goddard. Pp. 333-338. 25 cents. (Berkeley, Cal.: University of California Press.)

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Reprinted from Year Book No. 26 for the Year 1926-27.) Pp. 165-216. (Washington, D.C.: Smithsonian Institution.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Technical Bulletin No. 85: Studies in the Etiology of Roup and Allied Diseases of Fowls. By Edwin P. Johnson. Pp. 20. Circular Bulletin No. 107: The Mexican Bean Beetle. By R. H. Pettit. Pp. 8. (East Lansing, Mich.)

CATALOGUES.

Australasia: Books, Maps, Original Water Colour Drawings, Oil Paintings and Coloured Plates relating to Australia, Tasmania, New Zealand and the Islands of the Pacific Ocean. (Catalogue No. 505.) Pp. 92. (London: Francis Edwards, Ltd.)

Wild-Barfield Electro-Magnetic Furnaces for the Automatic Hardening of Steel. (Section A.) Pp. 20. (London: Automatic and Electric Furnaces, Ltd.)

Meteorological Instruments. (Catalogue No. 548.) Pp. 84. (London: C. F. Casella and Co., Ltd.)

Diary of Societies.

FRIDAY, MARCH 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—R. W. Gurney: Particles of High Velocity in the Chromosphere.—Dr. H. Jeffreys: Possible Tidal Effects on Accurate Time-keeping.—M. C. Johnson: Absorption by Nebulosity and the Temperature and Luminosity Sequences of Novæ.—Dr. H. Spencer Jones: The System of Procyon.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—Sir J. J. Thomson: Electrodeless Discharge through Gases (Guthrie Lecture).

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—W. R. Barclay: Special Alloys in relation to the Corrosion Problem.

SATURDAY, MARCH 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Transformation of Matter (I.).

MONDAY, MARCH 12.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—T. Hay: Some Topography of the English Lakes.

ROYAL SOCIETY OF MEDICINE (War Section), at 5.—Lieut.-Col. E. Cowell: The Pathology and Treatment of Traumatic Wound Shock.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. Schrödinger: Wave Mechanics (III.).

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—R. R. Dobson: Report of an Enquiry into the Attitude of Local Authorities towards Mental Tests.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.—G. L. Ensor: Notes on the Single Sleeve-Valve Principle.

INSTITUTION OF ELECTRICAL ENGINEERS (at Armstrong College, Newcastle-upon-Tyne), at 7.—T. N. Riley and T. R. Scott: Insulating Oils for High-Voltage Cables.

CERAMIC SOCIETY (at North Staffordshire Technical College, Stoke-on-Trent), at 7.30.—J. Williamson: A New Type of Tunnel Kiln Suitable for the Firing of Pottery.

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

INSTITUTE OF CHEMISTRY (Leeds Area Section) (at Leeds).—Dr. H. S. Houldsworth: The Expert Witness and the Law of Evidence.

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

TUESDAY, MARCH 13.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. I. Bennett: Some Problems of Nephritis (Goulstonian Lectures) (I.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. S. Huxley: The Behaviour of Animals (IV.).

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Lieut.-Col. S. J. M. Auld: The Natural Gas of South Persia, Process Development and Exploitation.

ILLUMINATING ENGINEERING SOCIETY (at Holophane, Ltd., Elverton Street, S.W.1), at 6.30.—Dr. S. English: The Manufacture and Properties of Glass and their Application in Illuminating Engineering.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—G. R. Hutchinson: Recent Developments in Propelling Equipment Practice of Reciprocating Engined Steamers.

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

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Burnley Section) (at Burnley Municipal College), at 7.15.—W. H. Meadowcroft: Foundry Conditions.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.30.—F. H. Rosencrants: Practice and Progress in Combustion of Coal as applied to Steam Generation.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—T. H. Savory: Spiders and their Environment.

PHARMACEUTICAL SOCIETY, at 8.—Dr. H. H. Dale: Some Reactions of Pharmacology on Pharmacy.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases, Psychiatry, Neurology, and Balneology Sections), at 8.30.—Special Discussion on Neuroses in the Tropics.

WEDNESDAY, MARCH 14.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. Schrödinger: Wave Mechanics (IV.).

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-Section of Proctology), at 5.30.—C. Dukes: Demonstration of the Pathology of Obstruction due to Tumours of the Bowel.—W. B. Gabriel: Intestinal Obstruction following Colostomy.—Dr. A. F. Hurst: The Recognition, Cause, and Treatment of Megacolon in Adults.—Sir Charles Gordon-Watson: A Method of Removing Adenomata of the Sigmoid through the Rectum.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.30.—H. M. Pearson: The Belgian Railways.

INSTITUTION OF ENGINEERS-IN-CHARGE (at St. Bride Institute, Bride Lane, E.C.4), at 7.30.—G. A. Hughes: Wells and Well Boring.

INSTITUTE OF METALS (Sheffield Local Section) (jointly with Kindred Societies) (in Department of Applied Science, Sheffield University), at 7.30.—Electrical Engineering Lecture.

ROYAL SOCIETY OF ARTS, at 8.—H. G. Brown: The Lead Acid Cell: Its Place in Modern Industry.

LANCASTER ASTRONOMICAL AND SCIENTIFIC ASSOCIATION (at Storey Institute, Lancaster), at 8.—Prof. H. E. Armstrong: Sir Edward Frankland, a Great Lancastrian.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Dr. W. R. K. Watson: Brixton Mental Tests.

INSTITUTE OF CHEMISTRY (Manchester and District Section) (at Manchester).—F. Twyman: Absorption Spectrography and some of its Applications in Chemistry.

THURSDAY, MARCH 15.

ROYAL SOCIETY, at 4.30.—Intense Magnetic Fields. Communications will be made by Sir Ernest Rutherford and Dr. P. Kapitza, and a general discussion will follow.—*To be read by title only*:—J. D. Cockcroft: The Design Coils for the Production of Strong Magnetic Fields.—D. Jack: The Band Spectrum of Water Vapour.—R. d'E. Atkinson: Statistical Experiments on the Motion of Electrons in Gases.—Lord Rayleigh: The Light of the Night Sky: its Intensity Variations when Analysed by Colour Filter III.

LINNEAN SOCIETY OF LONDON, at 5.—Dr. S. W. Kemp: Whaling Researches and the Work of the *Discovery* Expedition.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. I. Bennett: Some Problems of Nephritis (Goulstonian Lectures) (II.).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. J. J. Fox: Optics and Chemistry (II.).

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Prof. J. Dover Wilson: The Literature of Childhood from Isaac Watts to De La Mare.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—W. T. Townend: Some Considerations of the Economics of Electric Power Production.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—Dr. Rudorf: Testing of Materials used in Aircraft Construction.

INSTITUTE OF METALS (London Local Section) (at 83 Pall Mall), at 7.30.—W. Lambert: High Tensile Bronze.

CHEMICAL SOCIETY, at 8.—H. Burton and Prof. C. K. Ingold: Mobile-anion Tautomerism. Part I. A Preliminary Study of the Conditions of Activation of the Three-carbon System, and a Discussion of the Results in Relation to the Modes of Addition to Conjugated Systems.—Prof. T. M. Lowry, C. A. H. MacConkey, and H. Burgess: Studies of Dynamic Isomerism. Part XXVII. The Absorption-spectra of Prototropic Compounds. Physical Properties of the Enolic and Ketonic Forms of Benzoylcamphor.—J. J. Etridge and S. Sugden: The Parachor and Chemical Constitution. Part IX. Boron Compounds.—E. S. Hedges: Observations on the Passivity of Metals.

HARVEIAN SOCIETY OF LONDON (at Paddington Town Hall), at 8.30.—Sir William Willcox: Toxicology in its Application to Medical Practice.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch).—C. J. T. Billingham: Hydraulic Power.

INSTITUTION OF MECHANICAL ENGINEERS (Leeds Branch).—Informal Discussion: Payment by Results.

FRIDAY, MARCH 16.

BIOCHEMICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 4.30.—R. Robison and W. T. J. Morgan: A New Phosphoric Ester obtained by the Aid of Dried Yeast.—R. F. Corran and W. C. M. Lewis: The Influence of Normal and Cancerous Blood Serum on Pancreatic Lipase Action and the Effect of Ionic and Colloidal Lead.—J. G. Davis and W. K. Slater: The Anaerobic Metabolism of (*a*) The Cockroach, (*b*) The Earthworm.—E. Boyland and A. D. Ritchie: The Lactic Acid Production of Cardiac Muscle.—J. T. Irving: The Glucose Metabolism of Kidney Tissue *in vitro*.—D. Burk: The Free Energy of Glycogen-lactic Acid Breakdown in Muscle.—R. K. Cannan and G. M. Richardson: Observations on Iron-thiol Complexes.—A. Shore and R. K. Cannan: The Creatine-creatinine System.—H. D. Kay: Observations on the Phosphatases of Mammalian Tissues.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Variations and Anomalies of the Cervical and Costal Series of the Vertebral Column and their Application in Diagnosis and Treatment.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Annual Meeting.—W. Doran: Recent Developments in Micro-chemical Technique.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Capt. H. P. M. Beames: The Reorganisation of Crewe Locomotive Works.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (in Chamber of Commerce, Birmingham), at 7.—Dr. W. M. Hampton: Coloured Glasses.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.—F. Judge: Bromoil Lithography.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. M. Hurrell: An Outline of Petroleum Distribution (Chairman's Address, illustrated by Slides and a Film entitled The Persian Oil Industry).

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB (in Department of Biochemistry and Physiology, Oxford), at 8.15.—G. Stoney: Modern Practice in Steam Turbines.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting) (at Royal Army Medical College, Millbank, S.W.1), at 8.15.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—A. E. H. Pinch: The Present Position of Radium Therapy.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. T. Whittaker: The Quantum and Relativity Theories of Light.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Short Papers by Members.

SATURDAY, MARCH 17.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Associates and Students' Section) (at Neville Hall, Newcastle-upon-Tyne), at 3.—J. F. C. Friend: Coal Cleaning.—W. B. Brown: Explosives Accidents.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: The Transformation of Matter (II.).

PHYSIOLOGICAL SOCIETY (at University College).

PUBLIC LECTURES.

SATURDAY, MARCH 10.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—C. Daryll Forde: The First Metal Workers.

MONDAY, MARCH 12.

LEEDS UNIVERSITY, at 5.15.—Prof. W. J. Sollas: A Geological Contribution to Human History.

GRESHAM COLLEGE (Basinghall Street), at 6.—G. P. Bailey: Modern Science and Daily Life: The Conquest of the Air.

EAST ANGLIAN INSTITUTE OF AGRICULTURE (Chelmsford), at 7.—W. Brunton: Rotation Grazing.

TUESDAY, MARCH 13.

MEDICAL SCHOOL, GUY'S HOSPITAL, at 5.—Sir William Bragg: The Structure of an Organic Crystal (Fison Memorial Lecture).

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—Dr. C. Deslisle Burns: Ethics and Industry.

WEDNESDAY, MARCH 14.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.30.—Dr. R. Donaldson: Bacteriology in connexion with Foreign Medicine.

THURSDAY, MARCH 15.

EAST LONDON COLLEGE, at 5.—Prof. W. N. Haworth: The Structure of the Carbohydrates.

LEEDS UNIVERSITY, at 8.—A. N. Shimmin: Economics in Everyday Life: The Spending of Money.

FRIDAY, MARCH 16.

KING'S COLLEGE, at 5.30.—S. Smith: Babylonian Sculpture.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS (at Royal United Service Institution), at 5.30.—Major J. S. Buchanan: The Development of High Speed Aircraft.

SATURDAY, MARCH 17.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. Harcourt: Food and Famines in India.

CONFERENCES.

THURSDAY, MARCH 15.

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, at 11.30.—Malting Barley.

R. V. Reid: What the Barley Buyers Want.

J. Stewart: The Influence of Season on the Yield and Quality of Barley.

J. Joyce: Cultivation and Treatment of Barley grown for Malting in the Vale of Taunton.

G. H. Nevile: Cultivation and Treatment of Barley grown for Malting on the Lincolnshire Heath.

W. H. Parker: Malting Barley: Old and New Varieties.

Sir John Russell: Five Years' Experiments on Malting Barley.

MARCH 28 TO 31.

GERMAN BALNEOLOGICAL CONGRESS (at Baden, near Vienna).

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